STANDARD SPECIFICATIONS

FOR STATE ROAD AND BRIDGE CONSTRUCTION

★

★

Kansas Department of Transportation

Edition 2015

TABLE OF CONTENTS

DIVISION 100
GENERAL CLAUSES AND COVENANTS

TABLE OF CONTENTS

TABLE OF CONTENTS

DIVISION 150
EQUIPMENT

TABLE OF CONTENTS

DIVISION 200
EARTHWORK

DIVISION 300
STABILIZED SUBGRADE, BASE AND SHOULDERS

DIVISION 400
CONCRETE

TABLE OF CONTENTS

DIVISION 500
RIGID PAVEMENT

DIVISION 600
FLEXIBLE PAVEMENT

DIVISION 700
STRUCTURES

TABLE OF CONTENTS

DIVISION 800
INCIDENTAL CONSTRUCTION

TABLE OF CONTENTS

DIVISION 900
ROADSIDE IMPROVEMENT, PLANTING AND SEEDING

TABLE OF CONTENTS

MATERIALS DIVISION

DIVISION 1100
AGGREGATES

DIVISION 1200
ASPHALT MATERIALS

DIVISION 1300
BRICK AND CONCRETE MASONRY UNITS

DIVISION 1400
CONCRETE ADMIXTURES AND CURING MATERIALS

TABLE OF CONTENTS

DIVISION 1500
JOINT SEALING AND JOINT FILLER MATERIAL

DIVISION 1600
FERROUS AND NON-FERROUS METALS

DIVISION 1700
MISCELLANEOUS MATERIALS

TABLE OF CONTENTS

DIVISION 1800
PAINT MATERIALS AND MIXED PAINTS

DIVISION 1900
CULVERT, SEWER AND UNDERDRAIN PIPE

TABLE OF CONTENTS

DIVISION 2000
PORTLAND CEMENT, LIME AND FLY ASH

DIVISION 2100
MATERIALS FOR ROADSIDE IMPROVEMENTS

DIVISION 2200
REFLECTIVE MATERIALS AND ACCESSORY ITEMS

TABLE OF CONTENTS

DIVISION 2300
TIMBER, LUMBER, PILING AND POSTS

DIVISION 2400
WATER

DIVISION 2500
MISCELLANEOUS METHODS OF TEST

DIVISION 2600
MATERIALS CERTIFICATIONS

INDEX

SECTION 101

DEFINITIONS AND TERMS

101.1 RULES OF INTERPRETATION

Use of Imperative Mood. KDOT has generally written the standard specifications in the imperative mood, so the subject and helping verb are implied. Example: "Provide supervision" rather than "The Contractor shall provide supervision".

The word "will" generally pertains to the Kansas Department of Transportation's decisions or actions.

When used before a list, the word "include", "includes", or "including" means "including but not limited to" the items in the list.

Although the Contractor is the most-often implied subject, the subject may also include a subcontractor at any tier, supplier at any tier, vendor, fabricator, manufacturer, or other entity the Contractor engages to perform work (including the supply of materials, products, or equipment for use on the Project).

101.2 ABBREVIATIONS

Wherever the following abbreviations are used in these specifications or in other Contract Documents, they are intended to represent the following organizations, agencies, and/or their respective publications, standards, etc.:
AASHTO - American Association of State Highway and Transportation Officials.

ASTM - American Society for Testing and Materials.

AWS - American Welding Society.

CFR - Code of Federal Regulations.

DME - Designated Materials Engineer.

DWR - Division of Water Resources.

EEO - Equal Employment Opportunity.

FHWA - Federal Highway Administration-U. S. Department of Transportation.

GSA - General Services Administration.

KDOT - Kansas Department of Transportation.

LPA - Local Public Authority

MRC - Materials and Research Center

MUTCD - Manual on Uniform Traffic Control Devices.

OSHA - Occupational Safety and Health Administration.

101.3 DEFINITIONS

A + B BIDDING - A bidding method shown in the Contract Documents in which the bidder bids both the work and the working days or calendar days. KDOT assigns a set dollar value for each working day or calendar day the Contractor bids based upon some or all of the daily road user costs. The Secretary will total the amount bid for the work and the product of the working days or calendar days and the set daily dollar value. The contract is awarded to the lowest responsible and responsive bidder using the combination of the work and time. The contract price is the amount bid for the work. The contract time is the number of working days or calendar days the Contractor bid.

101- DEFINITIONS AND TERMS

ACTS OF GOD - A natural event, not preventable by a human agency, such as flood, tornado, or lightning. Forces of nature such as rain, wind, hail, and snow if these forces produce unusually severe weather. Unusually severe weather is adverse weather that at the time of year in which it occurred is abnormal for the place in which it occurred.

ADVERTISEMENT - The public announcement inviting bids for specified work.

AWARD - The State Transportation Engineer's acceptance of a Proposal and a prerequisite to executing a construction contract.

BID BOND - The approved security, on KDOT's form, the bidder and the bidder's surety or sureties execute, guaranteeing the execution of a satisfactory contract and the filing of an acceptable contract bond if the State Transportation Engineer accepts the bidder's proposal.

BIDDER - An individual, partnership, corporation, other legal entity, or any acceptable combination thereof (joint venture) submitting a proposal.

BID PRICE AND CONTRACT PRICE OR AMOUNT - The sum of the products of the quantities of work the Engineer estimates for the Project and the bidder's respective unit prices, lump sum prices, or both as set forth in the Proposal.

BRIDGE - A single or multiple span structure, including supports, erected over a depression or an obstruction, such as water, a highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having an opening measured along the center of the roadway of more than 20 feet between under-copings of abutments or spring lines of arches or extreme ends of openings of multiple boxes. If there are no abutment copings or fillets, the 20 foot measurement shall be between points 6 inches below the bridge seats or, in the case of frame structures, immediately under the top slab. All measurements shall include the width of intervening piers or division walls.

Bridge Length. The greater dimension of a structure measured along the center of the roadway between backs of abutment backwalls or between ends of the bridge floor.

Bridge Roadway Width. The clear width of structure measured at right angles to the center of the roadway between the bottom of curbs or, if curbs are not used, between the inner faces of parapet or railing.

BUSINESS DAY - Any day excluding Saturday, Sunday, federal legal holidays, and state legal holidays.

CALENDAR COMPLETION DATE - A specified date by which the Contractor shall complete Project construction.

CALENDAR DAY - Every day shown on the calendar, beginning at 12:01 a.m. and ending at midnight.

CATALOG CUTS - Manufacturers' technical literature that the Contractor is required to submit to the Engineer for approval. On projects where Buy America requirements apply, note on shop drawing and catalog cuts that steel and iron used meets Buy America, unless otherwise specified.

CENTER LINE OF HIGHWAY - A line equidistant from the edges of the median separating the main traveled ways on a divided highway or the center line of the main traveled way on a non-divided highway.

CHANGE ORDER - A written order the Engineer issues to the Contractor and both parties sign, which sets forth any contract change(s). Once both parties execute it, the change order becomes a part of the contract.

CLEANUP TIME (CLEANUP WORKING DAYS) - The number of working days, calendar days, or calendar completion date available to the Contractor after the Project Open Time expires for the Contractor to complete remaining, unfinished contract pay items, subsidiary items, incidental work, final cleanup, and final punch list.

COMPENSATE (COMPENSATION) - Depending on the context, compensate or compensation refers to time, money, or both money and time.

CONSTRUCTION LIMITS - The limits defined by the contract that actual construction work is to occur within.

CONTRACT - The written agreement between the Secretary and the Contractor setting forth the parties' obligations to perform and pay for the work.

The contract includes the following Contract Documents, all of which constitute one instrument and are incorporated by reference into the contract: the Proposal, exploratory work documents, addenda, amendments, contract form, contract bond, standard specifications, special provisions, project special provisions, general plans, detailed plans, the notice to proceed, material test methods, material test reports, material certifications, Part V of the KDOT Construction Manual, change orders, payment vouchers, guarantees, warranties, and other agreements, if any, that are required to complete the construction of the work timely and in an acceptable manner.

CONTRACT ADJUSTMENT - A contract change order for time, money or both time and money that compensates the Contractor for Contract Changes. A contract change order for time that compensates the Contractor for Acts of God.

CONTRACT BOND - The approved security, on KDOT's form, that the Contractor and the Contractor's surety or sureties execute, guaranteeing completion of the contract (performance of work and payment of all legal debts for the work).

CONTRACT CHANGE - A Contract Change is any event by which the Secretary, the Secretary's authorized representative, or the Secretary's authorized agents modify the contract whether at KDOT's or the Contractor's request. On City-owned or County-owned projects, a Contract Change also includes any event by which Local Public Authority (LPA), the LPA's representative, or the LPA's authorized agents modify the contract whether the LPA, KDOT, or the Contractor initiate the modification. Changes to the contract caused by Acts of God are not Contract Changes.

CONTRACT DOCUMENTS - An all-encompassing term for all documents relating to the contract. The Contract Documents include the Proposal, exploratory work documents, addenda, amendments, contract form, contract bond, standard specifications, special provisions, project special provisions, general plans, detailed plans, the notice to proceed, material test methods, material test reports, materials certifications, Part V of the KDOT Construction Manual, change orders, payment vouchers, guarantees, warranties, and other agreements, if any, that are required to complete the construction of the work timely and in an acceptable manner, all of which are incorporated by reference into the contract.

CONTRACT ITEM (PAY ITEM or BID ITEM) - Specific work item for which the contract provides a unit price or lump sum price.

CONTRACT TIME - The time set forth in the Contract Documents (including authorized extensions) for completing all work on the Project, expressed as working days, calendar days, specific calendar completion dates, or a combination thereof. See also Interim Contract Time.

CONTRACTOR - The individual partnership, corporation, other legal entity, or any acceptable combination thereof (joint venture) contracting with the Secretary to complete the contract. (The second party to the contract.)

CONTROLLED ACCESS FACILITY - A highway, road, or street designed to expedite and control through and local traffic and to give owners or occupants of abutting property restricted rights of access, light, air, or view over, from or to such highway, road, or street.

CONTROLLING ITEM(S) OF WORK. **(CIOW)** - Those work item(s) that are directly interrelated such that each has a definite influence on progress of the overall work.

CULVERT - Any structure providing an opening under the roadway that does not meet the classification of a bridge.

DAMAGES - Depending on the context in the specifications, a broad term that includes injury to persons, injury to property, destruction of property, economic loss, and monetary expenses.

DAYLIGHT HOURS - The period ½ hour after sunrise to ½ hour before sunset.

DELAY - When used as a noun, Delay means an event(s) that increases, disrupts, hinders, or interferes with the duration of the Contractor's work. When used as a verb, Delay means the action of increasing, disrupting, hindering, or interfering with the duration of the Contractor's work. The Contractor cannot avoid application of specifications using the term "Delay" by characterizing an event as a disruption, hindrance, or interference with the work.

DETOUR - A designated, temporary traffic route the Secretary has approved around a closed road.

DISTRICT MATERIALS ENGINEER (DME) - Each District has a designated District Materials Engineer. The specifications use the abbreviation DME to refer to these individuals.

EMBANKMENT - That portion of the work that is constructed from natural material, such as soil, shale, rock, or a combination thereof either as a fill section.

ENGINEER - The State Transportation Engineer acting directly or through duly authorized representative(s) for engineering and administrative supervision of the contract. Authorized representatives for engineering and administrative supervision of the contract include the KDOT Director of Operations, Bureau Chief of Construction and Materials, Bureau Chief of Research, District Engineer, District Construction Engineer, Metro Engineer, Field Engineering Administrator, Area Engineer, Area Construction Engineer, and Construction Managers.

ENGINEER OF TESTS - The Engineer of the Materials Test Unit of the Bureau of Construction and Materials. The Engineer of Tests is located at the Kansas Department of Transportation, Materials and Research Center, 2300 Van Buren, Topeka, Kansas 66611.

EQUIPMENT - All machinery, tools, and apparatus necessary to complete the contract, including fuels, lubricants, and other parts required to use, operate, and maintain such machinery, tools, and apparatus.

EQUIPMENT SPREAD - Machinery necessary to excavate move, spread, and compact rock or common material.

EXPLORATORY WORK DOCUMENTS - Documents KDOT, local government owners, or Engineering Design Consultants develop to determine the Project's engineering requirements. These may include geotechnical foundation investigation reports; soils reports; geology reports; hydraulic investigations; hydrological investigations; bridge reports; earth work computations; boring logs; surveys; rock investigations; soils investigations; environmental investigations; building investigations; bridge investigations; and other geological, geotechnical, or design information for the Project. Exploratory work documents are Contract Documents.

EXTRA WORK - See **subsection 104.6**.

FIELD ENGINEER - The KDOT employees directly in charge of administering contracts for KDOT. This term includes the KDOT Metro Engineer, Field Engineering Administrator, Area Engineer, Area Construction Engineer, or Construction Manager.

FREEWAY - A controlled-access highway with access to interchanges.

FRONTAGE ROAD - A highway, road or street which is auxiliary to and located on the side of another highway, road or street for service to abutting property.

GENDER REFERENCES - No particular gender is intended by the use of the words "he," "she," "him," or "her" in these specifications or other Contract Documents.

HIGHWAY - The whole right-of-way used in constructing a facility for the purpose of vehicular travel as part of the State Highway System and under the Secretary's jurisdiction.

HIGHWAY DISTRICTS - There are 6 Highway Districts each headed by a District Engineer. Each District has from 16 to 19 Counties which represent the boundaries of the District. Obtain details of the District boundaries from the KDOT District Offices in Topeka, Salina, Norton, Chanute, Hutchinson, Garden City, or KDOT's Bureau of Construction and Materials.

INSPECTOR - The Engineer's authorized representative assigned to both observe and check contract performance at Project sites, field laboratories, manufacturers' establishments, fabricators' facilities, Contractors' home offices, or other work locations.

INTERIM CALENDAR COMPLETION DATE - A specified date by which the Contractor shall complete construction of certain parts of the Project.

INTERIM CONTRACT TIME - The time allowed (including authorized extensions) for completing certain parts of the Project, expressed as hourly periods, working days, calendar days, a calendar completion date, or a combination thereof.

INTERSTATE HIGHWAY - Any highway the Secretary officially designates and the Federal government approves as a part of the National System of Interstate and Defense Highways.

KANSAS DEPARTMENT OF TRANSPORTATION (KDOT) - Kansas Department of Transportation as constituted under the laws of Kansas headed by the Secretary of Transportation and created to administer various transportation activities for roads and bridges throughout the state of Kansas. Contract Documents may use the term "Department" or "Agency" as well as "KDOT".

KANSAS TEST METHOD (KT-*) - Testing methods found in Part V of the KDOT Construction Manual. The (*) refers to the actual test number. Those test methods identified in the Contract Documents are the acceptable method of testing materials.

LEGAL HOLIDAYS - Legal holidays are defined as State Civil Service holidays, including New Year's Day, Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, Christmas Day and any other day proclaimed by the Governor of the State of Kansas, Saturdays following a Friday holiday, and Saturdays preceding a Monday holiday. When the Contract Documents use the term "Business Days", the list will also include Columbus Day, Presidents Day, and any other federal holiday not recognized by the state of Kansas.

LETTING - An event conducted at a specific time and location at which bidders proposals are read by KDOT in public.

LIQUIDATED DAMAGES - Predetermined amounts owed (subtracted or withheld from the contract price if possible) for each day work remains uncompleted beyond specific Interim Contract Times or Contract Times.

LOCAL PUBLIC AUTHORITY (LPA) - A division of government at the County, City, or Township level responsible for a system of roads, streets, and bridges under that entity's jurisdiction. Generally, KDOT acts as the agent for the Local Public Authority when the Local Public Authority is the owner of the Project but the Project is financed by federal or state funds in whole or in part.

MAJOR AND MINOR CONTRACT ITEMS - A major contract item is any contract item, excluding mobilization, having an original contract value of 5% or more of the original contract amount. Any other contract item shall be considered a minor contract item.

MATERIALS - Substances specified for use in constructing the Project and its appurtenances.

MATERIALS AND RESEARCH CENTER (MRC) - The Materials and Research Center located at 2300 Van Buren, Topeka, KS 66611.

MEDIAN - The portion of a divided highway or street separating the traveled ways for traffic moving in opposite directions.

NOTICE TO PROCEED - Written notice to the Contractor to begin the contract work including, when applicable, the date from which the Engineer will start charging Contract Time.

PAVEMENT STRUCTURE - The combination of subbase, base course, and surface course placed on a prepared or treated sub-grade to support the traffic load and distribute the load to the underlying materials.

- Subgrade: The top surface of an embankment or finished cut upon which the pavement structure, shoulders, and curbs are constructed.
- Subgrade Treatment: Stabilization of underlying earthen material or roadbed material.
- Subbase: The layer or layers of specified material of designed thickness placed on a subgrade to support a base course.
- Base Course: The layer or layers of specified material of designated thickness placed on a subbase or a subgrade to support a surface course.
- Surface Course: The layer or layers of pavement structure designed to accommodate the traffic load. The top layer resists skidding, traffic abrasion, and the disintegrating effects of climate and may be identified as the "Wearing Course".

PART V - Part V of the KDOT Construction Manual which primarily refers to materials and tests for materials used in the Project. Part V is a Contract Document.

PLANS - The KDOT-prepared, LPA-prepared, or Consultant-prepared and owner approved plan profiles, typical cross sections, and other detail sheets showing the location, character, dimensions, and details of the work.

PRIME CONTRACTOR - See CONTRACTOR.

PROFILE GRADE - The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the traveled way. Profile grade means either elevation or gradient of such trace according to the context.

PROJECT - The specified location on which construction is to be performed together with all improvements to be constructed under the contract.

PROJECT LIMITS - The limits of all work that is associated with the Project, including traffic control and detours.

PROJECT OPEN TIME - The time allowed (including authorized extensions) for completing work on the Project necessary to open the Project to unrestricted traffic, expressed as working days, calendar days, a specific calendar completion date, or a combination thereof.

PROPOSAL (BID) - A bidder's offer, on the prescribed form to perform the work at the prices quoted.

PROPOSAL FORM - The prescribed form that the Secretary provides and that the Secretary requires a bidder to use in preparing its offer or Proposal.

QUALIFICATION STATEMENT AND EXPERIENCE QUESTIONNAIRE - The specified form, filed annually, on which the Contractor shall provide the required information as to the Contractor's ability to perform and finance the work.

RIGHT-OF-WAY - Land, property, or an interest therein the Secretary acquires for transportation or transportation-related purposes.

ROAD - A public way for purposes of vehicular travel, including the entire area within the right-of-way.

ROADSIDE - The land area adjoining the outer edge of roadway. The land area as well as the median, if any, between the roadways of a divided highway.

ROADWAY - The portion of a highway from outside edge of shoulder to outside edge of shoulder including the traveled way.

SECRETARY - The Secretary of Transportation, Kansas Department of Transportation, appointed by the Governor. The Chief Executive Officer of the Kansas Department of Transportation.

SHOP DRAWINGS - See WORKING DRAWINGS.

SHOULDER - The portion of the roadway contiguous with the traveled way that contributes to the lateral support of the base and surface courses and that is used by stopped vehicles in emergency situations.

SIDEWALK - That portion of the right-of -way primarily constructed for the use of pedestrians.

SPECIAL PROVISIONS AND PROJECT SPECIAL PROVISIONS -

a. SPECIAL PROVISIONS. Approved additions or revisions to the standard specifications.

b. PROJECT SPECIAL PROVISIONS. Approved additions or revisions to the standard specifications that address conditions particular to an individual Project.

STABILIZATION - Modification of soils or aggregates by incorporating materials that will increase load bearing capacity, firmness, and resistance to weathering or displacement.

STANDARD SPECIFICATIONS - The current edition of the Kansas Department of Transportation's Standard Specifications for State Road and Bridge Construction.

STATE - The State of Kansas acting through its authorized representative, the Secretary of Transportation.

STATES DELAY OR OWNERS DELAY - An event(s) that increases, disrupts, hinders, or interferes with the duration of the Contractor's work (Delay) caused by actions of KDOT or a LPA (including authorized representatives and agents).

STATE TRANSPORTATION ENGINEER - The Deputy Secretary & State Transportation Engineer reporting to the Secretary of Transportation and having authority over all engineering and construction functions of KDOT (See **subsection 105.1**).

STREET - A public way for vehicular travel, including the entire area within the right-of-way, that is generally located within cities and developed areas.

STRUCTURES - Bridges, culverts, catch basins, drop inlets, retaining walls, manholes, headwalls, buildings, sewers, service pipes, underdrains, foundation drains and other features encountered in the work.

SUBCONTRACTOR - An individual, partnership, corporation, other legal entity, or any combination thereof (joint venture) to which the Contractor sublets part of the contract. Subcontractors are not a party to the contract between the Secretary and Contractor. However, the Contractor assumes liability for the subcontractors as if the Contractor were performing the sublet work with its own forces. Thus, when the specifications refer to the word "Contractor" but subcontractors are performing the work, the word "Contractor" includes the subcontractors.

SUBGRADE - The top surface of an embankment or finished cut upon which the pavement structure, shoulders, and curbs, if any, are constructed.

SUBSIDIARY - Materials, labor, or other elements that because of their nature or quantity have not been identified as a separate contract item and are included within the contract item on which they necessarily depend.

SUBSTRUCTURE - All of that part of a structure below the bearing of simple and continuous spans, skewbacks of arches or top of footings of rigid frames, together with backwalls, wingwalls and wing protection railings.

SUPERINTENDENT - The Contractor's representative that has authority to communicate with the KDOT Field Engineer and Inspectors and to coordinate the Contractor's, subcontractors', and suppliers' activities. See **subsection 105.7d**.

SUPERSTRUCTURE - All of that part of a structure above and including the bearing of simple and continuous spans, skewbacks of arches or top of footings of rigid frames, excluding backwalls, wingwalls, and wing protection railings.

SUPPLIERS - An individual, partnership, corporation, other legal entity, or any combination thereof (joint venture) from which the Contractor obtains commodities needed to fulfill the contract. Suppliers are not a party to the contract between the Secretary and Contractor. However, the Contractor assumes liability for the suppliers as if the Contractor were providing the commodities with its own forces. Thus, when the specifications refer to the word "Contractor" but suppliers are providing the commodities the word "Contractor" includes the suppliers.

SURETY - An individual, partnership, corporation, or other legal entity (not the Contractor) executing a bond provided by the Contractor. The Surety shall be licensed by the State of Kansas to do business in the State.

TRAFFIC CONTROL DEVICES - All items used to control the movement of traffic through work zones, including safety barrels, barricades, fences, traffic signs, warning signs, striping, traffic lights, and traffic signals.

TRAVELED WAY - The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes. This may be 1 or multiple driving lanes in each direction.

UNRESTRICTED TRAFFIC - All roadways (lanes, turn lanes, ramps, side roads, medians, shoulders, etc.) within the Project limits are open to unobstructed, continuous traffic flow with temporary or permanent striping, temporary or permanent signing, and required safety features such as guardrail and traffic control device in place and operational. Unobstructed continuous traffic flow means traffic is following the final lane configurations required by the plans and there are no lane closures.

UTILITY or **UTILITY OWNER** - Electric, telephone, cable, water, gas, pipeline, or sewer service owned and operated by a corporation or an LPA.

WORK - The providing of all labor, materials, equipment, and other incidentals necessary to complete the contract, regardless of whether the Contractor, subcontractors at any tier, suppliers at any tier, or a combination thereof carry out the contract obligations. In context, the term "work" may also refer to providing labor, materials, equipment, and other incidentals necessary to complete physical construction of the Project or a specific portion of the Project or contract.

WORKING DAY - A working day shall be any day the Contractor is not restricted from prosecuting the CIOW because of KDOT, LPAs, or weather as further provided in **subsection 108.5**.

WORKING DRAWINGS - Stress sheets, shop drawings, erection plans, falsework plans, framework plans, cofferdam plans, bending diagrams for reinforcing steel, other supplementary plans, or similar information that the Contractor is required to submit to the Engineer for approval. On projects where Buy America requirements apply, note on shop drawing and catalog cuts that steel and iron used meets Buy America, unless otherwise specified.

SECTION 102

BIDDING REQUIREMENTS AND CONDITIONS

102.1 NOTICE TO CONTRACTORS (ADVERTISEMENT)

The Secretary will publish a "Notice to Contractors" in the official "Kansas Register" website at http://www.kssos.org/pubs/pubs_kansas_register.asp. The Notice will notify prospective Contractors of a Letting. The Notice describes the contemplated work, informs the prospective Contractor to obtain Bidding Proposal Forms from KDOT's website, identifies the location of plans and specifications, identifies the time and place for the public opening and reading of proposals and reserves the Secretary's right to reject bids.

102.2 PREQUALIFYING CONTRACTORS

a. Prequalification Requirements. Before submitting a Proposal, be prequalified to bid as a Contractor upon one or more classifications of work.

To prequalify, submit to the KDOT Director of Operations in Topeka, Kansas, a completed Qualification Statement and Experience Questionnaire (Questionnaire) DOT Form No. 208 at least 10 business days before the Letting at which the Contractor plans to bid. KDOT does not prequalify subcontractors but approves subcontractors under **subsection 105.9**.

b. Classifications of Work.

A. All Earthwork.
B. Earthwork-Minor: Less than 10,000 CUYD.
C. Stabilized Subgrades and Base Courses: Subgrade Modification, Lime Treated Subgrade, Cement or Fly Ash Treated Subgrade, Crushed Stone Subgrade, Aggregate Base, Cement Treated Base, Granular Base.
D. All Structures.
E. Bridge Repair: Bridge Repair, Area Prepared for Patching, Multi-Layer Polymer Overlay, Slurry Polymer Concrete Overlay, Polymer Overlay Repair, Expansion Devices.
F. Reinforced Concrete Box Structures.
G. Retaining Wall Systems: Retaining Walls, Landscape Retaining Walls and MSE Fills.
H. Retaining Walls-Cast-in-place.
I. Misc. Concrete: Curb and Gutter, Sidewalk, Concrete Ditching Lining, Concrete Riprap, Flumes, Inlets.
J. Pipe: Entrance, Cross Road, Erosion and Liner Pipe, Storm and Sanitary Sewer, Underdrains, Edge Drains.
K. All Portland Cement Concrete Pavement.
L. Portland Cement Concrete Pavement-Minor: Less than 10,000 SQYD, Pavement Patching (excluding Asphalt Patching).
M. All Hot Mix Asphalt.
N. Hot Mix Asphalt-Minor: Less than 2000 tons.
O. Asphalt Treatments: Cold Recycled Asphalt Construction, Surface Recycled Asphalt Construction, Microsurfacing, Asphalt Prime Coat, Asphalt Sealing, Asphalt Surface Treatments, Ultrathin Bonded Asphalt Surface, Crack Seals, Crack Repairs.
P. Aggregate Drainage Improvements.
Q. Painting Structural Steel.
R. Guardrail and Fencing.
S. Pavement Marking.
T. Signing and delineation: Structural signs.
U. Signing-Minor: Post mounted signs, excluding structural signs.
V. Electric Lighting and Traffic Signals.
W. Rest Area Structures and Buildings.
X. Planting and Seeding: Temporary Erosion and Pollution Control, Seeding, Mulching, Topsoil, Trees, Shrubs and other Plants.
Y. Miscellaneous: Construction not otherwise classified.

c. Qualification Rating. The KDOT Prequalification Committee (Committee) will assign a qualification rating after reviewing the prospective Contractor's Questionnaire and, if available, the Contractor's performance record. The Questionnaire solicits the prospective Contractor's financial worth, equipment, and experience.

The Questionnaire requires the Contractor to submit a financial statement showing the Contractor's net worth (see **subsection 102.2h.**). If a Certified Public Accountant (CPA) meeting the requirements below audits the financial statement, the Contractor's qualification rating and qualification amount will be determined using the Contractor's audited net worth and the Contractor's equipment, experience, and performance record. If the Contractor submits an unaudited financial statement, the Contractor's qualification amount will be a maximum of $3,000,000.00 for all projects. To meet the requirements of this **subsection 102.2**, a CPA shall be duly licensed at the time the CPA audits the financial statement.

The performance record should describe classification of work performed, work quality, work timeliness, payment of accounts, cooperation with owners and the public, public safety, work site safety, and contract compliance. Additionally, the Committee may consider whether the Contractor is in good standing with other state and federal agencies and the Contractor's compliance with legal obligations. The Committee will consider both owned and leased equipment when determining which classifications of work the Contractor may perform.

The Committee will notify the prospective Contractor of its qualification rating. This qualification rating includes the dollar value and classifications of work the prospective Contractor may have under contract at a given time. KDOT will protect from disclosure the assigned qualification rating and confidential information contained in the Questionnaire. The financial information contained in the Questionnaire is confidential and is not required to be disclosed under the Kansas Open Records Act, See K.S.A. 45-221(a)(33). The qualification rating will remain effective for 1 year unless the Committee revises the rating under **subsections 102.2d**.

d. Revised Qualification Rating. At annual renewal, at the Contractor's request, or at any other time the Committee deems appropriate, the Committee may revise the Contractor's qualification rating based on the Contractor's updated, performance record, or changes in financial conditions, ownership, or organizational structure.

e. Remaining Qualified. Once qualified, a Contractor's eligibility to bid is valid for 1 year from the date of qualification. To remain qualified, submit a completed Questionnaire annually, at other times the Committee requests, and within 30 calendar days after a change in business ownership. The Committee will not issue a proposal form to a Contractor who has failed to renew the Contractor's qualification status. The Contractor's prequalification under this **subsection 102.2** does not limit the Secretary's authority to determine the Contractor is non-responsible under **subsection 102.18**.

f. Committee's Reconsideration of Qualification Rating and Secretary's Review. If dissatisfied with an initial or revised qualification rating, submit to the Committee a written request for reconsideration within 10 calendar days after receiving notice of the initial or revised qualification rating. Explain why the Committee should reconsider the assigned rating. The Committee will hold a hearing and provide the Committee's final decision within 30 calendar days after receiving the request for reconsideration. If still dissatisfied, submit a written appeal to the Secretary within 10 calendar days after receiving the Committee's final decision. Explain why the Secretary should overturn the assigned rating. The Secretary, or the Secretary's designee, will hold a final hearing. The Secretary, or the Secretary's designee, will provide KDOT's final decision within 15 calendar days after the final hearing. The Contractor may have legal representation at both the Committee's hearing and the Secretary's hearing. See K.A.R. 36-30-3(b). The decision of the Secretary, or the Secretary's designee, under this **subsection 102.2f.** is considered final agency action under the Kansas Judicial Review Act, K.S.A. 77-601 *et seq*.

g. Qualification Rating for Joint Ventures. For a joint venture's qualification rating, the Committee will adjust the Contractor's combined qualification on each Contractor's individual experience in the classifications of work being considered. This rating will not exceed the sum of the Contractor's separate qualification ratings.

h. Financial Statements (Audited or Unaudited).

(1) The financial statements shall present the net worth of the enterprise as of a date not more than 1 year prior to the date that the Questionnaire is submitted.

(2) The name of the enterprise identified in the financial statements (except as noted in **subsection 102.2h.(3)** below) shall be the same name used for prequalification, bidding and contracting with KDOT.

(3) If a Contractor desires to be prequalified as a separate entity of the enterprise, then the requirements are as follows:

- Submit the audited financial statements of the consolidated entity with unmodified opinion of an independent Certified Public Accountant; or
- Submit audited financial statements of the separate entity with an independent Certified Public Accountant report with a modified opinion that, if qualified, is only qualified due to the lack of consolidation because of a Variable Interest Entity; or
- Submit consolidated audited financial statements and the schedule for consolidation that separates all entities including the separate entity that is desired to be prequalified; then
- The financial information for the separate entity will be considered in the prequalification process.

102.3 PROPOSAL FORM, PROPOSAL, AND CONTRACT

a. Proposal Forms. Acquire the Proposal Form from KDOT's website at (http://www.ksdot.org) by choosing the following selections: "Doing Business", "Bidding & Letting" and "Proposal Information" and then using the links provided in the Project information for the particular Project of interest. The Proposal Form consists of the following documents:

(1) The Project electronic bidding system file (EBS file) on the Bid Express website that contains:

(a) DOT Form No. 202 with a description of the location and type of construction; the time for performance, and the date, time, and place for opening proposals.

(b) The Unit Prices List which consists of price sheets that list the Project's bid items and estimated quantities for each bid item and spaces for the contractor to insert its unit price and total price for each bid item.

(c) Required contract provisions that require information from the Bidder and apply to the Project as identified on the Special Provision List.

(d) Amendments that KDOT makes after KDOT first placed the Bidding Proposal Form on KDOT's website. (See **subsection 102.4.c.)**.

(2) The Special Provision List, if any, in effect at the time of the Letting. The Special Provision List identifies all required contract provisions, project special provisions, and special provisions that apply to the Project. The EBS file may not contain all required contract provisions. The EBS file may contain provisions that do not apply to the Project. The Bidder is responsible for consulting the Special Provision List to identify which provisions are included in the Proposal Form.

(3) The required contract provisions, project special provisions and special provisions identified in the Special Provision List, if any.

(4) Bid Bond that complies with **subsection 102.11**.

(5) The Standard Specifications.

(6) The Project plans, if any.

(7) The exploratory work documents, if any.

(8) All remaining, attached and unattached documents relating to the Project, including but not limited to addenda and amendments, if any.

b. Proposal. The Proposal Form becomes the Bidder's Proposal after the Bidder completes the EBS file (which includes DOT Form No. 202, the Unit Prices List, and applicable required contract provisions), electronically signs the Proposal where required on DOT Form No. 202, and delivers the completed EBS file documents, the EBS data file, and bid bond to KDOT using Bid Express. The Special Provision List, required contract provisions not requiring information from the Bidder, project special provisions, special provisions, Standard Specifications, plans, exploratory work documents, any additional contract information, and any addenda are incorporated by reference into the Bidder's Proposal.

c. Contract. After the parties have executed a Contract, the Proposal becomes the Contract.

102.4 ISSUING PROPOSAL FORM

a. The Secretary will provide Proposal Forms in electronic format on KDOT's website at http://www.ksdot.org which can be viewed by choosing the following selections: "Doing Business", "Bidding & Letting" and "Proposal Information", and using the links provided in the Project information for the particular Project of interest. The current version of the Standard Specifications For State Road and Bridge Construction may be printed from KDOT's website at http://www.ksdot.org by choosing the following selections: "Doing Business", "Bidding & Letting" and "Specifications". Paper copies of the current Standard Specifications may be requested of the Bureau of Construction and Materials and will be billed at the current fee.

b. Prime Contractor Bid Holders. Bidders wanting to bid as a prime Contractor shall identify themselves on the website in **subsection 102.4a.** as a Bid Holder no later than the close of business on the Monday preceding the scheduled Letting Date. A Bidder shall furnish this notice by marking the "Bid Holders List" box contained in the Proposal Information for each Project on which the Bidder intends to bid. This notice is necessary for KDOT to determine a Bidder's eligibility and approval to bid as a prime Contractor on the Project. A Bidder shall not be eligible to bid as a prime Contractor if, at the close of business on the Monday preceding the scheduled Letting Date, the Bidder:

- is not prequalified or qualified under **subsection 102.2**;
- does not have available bidding capacity, because the Engineer's estimate for the Project alone or when combined with the Bidder's outstanding contract work and subcontract work exceeds the Bidder's qualification amount;
- is deemed unable to perform at least 30% of the contract amount, because the estimated dollar value of the classifications of work for which the Bidder is qualified do not equal at least 30% of the estimated dollar value of the Project, using the Engineer's estimate. The Bidder shall not be allowed to manipulate this requirement by submitting mathematically unbalanced unit prices for mobilization and other contract items;
- did not attend a mandatory pre-bid conference for the Project;
- is prohibited from rebidding on a Project, because the Bidder withdrew from a previous award of contract for the Project without forfeiting its bid bond;
- is prohibited from rebidding on a Project, because the Bidder failed to enter into a Contract after award to that Bidder in the first Letting; or
- is currently suspended or debarred from bidding or under a notice of suspension or proposed debarment by KDOT, another Kansas state agency, other state government agency, FHWA, or other federal agency.

c. Addenda and Amendments. Proposal Forms include contract addendum and amendments. Addenda identify changes to the Proposal Form that KDOT makes after initial advertising on KDOT's website. Amendments are addenda that change the documents contained in the EBS file (DOT Form No. 202's time for performance and the Unit Prices List). An addendum will be sent by email to all Bid Holders and the Bid Holders shall acknowledge receipt of the addendum by either return email or facsimile. The addendum will also be included on the KDOT website above. Addenda (other than amendments) are incorporated by reference into the Proposal. Amendments are included in the Proposal's EBS file by Bid Express or the Bidder. The Bidder is responsible for ensuring the EBS file that the Bidder uses to prepare its Proposal and submits to KDOT contains any amendments. The Bidder may accomplish the change by either loading the amendment into the Bidder's saved EBS file or downloading an updated EBS file that contains the amendment. See InfoTech's website (www.bidx.com) for further instructions on accomplishing these changes. The Secretary may reject Proposals that fail to include amendments. (See **subsection 102.17**).

d. Non-bid Holders. Subcontractors, suppliers, and other interested entities may identify themselves as a Non-bid Holder in the space provided on KDOT's website to inform Bidders of their interest in the Project. Subcontractors, suppliers, and other interested entities not needing Proposal Forms may use the Non-Bidding EBS file link provided in the Project Information on KDOT's website to view a pdf copy of the Project EBS file rather than downloading the EBS file that Bidders use to prepare their proposal.

e. Errors in Issuing Proposal Form. A Bidder's obtaining of a Proposal Form by mistake of Bid Express or KDOT shall not be construed as a waiver of the contract requirements for qualification, eligibility, and responsibility as provided in **subsections 102.2, 102.4**, and **102.18**, and the Bidder shall have no claim against KDOT for the mistaken issuance of a Proposal Form and corresponding rejection of the Bidder's Proposal.

102.5 COMBINATION BIDS, TIES, RIDERS AND ALTERNATE BIDS

a. Combination Bids. A combination bid is the act of joining two or more projects by tying the projects or by taking a dollar deduction on a project(s) if awarded more than one project.

(1) Only the Secretary may combine projects located in different Highway Districts, regardless of the funding source.

(2) The Secretary will accept combination bids for:

(a) Projects the Secretary requires the Bidder to tie, including projects located in different Highway Districts.

(b) Federal-Aid funded state projects in the same Highway District.

(c) Kansas-funded state projects in the same Highway District.

(d) County-funded projects in the same county.

(e) City-funded projects in the same city.

(f) Kansas-funded state projects "tied to" Federal-Aid funded state projects.

(g) Projects containing the same classification of work and not violating **subsections 102.5a.(2)(a)** through **(f)**.

(h) Projects containing Classification D, E and F work and not violating **subsections 102.5a.(2)(a)** through **(f)**.

(i) Projects containing Classification M, N, and O work and not violating **subsections 102.5a.(2)(a)** through **(f)**.

(j) Projects containing Classification S, T and U work and not violating **subsections 102.5a.(2)(a)** through **(f)**.

(k) Projects containing Classification G and H work and not violating **subsections 102.5a.(2)(a)** through **(f)**.

(l) Projects containing Classification I, J and P work and not violating **subsections 102.5a.(2)(a)** through **(f)**.

(3) Designate combined bids in the space provided on the first page of the Proposal (DOT Form No. 202). The Secretary will accept only combined bids the Bidder identifies in the space provided on DOT Form No. 202.

b. Ties.

(1) Unless the Bidding Proposal Form prohibits tied bids or unless the tie would result in an unacceptable combination bid, the Secretary will accept the following ties:

- Project A and Project B "are tied" - Two-way tie. Neither A nor B can be awarded without the other.
- Project A "tied with" Project B - Two-way tie. Neither A nor B can be awarded without the other.
- Project A "tied to" Project B – One-way tie. Project B can be awarded without awarding Project A (but Project A cannot be awarded without also awarding Project B).

(2) Only the Secretary may tie projects located in different Highway Districts.

(3) Designate ties in the space provided on the first page of the Proposal (DOT Form No. 202). The Secretary will accept only ties that are identified in the space provided on DOT Form No. 202.

c. Riders.

(1) The Secretary will accept the following riders when the Bidder bids on more than one project:

(a) A maximum dollar amount of work the Bidder will undertake in a specific Letting.

(b) A maximum number of projects the Bidder will undertake in a specific Letting.

(c) Deductions from Projects in Same Funding Source. A monetary deduction to a unit price on one or more items of work for projects in the same funding source when the following requirements are met:

- The projects are located in the same Highway District;
- The projects contain the same classifications of work or like classifications of work as permitted in **subsections 102.5a.(2)(g)** through **(j)**; and
- The Bidder includes in the space provided for riders on DOT Form No. 202 the following language "Deduct (Amount of dollars from line item #) from Project B if awarded Project A." These are combination bids. See **subsection 103.1b.(4)** for the Secretary's method of calculating the lowest dollar cost.

(d) Deductions from Projects in Different Funding Sources. A monetary deduction to a unit price on one or more items of work for projects with different funding sources when the following requirements are met:

- The projects are located in the same Highway District;
- The projects contain the same classifications of work or like classifications of work as permitted in **subsections 102.5a.(2)(g)** through **(j)**;
- The Bidder includes in the space provided for riders on DOT Form No. 202 the following language: "Deduct (Amount of dollars from line item #) from Project B if awarded Project A."; and
- The Bidder making the deduct shall be determined the lowest responsible and responsive bidder on Project A, the primary project, standing alone and regardless of the deduct on Project B. Deducts from projects in different funding sources are not combination bids as the Secretary does not join the bids in calculating the lowest dollar cost. See **subsection 103.1b.(4)** for the Secretary's method of calculating the lowest dollar cost.

(2) Do not make monetary deductions across Highway Districts, regardless of the funding source.

(3) Designate riders in the space provided on the first page of the Proposal (DOT Form No. 202). The Secretary will accept only riders that are identified in the space provided on DOT Form No. 202.

d. Alternate Bids.

(1) The Secretary will accept alternate bids when the Bidding Proposal Form allows or requires the Bidder to price alternates for materials, methods of operation, contract items, work schedules, or other items.

(2) Alternate Work Schedules. The Secretary may offer a non-accelerated and an accelerated time for completion. Bid the non-accelerated time for completion, placing a unit price in each unit price column, and summing the products of the unit prices and estimated quantities (Base Bid). Bid the accelerated time for completion in the Line Item, "Accelerated Work Schedule". Include in the lump sum price for "Accelerated Work Schedule" all mobilization, overhead, traffic control, and other costs necessary to meet the accelerated schedule. Complete the Special Bid Summary on the Unit Price List sheets, identifying the Base Bid and the Accelerated Bid total (obtained by combining the Base Bid and the Accelerated Work Schedule bid item).

(3) The Secretary, not the Bidder, has discretion to determine which alternate to accept.

102.6 START DATE

Before the Letting, obtain the earliest and latest starting dates for a Project from the KDOT website http://www.ksdot.org by choosing the following selections: "Doing Business", "Bidding & Letting" and "Proposal Information". The Notice to Proceed will be issued and the Contract Time will start within the earliest and latest starting dates (see **subsection 108.1)**. The Engineer will not modify these dates except as allowed in **subsection 108.1**.

The earliest and latest starting dates for the twelve (12) months prior to the current Letting may be found on KDOT's website http://www.ksdot.org by choosing the following selections: "Doing Business", "Bidding & Letting" and "Earliest/Latest Start Date Archive".

102.7 ESTIMATED AND UNDETERMINED QUANTITIES

The quantities in the Unit Prices List sheets are estimates. The Secretary may increase, decrease, or eliminate these quantities. If the Secretary finds it impossible or impractical to estimate the quantity of an item, the Secretary may set a unit price for this item. The set price will become the unit price.

102.8 EXAMINING PROPOSAL FORM AND PROJECT SITE, INCLUDING EXPLORATORY WORK DOCUMENTS

a. Except when the contract requires the Bidder to provide plans or working drawings, the Secretary, a LPA, or both will prepare plans and specifications that enable a Bidder to construct the Project.

b. Examine the Bidding Proposal Form before submitting a bid. Notify the Construction Letting Engineer in the Bureau of Construction and Materials of errors, omissions, or ambiguities in the Bidding Proposal Form before the Letting. The Secretary will pay no claims for obvious errors, omissions, or ambiguities in the Bidding Proposal Form.

c. Examine the Project site before submitting a bid. Refer questions to the Construction Letting Engineer in the Bureau of Construction and Materials regarding the scope of work and Project site conditions. Review and analyze exploratory work documents in conjunction with visiting the Project site.

(1) The Bidding Proposal Form includes exploratory work KDOT, a LPA, or both prepared or had prepared for the Project. This exploratory work may include geotechnical foundation investigation reports; soils reports; geology reports; hydraulic investigations; hydrological investigations; bridge reports; earthwork computations; boring logs; surveys; rock investigations; soils investigations; environmental investigations; building investigations; bridge investigations; and other geological, geotechnical, or design information for the Project.

(2) The Bidders may obtain exploratory work documents from the KDOT website at http://www.ksdot.org by choosing the following selections: "Doing Business", "Bidding & Letting" and "Proposal Information", using the "Exploratory and Project Reports" link provided in the Project information for the particular Project of interest or from the Bureau of Construction and Materials.

(3) The Bidder shall be responsible for utilizing the most recent exploratory work documents in preparing its Proposal. KDOT will not notify Bidders of a change in the exploratory work documents made after KDOT has placed these documents on the website.

d. KDOT and LPAs assume no responsibility to a Bidder for the conclusions or interpretations the Bidder forms based upon information KDOT, LPAs, or both make available to the Bidder. The Bidder understands that persons performing exploratory work and persons preparing geotechnical, geological, or design information are exercising their own independent professional judgment.

e. KDOT and LPAs assume no responsibility to a Bidder for any understanding reached outside the Proposal Form between the Bidder and employees or agents of KDOT, LPAs, or both unless that understanding is put in writing and added to the Proposal Form before the Letting.

f. KDOT and LPAs assume no responsibility to a Bidder for any representation made outside the Proposal Form by employees or agents of KDOT, LPAs, or both unless that representation is put in writing and added to the Proposal Form before the Letting. Oral representations concerning the site conditions do not bind the Secretary, LPA, or both.

g. Do not use the information KDOT, LPAs, or both make available as a substitute for the exercise of the Bidder's or its agents' independent professional judgment. Do not use the information KDOT, LPAs, or both make available to excuse the Bidder's obligation to determine the means and methods of constructing the Project. The existence of exploratory work documents does not excuse the Bidder from performing a Project site examination and using the Bidder's own interpretation and judgment concerning the site. The Secretary will pay no site condition claims for conditions the Bidder discovered or should have discovered in a Project site examination.

h. Before the Letting, notify the Construction Letting Engineer in the Bureau of Construction and Materials of any discovered errors, omissions, or ambiguities in the geotechnical, geological, or design information KDOT, a LPA, or both provide.

i. Before the Letting, notify the Construction Letting Engineer in the Bureau of Construction and Materials of any perceived inadequacies in the geotechnical, geological, or design information KDOT, a LPA, or both provide.

j. Obtain the exploratory work documents from the Bureau of Construction and Materials if unable to retrieve some or all of the exploratory work on the KDOT website. The Bidder's inability to obtain exploratory work documents on the internet does not excuse the obligation to review all exploratory work documents before submitting a bid for the Project.

102.9 FAMILIARITY WITH LAWS AND ORDINANCES

Examine Federal, State, County, and Municipal laws, regulations, rules, and ordinances that apply to the Project before submitting a bid. Include in the bid, costs to comply with such laws.

102.10 PREPARING PROPOSALS

a. Rules for All Proposals.

(1) Access Bidding Proposal Forms on KDOT's website. See **subsection 102.3a.**

(2) Use the AASHTOWare Project software version of Expedite (most current version) and Bid Express to prepare and submit a Proposal.

(a) Bid Express is a subscription-based Web Site service developed by Info Tech.

(b) To establish an account with Bid Express, contact Bid Express at www.bidx.com.

(c) Obtain a digital I.D. (key) from Info Tech that enables the Bidder to submit an electronic internet bid. (It takes Info Tech approximately 3 to 5 business days to issue this key.)

(d) KDOT is not a party to the agreement between the Bidder and Bid Express. KDOT does not warrant that the Bid Express internet services will be uninterrupted, error free, or completely secure. KDOT assumes no liability for damages to the Bidder or third parties arising out of the Bidder's use of Bid Express or inability to use Bid Express.

(3) To prepare a Proposal, download the electronic bidding system file [EBS file] for the Project, insert on the Unit Prices List in the EBS file the unit price for each bid item in the blank spaces after each item (showing the sum of money for which the Bidder shall perform the work), complete the required contract provisions contained in the EBS file, and electronically sign DOT Form No. 202 by using an electronic identification on the blank space provided on DOT Form No. 202. If the Proposal is made by a partnership or corporation, include the name and address of the partnership or corporation and title of person signing for the partnership or corporation. The one signature binds the Bidder to the Proposal and all attached certifications.

(4) Provide all information the Bidding Proposal Form requests or requires. Include costs for subsidiary and incidental work in the contract unit prices or lump sum prices.

(5) Assume responsibility for the accuracy of the electronic forms and include all amendments that KDOT makes before the Letting. (See **subsection 102.4.c**). Upon being notified of a contract amendment, download from the Bid Express website a new EBS file that contains the amendment or load the amendment from the Bid Express website onto the Bidder's existing EBS file and submit the revised Proposal using Bid Express.

(6) Do not alter the Bidding Proposal Form except to comply with contract addenda or amendments as provided in **subsection 102.4.c**.

(7) Assume all risk for the timely delivery to KDOT of the Bidder's bid submitted through Bid Express.

(8) Joint Ventures.

(a) Indicate which company is the lead on the joint venture to receive the necessary documents and identify the individuals that are authorized to digitally sign the electronic internet bid for the joint venture.

(b) Obtain KDOT's approval to bid as a joint venture and a new contractor number for the joint venture.

(c) Obtain a new digital I.D. (key) from Info Tech for the joint venture. KDOT must approve the joint venture before Info Tech will issue the Bidder a new key.

102.11 BID BONDS

Submit an electronic Bid Bond that complies with the requirements of this **subsection 102.11,** with the Proposal. Contact a company that has an agreement with Bid Express to submit bid bonds electronically and include the required bid bond information on the Bidder's Proposal before submitting the Proposal.

The Surety executing the Bid Bond shall be authorized to transact business as a Surety in Kansas. Guaranty the Secretary that within 10 business days after notice of the award of the contract, the Bidder shall sign the contract and provide the required Contract Bond and insurance coverages. The penal sum of the Bid Bond is 5% of the amount bid. The Bidder forfeits to the Secretary the penal sum of the bond as liquidated damages if the Bidder fails to sign the contract or provide the required documents for reasons other than a nonjudgmental bid error. See **subsection 102.16**. The two lowest Bidders' Bid Bonds shall remain effective until the Secretary executes a contract or the Bidder forfeits the penal sum of the bond.

102.12 SUBMITTING PROPOSALS

a. Deliver a Proposal to KDOT by transmitting the Proposal through Bid Express using the Bid Express website (www.bidx.com) before the time set for receiving proposals expires. Assume all risk for the timely delivery to KDOT of the Proposal, transmitted through Bid Express.

b. Bid Express includes in the Proposal the Project's completed EBS data file saved in .ebs format which contains DOT Form No. 202, the Unit Prices List, and required contract provisions. Submit the Bid Bond with the Proposal as stated in **subsection 102.11**.

c. Allowing the Bidder to submit some rather than all Proposal documents is for the Bidder's convenience and expense. The Bidder is bound to all provisions in the Proposal whether incorporated physically or by reference into the Bidder's Proposal.

102.13 WITHDRAWING PROPOSALS BEFORE THE LETTING

Before the time for receiving proposals expires, a Bidder may withdraw a Proposal in writing or by email directed to the Chief of the Bureau of Construction and Materials, without Bid Bond forfeiture.

102.14 REVISING PROPOSALS

a. Before the time for receiving proposals expires, a Bidder may revise its Proposal by making changes on its EBS file and resubmitting the Proposal to KDOT through Bid Express.

b. The Secretary's representatives will not revise Bidders' proposals and have no access to proposals before the Letting.

c. A Bidder shall not revise its Proposal after the Letting and the Secretary's representatives have no authority to revise proposals after the Letting.

102.15 PUBLIC OPENING OF PROPOSALS

KDOT will open and read in public at the time and place indicated in the Bidding Proposal Form, all proposals received unless KDOT has to delay the opening to accommodate internet or other technical difficulties in downloading proposals. KDOT invites all Bidders, their authorized agents and other interested parties to be present. If KDOT incurs a delay in downloading the proposals, KDOT will delay the public reading until KDOT has been able to download all proposals from the Internet. If KDOT incurs technical difficulties that prevent KDOT from reading some or all proposals on the Letting date, KDOT will postpone the reading of proposals to another day or change the Letting date. KDOT will notify Bidders of KDOT's planned action on KDOT's website and on the Bid Express website. KDOT also will notify Bidders directly by e-mail.

Following the public reading, KDOT will take the proposals to the Bureau of Construction and Materials. At this time, the Bureau of Construction and Materials will check the proposals for compliance with the Contract Documents (responsiveness), will verify the Bidders are prequalified in the appropriate classifications and dollar value of work, and will determine the Bidders are otherwise responsible. The Bureau of Construction and Materials will notify a Bidder by email or other writing if the Secretary rejects the Bidder's Proposal.

102.16 WITHDRAWING PROPOSALS FOR BID MISTAKES AFTER THE LETTING

a. A Bidder shall not revise its Proposal after the Letting.

b. A Bidder may withdraw its Proposal after the Letting for a nonjudgmental error (See **subsection 102.16e.** for definition) without forfeiting its bid bond if:

(1) The nonjudgmental error is evident on the face of the Proposal or established by clear and convincing evidence; and

(2) The Bidder notifies KDOT of the nonjudgmental error within 2 business days after the Letting.

c. A Bidder may withdraw its Proposal after the Letting but will forfeit its bid bond as liquidated damages if:

(1) The error is a judgmental error (See **subsection 102.16f.** for definition); or

(2) The error is a nonjudgmental error, but the Bidder notifies KDOT of the nonjudgmental error more than 2 business days after the Letting.

d. If the Bidder withdraws its Proposal without bid bond forfeiture as permitted in **subsection 102.16b.**, the Bidder shall not perform subcontract work on the Project and shall not re-bid if the Secretary re-lets the Project.

e. A nonjudgmental error is a mathematical error, a clerical error, or an error not involving the use of judgment or reason.

f. A judgmental error is an error resulting from incorrect or flawed reasoning, assessments of facts, or assumptions on how to satisfy contract requirements.

g. K.S.A. 75-6901 *et seq.* governs this **subsection 102.16**.

102.17 REJECTION OF PROPOSALS; NON-RESPONSIVENESS

a. Before the award of contract and without liability, the Secretary has full authority to reject all proposals and either re-let or cancel the Project.

b. Before the award of contract and without liability, the Secretary has full authority to waive technicalities and irregularities (non-conformities) in individual proposals except for those identified in **subsection 102.17f.** and **g**.

c. Before the award of contract and without liability, the Secretary may reject an individual proposal as non-responsive for failing to comply with a contract requirement or for changing a contract requirement. The Secretary's authority to reject a Proposal as non-responsive under this **subsection 102.17c.** is not limited to the non-conformities identified in **subsections 102.17d.**, **e.**, **f.** and **g**.

d. The Secretary may reject a proposal as non-responsive if the Bidder submitted an(a):

(1) Altered form.

(2) Unapproved form.

(3) Unauthorized conditional bid.

(4) Unacceptable combination.

(5) Unauthorized alternate bid.

(6) Mathematically unbalanced unit price(s). A Proposal is mathematically unbalanced when the Proposal contains lump sum or unit prices that do not reflect the reasonable actual costs (plus reasonable profit, overhead costs, and other indirect costs) to construct the item. See **subsection 103.1b.(7)**.

(7) Materially unbalanced bid. A materially unbalanced bid is a bid that generates reasonable doubt that award to that bidder would result in the lowest ultimate cost to KDOT, a LPA, or both. See **subsection 103.1b.(7)**.

(8) A bid amount in the Proposal which, when added to the unearned amounts of the Bidder's other outstanding contract obligations, exceeds the total dollar amount of the Bidder's qualification. The outstanding contract amount includes all contract and subcontract work that the Bidder performs with its own forces. (See **subsection 102.2)**.

e. The Secretary may reject a Proposal as non-responsive if the Bidder failed to:

(1) Identify itself as a Bid Holder and obtain KDOT's approval to bid (see **subsection 102.4b.)** even though the Bidder is prequalified.

(2) Follow instructions on a KDOT addendum.

f. The Secretary will reject a Proposal as non-responsive if the Bidder added language, giving the Bidder a right to reject or accept an award of contract.

g. The Secretary will reject a Proposal as non-responsive if the Bidder failed to:

(1) Include a unit price in the Unit Bid column for each line item of work listed in the Unit Prices List.

(2) Insert a principal's electronic signature on an electronic internet Proposal. (DOT Form No. 202).

(3) Submit a completed electronic internet bid bond as **subsection 102.12** requires.

(4) Complete Required Contract Provision dated 08-10-66 (latest revision), Certification-Noncollusion and History of Debarment.

(5) Complete Required Contract Provision dated 04-30-82 (latest revision), Certification-Prequalified Financial Amount.

(6) Complete Required Contract Provision dated 07-19-80 (latest revision), DBE Contract Goals, for all Federal Aid Projects.

(7) Submit only KDOT-certified DBE's on Required Contract Provision dated 07-19-80 (latest revision), DBE Contract Goals, for all Federal Aid Projects, unless the total value of KDOT-certified DBE's on this provision equals or exceeds the DBE Contract Goal.

(8) Include in the Proposal acceptable ties, riders, combinations, or alternates, if any, that comply with **subsection 102.5**.

(9) Use Expedite software to prepare the Bidder's Proposal.

(10) Include in the Proposal amendments, if any, as **subsection 102.4** requires.

(11) Have a current Tax Clearance Certificate at the time of award of contract.

h. The Bureau of Construction and Materials will notify a Bidder, by email or other writing, that the Secretary rejects the Bidder's Proposal.

102.18 REJECTION OF PROPOSALS; NON-RESPONSIBLE CONTRACTOR

a. Even though a Bidder is prequalified under **subsection 102.2**, the Prequalification Committee may determine a Bidder is otherwise non-responsible as lacking the skills, abilities, or integrity to perform the work.

b. Before the award of contract and without liability, the Prequalification Committee has full authority to determine a Bidder is non-responsible. The Prequalification Committee may determine a Bidder is non-responsible for reasons other than those identified in this **subsection 102.18**.

c. The Prequalification Committee may determine a Bidder is non-responsible and reject the Bidder's Proposal if the Bidder:

(1) Made false, deceptive or fraudulent statements in the "Contractor's Qualification Statement and Experience Questionnaire" or in a qualification hearing.

(2) Owes outstanding labor and materials bills on a current contract without a good cause exception for non-payment as permitted in **subsection 109.6d**.

(3) Owes the Secretary monies on a current contract and has no good cause for failing to reimburse the Secretary for the monies owed.

(4) Performed unacceptable work on a current or recent project(s), calling into question the Bidder's ability to perform future, quality work.

(5) Performed work unsatisfactorily on a current contract regarding the timeliness of work and the award of additional work could affect timely completion of the current contract work.

(6) Lacks financial resources, equipment, experience, or supervision to perform classifications of work.

(7) Has been suspended or debarred from bidding or been given a notice of suspension or proposed debarment from bidding by KDOT, another Kansas state agency, other state government agency, FHWA, or other federal government agency.

d. Before an award of contract occurs, the Prequalification Committee will provide the Bidder an initial written notice of non-responsibility, specifying the reasons the Committee has determined the Bidder is non-responsible. The Bidder may object to the Committee's determination in writing or by requesting an informal hearing. The Bidder shall identify the reasons for the Bidder's disagreement with the Committee's initial determination of non-responsibility. After receiving the Bidder's written arguments or holding an informal hearing, the Prequalification Committee will issue either a final notice of responsibility or a final notice of non-responsibility. If issuing a final notice of non-responsibility, the Committee will specify the reasons the Committee has determined the Bidder is non-responsible.

e. The Prequalification Committee's final notice of non-responsibility under **subsection 102.18d.** is considered final KDOT agency action under the KJRA, K.S.A. 77-601 *et seq*.

f. If a Bidder's conduct represents such serious acts, omissions, or misconduct, calling into question the Bidder's ability to perform future work, the Prequalification Committee may decline to renew the Contractor's qualification and/or initiate suspension or debarment under **subsection 102.19** rather than repeatedly finding a Contractor is non-responsible under this **subsection 102.18**.

g. The Secretary will reject a Proposal from a Bidder that is not properly prequalified or qualified under **subsection 102.2** or is not otherwise eligible to bid as a prime Contractor under subsection **102.4** even though the electronic bidding system or a KDOT representative may have allowed the Bidder to obtain a Proposal Form and submit a Proposal.

102.19 SUSPENSION OR DEBARMENT

a. Definitions.

(1) Debarment. An exclusion or bar from contracting with or bidding on contracts let by the Secretary for a specified period.

(2) Suspension. An exclusion or bar from contracting with or bidding on contracts let by the Secretary for a temporary period of time, pending the completion of legal or debarment proceedings.

b. The Secretary may impose debarment on a Contractor if the Contractor:

(1) Makes false, deceptive, or fraudulent statements in the "Contractor's Qualification Statement and Experience Questionnaire" or in a qualification hearing.

(2) Lacks financial resources, equipment, experience, or supervision to perform classifications of work.

(3) Fails to pay the Secretary monies owed on previous contracts.

(4) Is suspended or debarred in Kansas or in a different state by a Kansas state agency, another state government agency, the FHWA, or another federal government agency.

(5) Submits more than one Proposal for the same Project under the same or different names.

(6) Commits fraud, anti-trust violations, theft, labor violations, wage law violations, illegal discrimination, or other actions indicating a lack of business integrity or business honesty. The Secretary may rely upon a criminal conviction, an adverse civil judgment, the Contractor's admission, or other evidence as proof of the offense.

(7) Violates a contract the Secretary let or violates an associated subcontract by:

(a) Willfully failing to comply with the Contract Documents.

(b) Failing to perform one or more contracts within a reasonable time preceding the decision to suspend or debar and the Contractor's actions or actions within the Contractor's control substantially caused this failure to perform.

(c) Unsatisfactorily performing work (quality or timeliness) on one or more contracts within a reasonable time preceding the decision to suspend or debar and the Contractor's actions or actions within the Contractor's control substantially caused this unsatisfactory performance.

(d) Failing to pay labor or material bills on one or more contracts.

(e) Performing any other act or omission that affects the Contractor's responsibility as a Contractor or subcontractor.

c. The Secretary may suspend a Contractor from bidding if the Secretary has evidence that raises a reasonable suspicion that the Contractor has committed any of the acts set forth in **subsection 102.19b.** and if the Secretary determines that the suspension is in the best interests of the state of Kansas. The Secretary may impose suspension instead of or prior to debarment.

d. Before suspending or debarring a Contractor, the Secretary will give the Contractor notice of suspension or debarment and hold hearings as K.A.R. 36-31-2 and K.A.R. 36-31-3 require.

e. Nothing in this **subsection 102.19** limits the Secretary's authority to determine the Bidder is non-responsible under **subsection 102.18**.

f. The Secretary will reject a Proposal from a Bidder suspended or debarred at the time of Letting even though the electronic bidding system or a KDOT representative may have allowed the suspended or debarred Bidder to obtain a Bidding Proposal Form and submit a Proposal.

SECTION 103

AWARD AND EXECUTION OF CONTRACT

103.1 AWARD OF CONTRACT

a. Lowest Responsible and Responsive Bidder.

(1) If awarded, the Secretary will award the contract to the lowest, responsible, and responsive Bidder. The lowest bidder is the Bidder who offers to complete the Project at the lowest dollar cost as determined in **subsection 103.1b**.

A responsible Bidder is a Bidder who is prequalified before the Letting date and who has the skills, abilities, and integrity to perform the work at the time the Secretary awards the contract. See **subsection 102.2** for prequalification. See **subsection 102.18** for determinations of non-responsibility.

A responsive Bidder is a Bidder who has complied with all Bidding Proposal Form requirements. See **subsection 102.17** for determinations of non-responsiveness.

(2) The Secretary may award a contract to a responsible and responsive lone Bidder.

b. Calculating Lowest Dollar Cost.

(1) Base Bid. To determine the lowest dollar cost, the Secretary will sum the products of the estimated quantities by the unit bid prices (base bid).

(2) Combination Bids. For allowed combination bids, the Secretary will determine the base bid for each project and compare each project's base bid with the sum of the projects' base bids. The Secretary will award the contract based on whichever base bid or combination results in the lowest overall cost to KDOT or the LPA.

(3) Tied Bids. For allowed tied bids, the Secretary will determine the base bid for each project and compare each project's base bid with the sum of the projects' base bid. The Secretary will award the contract based on whichever base bid or tie results in the lowest overall cost to KDOT or the LPA.

(4) Bids involving Riders. For allowed deducts under **subsection 102.5c.(1)(c)**, the Secretary will determine the base bid for each project and compare each project's base bid with the sum of the projects' base bids as adjusted by the deduct(s). The Secretary will award the contract based on whichever base bids or combination results in the lowest overall cost to KDOT or the LPA.

For allowed deducts under **subsection 102.5c.(1)(d)**, the Secretary will not combine the projects' base bids to determine the lowest overall cost to KDOT or the LPA. Rather, the Secretary will determine the lowest responsible bidder on the project for which an award was mandatory (the primary project or Project A) using the base bids on Project A. If the lowest bidder on Project A is the bidder offering the deduct, the Secretary will apply the deduct to Project B and then determine the lowest bidder on Project B. If the lowest bidder on Project A is not the bidder offering the deduct, the Secretary will ignore the deduction offered on Project B and determine the lowest bidder using the base bids on Project B with no deducts. KDOT reserves the right to ignore deducts in situations in which KDOT is unable to administer application of the deducts equitably. For instance, one bidder's Project A may be another bidder's Project B and produce a conflict among the primary projects.

(5) Bids with Time Costs. If the Bidding Proposal Form requests or requires A+B bidding or lane-rental bidding, the Secretary will add to the base bid the product of the time for performance by the daily road user cost or lane rental cost. The Secretary will use this total to determine the lowest bid but will not use this total to determine the contract amount. Instead, the contract amount is the base bid and the Contract Time is the number of days the Bidder bid.

(6) Alternate Bids. If the Bidding Proposal Form requests or requires an alternate bid, the Secretary may award the contract based upon the lowest cost of whichever alternate the Secretary determines is in the best interests of the state of Kansas. For example, with an accelerated work schedule alternate bid, the Secretary may award the contract either to the lowest, responsible and responsive base Bidder or to the lowest, responsible and responsive accelerated Bidder.

(7) Unbalanced Bids. See **subsections 102.17d.(6)** and **(7)**.

(a) The Secretary may determine that a mathematically unbalanced price(s) or a materially unbalanced bid does not reflect the lowest dollar cost to KDOT and reject a Proposal containing such unbalancing.

(b) Mathematically unbalanced price(s). A Proposal is mathematically unbalanced when the Proposal contains lump sum prices or unit prices that do not reflect the reasonable, actual cost (plus reasonable profit, overhead costs, and other indirect costs) to construct the item.

(c) Materially unbalanced bid. A materially unbalanced bid is a bid that generates reasonable doubt that award to that bidder would result in the lowest ultimate cost to KDOT, an LPA, or both.
(d) If KDOT suspects the bidder has submitted mathematically unbalanced price(s) or a materially unbalanced bid, the Bureau Chief of Construction and Materials will request that the bidder submit an explanation and documentation that demonstrates why the prices or bid are not unbalanced.
(e) If the bidder is unable to demonstrate that the prices or bid are not unbalanced, the Bureau Chief of Construction and Materials will notify the Secretary who has complete discretion to accept or reject the bidder's Proposal.
(f) If the Secretary accepts a Proposal that, in the Secretary's judgment, contains a mathematically unbalanced price(s), the Bidder waives the right to seek compensation beyond the contract unit price or lump sum price for the work if such item overruns or underruns. Thus, **subsections 104.2** and **104.3** shall not apply to a mathematically unbalanced item(s).

c. Notice of Award. The Secretary will provide the successful Bidder notice of award of contract within 45 calendar days after the Letting. The Secretary may extend the time within which the award is made if the apparent lowest, responsible and responsive Bidder agrees to such extension. A Bidder other than the apparent lowest, responsible and responsive Bidder may agree to a time extension for award or may withdraw a bid without forfeiting its bond.

103.2 CANCELLATION OF AWARD

Before the Secretary signs the contract, the Secretary may cancel the award of contract with no liability. Assume the risk for costs incurred, materials ordered, or work started before the Secretary signs the contract.

103.3 CONTRACT BOND REQUIREMENTS

a. Provide a contract bond on D.O.T. Form 282, for contract performance and payment of labor, materials, supplies, and other items as specified in D.O.T. Form 282. Secure a penal sum that equals the contract amount. Obtain the contract bond from an insurer or Surety the Kansas Commissioner of Insurance has authorized to do business in Kansas and the Secretary approves. Within 5 business days after the insurer or Surety fails or becomes financially insolvent, file a new contract bond executed by an approved insurer or Surety.

b. Payment Bond Claims. Subcontractors and suppliers may file a claim on the contract bond before the Project is completed and a maximum of 6 months after the Project is completed. For purposes of this provision and K.S.A. 68-410, the Project is completed on the date the Engineer issues the Notice of Acceptance of Contract under **subsection 105.16**. This Notice of Acceptance date may follow an observation or establishment period.

103.4 EXECUTING THE CONTRACT

a. Within 10 business days after notice of the award of contract or within any time extension the Bureau Chief of Construction and Materials has granted:

(1) Provide to the Secretary the contract bond, certificate(s) of insurance, authorization to do business in Kansas, and other documents the Proposal Form requires. To obtain authorization to do business in Kansas, register with the appropriate state agencies. If the Bidder is not domiciled in Kansas then appoint an individual or organization, other than a government employee, as the Bidder's resident agent in Kansas for service of process.

See **subsection 107.10** for liability insurance requirements that must be in place before the parties execute the contract.

See **subsection 107.11** for railroad protective liability insurance requirements. Though not a prerequisite to contract execution, the railroad protective liability policy must be in place and approved before the Contractor begins work at railroad crossings, work adjacent to railroad right-of-way, or work within 50 feet of the centerline of a railroad track; and

(2) Sign and return to KDOT the contract and contract bond. Persons with the Contractor's Power of Attorney may sign the contract, contract bond, or both in lieu of an authorized Contractor representative. Persons with the Surety's Power of Attorney may sign the contract bond in lieu of an authorized Surety's representative. Submit the required Powers of Attorney with the contract and contract bond. Select one of the following methods

and advise the Contract and Proposal Coordinator in the KDOT Bureau of Construction and Materials of the method the Bidder has selected.

- Sign the contract and contract bond at the Office of the Bureau of Construction and Materials.
- Request that KDOT electronically transmit the contract and contract bond to an e-mail address the Bidder has designated. Print the contract and contract bond. Sign and return by mail the contract and contract bond to the Contract and Proposal Coordinator in the Bureau of Construction and Materials.

b. The Secretary will not sign the contract until the Bidder has provided the documents required under **subsection 103.4a**. The date the Secretary signs the contract becomes the effective contract date.

103.5 FAILING TO EXECUTE THE CONTRACT

If the Bidder fails to provide required documentation or fails to sign the contract according to **subsection 103.4**, the Secretary will cancel the award of contract to that Bidder and either re-award the contract to the next lowest, responsible, and responsive Bidder or re-let the Project. The Bidder shall forfeit its Bid Bond as liquidated damages for the delay, re-letting expenses or both. The Bidder shall not perform subcontract work on the Project and shall not re-bid if the Secretary re-lets the Project.

103.6 ASSIGNMENT OF CONTRACT

a. General. A Contractor may assign the entire contract to another prequalified Contractor if the following conditions are met:

(1) The Secretary finds the Assignment has a valid business purpose and is in the best interests of the State of Kansas; and

(2) Either the existing Surety agrees to continued liability on the contract bond or a new Surety executes a contract bond assuming all contract obligations as of the contract execution date. The Secretary will not recognize any Assignment until the Secretary and Surety or Sureties have consented in writing to the Assignment.

b. Reorganization of Contractor's Business Organization. A partnership change or a Contractor's reorganization as an individual proprietorship, partnership, or corporation shall not prevent the reorganized partnership, or company from completing pending contracts with the Secretary if the following conditions are met:

(1) The Surety on the contract bond executes a supplemental agreement, endorsement, or rider assuming liability for the reorganized partnership or company; and

(2) The original partners or original organization remains liable on the contract and contract bond, and the new partners and new organization assume liability for future contract performance; or

(3) The new partners and new organization assume liability for past contract performance and future contract performance.

c. Death. If the Secretary and Surety on the contract bond approve, the heirs, executor or administrator of a sole proprietorship's estate may complete the deceased Contractor's contract.

SECTION 104

SCOPE OF WORK

104.1 INTENT OF CONTRACT AND SCOPE OF CONTRACT

a. Perform all work necessary to construct or reconstruct the Project. Use the best general engineering and construction practices.

b. Assume responsibility for the following:

- all work necessary to construct or reconstruct the Project;
- sublet work at any tier as if the Contractor were performing that work (**subsection 105.9**);
- materials supplied at any tier as if the Contractor were supplying the materials directly (**SECTION 106**);
- unacceptable work and unauthorized work (**subsection 105.5**);
- damage to Project work (**subsection 104.20**); and
- damage to persons and property (**subsection 107.10**).

c. Accept Contract Changes such as differing site conditions, quantity changes, eliminated items, extra work, and temporary suspensions of work, among others. Contract Changes do not release the Contractor or Surety from liability for completing the contract. The Engineer will prepare a change order for Contract Changes.

d. If the Contractor believes that a Contract Change or any other acts or omissions fundamentally change the scope of the original contract and thus represent a breach of contract, notify the Engineer in writing. See **subsection 108.10b**.

e. Changes caused by Acts of God are not Contract Changes.

104.2 SIGNIFICANT CHANGE IN MAJOR CONTRACT ITEM QUANTITIES

a. A major contract item is any contract item, excluding mobilization, having an original contract value of 5% or more of the original contract amount.

b. A significant change in contract quantities is an increase or decrease to a major contract item of work by more than 25% of the original contract quantity. For decreases of 100%, see **subsection 104.4** for eliminated items.

c. The Engineer will make a contract adjustment for a significant change in contract quantities if the Contractor proves:

(1) the changed quantities reasonably increase or decrease the Contractor's time for performance (CIOW or Project critical path), price for performance, or both;

(2) the Contractor, its suppliers at any tier, or its subcontractors at any tier did not cause or contribute to the changed quantities; and

(3) the Contractor has provided the required notice under **subsection 104.8**.

d. Limits on Compensation. A price adjustment will apply only to that quantity above 125% or below 75% of the original contract quantity. The Secretary will not compensate the Contractor for expenses not recovered because of the way the Contractor allocated overhead, profit, or other expenses among the various bid items.

104.3 CHANGES IN MINOR CONTRACT ITEM QUANTITIES

a. Any item not considered a major contract item is considered a minor contract item.

b. The Engineer will not provide monetary compensation for changes in quantities of minor contract items.

c. The Engineer may grant a time extension if the Contractor proves:

(1) the quantity change in minor contract items increases the time for performance (CIOW or Project critical path);

(2) the Contractor, its suppliers at any tier, or its subcontractors at any tier did not cause or contribute to the changed quantities; and

(3) the Contractor has provided the required notice under **subsection 104.8**.

104.4 ELIMINATED ITEMS

a. The Engineer may eliminate items from the contract regardless of whether the eliminated item(s) represents an entire subcontract.

b. Determining the Contract Adjustment (Price and Time).

(1) Money allowed. The Secretary will pay for work actually performed and materials purchased (but non-returnable) before KDOT gave the Contractor notice of eliminating the item from the contract. Deliver to KDOT, materials the Secretary purchased under this **subsection 104.4**. Such materials become KDOT's property. The cost of materials purchased but non-returnable shall include the invoice price of the materials and shipping/delivery charges that represent the most economical movement of the materials to the Contractor's office and/or to the Project site or other location KDOT designates.

(2) Prohibited Costs. The Secretary will not pay for bidding costs, overhead, anticipated profit, interest, or other indirect costs associated with the eliminated item.

(3) Subcontracts. If the eliminated item is a subcontracted item, neither the Contractor nor the pass-through subcontractor is entitled to recovery beyond reimbursement for actual work performed and materials purchased. The Secretary will not pay for the pass-through subcontractor's bidding costs, overhead, anticipated profit, interest, or other indirect costs associated with the eliminated item even if the eliminated item results in canceling the subcontract.

(4) Time. The Secretary will not increase or decrease the Contract Time for eliminated items.

c. Subsections 104.8 through **104.10** do not apply to eliminated items.

104.5 DIFFERING SITE CONDITIONS

a. Differing site conditions are:

(1) Type I. Type I site conditions are subsurface or latent physical conditions encountered at the site differing materially from those affirmatively indicated in the Contract Documents.

(2) Type II. Type II site conditions are unknown and unusual physical conditions differing materially from those ordinarily encountered and generally recognized as inherent in the contract work.

b. Unless **subsection 104.5c.** applies, the Engineer will make a contract adjustment for a differing site condition if the Contractor proves:

(1) the differing site condition reasonably increases or decreases the Contractor's time for performance, price for performance, or both;

(2) the Contractor, its suppliers at any tier, or its subcontractors at any approved tier did not cause or contribute to the differing site condition; and

(3) the Contractor has provided the required notice under **subsection 104.8**.

c. The Engineer will not make a contract adjustment for a differing site condition if:

(1) the Contract Documents address the Type I conditions encountered.

(2) the Contract Documents address the Type I or Type II nature of the work.

(3) a provision in the Contract Documents shifts to the Contractor the responsibility for the Type I or Type II conditions encountered or nature of the work.

(4) the average Contractor should have been able to discover the differing Type I or Type II site condition from reviewing the Contract Documents or from investigating the site.

(5) the Contractor knew or should have known of the Type I or Type II conditions encountered or nature of the work.

d. Contract Changes or claims associated with unidentified and improperly relocated utilities under **subsection 105.11** shall be treated as differing site conditions and evaluated under **subsections 105.11 and 104.5.**

104.6 EXTRA WORK

a. Extra Work is:

(1) work not foreseen or included in the original contract.

(2) work that differs materially in kind or nature from that involved or included in the original proposed construction.

(3) work caused by, delay to work caused by, or acceleration of work caused by:

(a) written changes that KDOT, a LPA, or both make to the Contract Documents or the Contractor's work.

(b) verbal changes that KDOT, a LPA, or both make to the Contract Documents or the Contractor's work.

(c) other acts or omissions that change the contract terms.

b. The Engineer will make a contract adjustment for extra work if the Contractor proves:

(1) the Engineer and Contractor agreed that the written or verbal Contract Change is extra work and reached this agreement before the Contractor began the extra work;

(2) the Contractor, its subcontractors, or its suppliers did not voluntarily perform or provide the extra work;

(3) the extra work was necessary to complete the Project;

(4) the extra work reasonably increases or decreases the Contractor's time for performance (CIOW or Project critical path), price for performance, or both;

(5) the act or omission of the Contractor, its suppliers at any tier, or its subcontractors at any tier did not cause or contribute to the extra work;

(6) another Contractor on this Project or an adjacent project did not cause or contribute to the extra work (refer to **subsection 105.12** for claims between Contractors); and

(7) the Contractor has provided the required notice under **subsection 104.8**.

c. Examples of extra work include work caused by, delay to work caused by, or acceleration of work caused by:

- changes KDOT, a LPA, or both make that affect the Contractor's method of operations.
- changes KDOT, a LPA, or both make that affect the Contractor's manner of performing the work.
- changes KDOT, a LPA, or both make that affect the Contractor's schedule.
- changes KDOT, a LPA, or both make to the Contract Documents because of an error or omission in the Contract Documents.
- changes in government-provided facilities, equipment or materials.
- changes in federal, state, or municipal law enacted after the Letting.

d. For purposes of **subsection 104.6**, KDOT includes KDOT employees and KDOT hired third party consultants operating within their authority and duties (see **subsection 105.2** and **105.3**). For purposes of **subsection 104.6**, LPA includes LPA employees and LPA hired third party consultants operating within their authority and duties (see **subsection 105.2** and **105.3**).

e. Contract Changes or claims for negligent inspection, excessive inspection, or both shall be treated as extra work and evaluated under **subsection 105.7 and 104.6;** however, the Contractor's failure to provide timely notice as required by **subsection 104.8a.** will result in the denial of the claim and waiver of the claim under **subsection 104.8c.(3).** Allowances made for lack of timely notice in **subsection 104.8c.(1)** and **104.8c.(2)** do not apply to claims for negligent inspection or claims for excessive inspection.

104.7 TEMPORARY SUSPENSION OF WORK

a. A temporary suspension of work occurs when:

(1) The Engineer orders the Contractor to suspend all or part of the work. The Engineer will follow a verbal suspension with written notice to the Contractor.

(2) The Engineer's acts or omissions result in a suspension of all or part of the work. Verbally, without delay, notify the Engineer if such acts or omissions result in a suspension. Follow the verbal notice with a written notice to the Engineer. The Engineer may not know the acts or omissions caused the suspension.

b. Unless **subsection 104.7c.** applies, the Engineer will compensate for a temporary suspension of part or all of the work if the Contractor proves:

(1) the temporary suspension reasonably increases or decreases the Contractor's time for performance, price for performance, or both;

(2) the Contractor, its suppliers at any tier, or its subcontractors at any approved tier, did not cause or contribute to the suspension;

(3) the Contractor submits its request for a contract adjustment within 7 calendar days after the suspension or within any additional time the Engineer grants in writing;

(4) no other provision in the contract permits or denies a contract adjustment for the acts or omissions causing the temporary suspension; and

(5) the suspension:

- was not originally anticipated or should not have been anticipated in the original contract;
- is not a suspension customary in, ordinarily encountered in, or inherent to the construction industry; or
- is for a period longer than anticipated.

c. Compensation Denied for Certain Suspensions.

(1) The Engineer will not compensate for a temporary suspension if the suspension was caused by:

- unsafe conditions.
- violation of laws.
- requirements of KDHE, Corp of Engineers, or other governmental entities.

(2) The Engineer will not grant monetary compensation but will suspend working day charges or grant a time extension, whichever applies, under **SECTION 108** if the suspension was caused by:

- an Act of God as provided in **subsection 108.6c.(3)** (calendar day contracts).
- weather/recovery days as provided in **subsections 108.5c.(1)** and **108.5d.(1)** (working day contracts).
- unusually severe weather as provided in **subsection 108.6c.(2)** (calendar day contracts).
- an agreement to suspend the Project for a winter shutdown period as provided in **subsection 108.5d.(6)**.

d. Determining the Contract Adjustment (Price and Time).

(1) Money. The Secretary will pay the Contractor using the Force Account provision of **subsection 109.3**. The Contractor is responsible for keeping track of and submitting all costs. The Secretary will not pay suspension costs not documented with Force Account records. The Secretary will not pay suspension costs if the Contractor would have incurred these costs notwithstanding KDOT's temporary suspension of work. Exception: if the Contractor can segregate suspension costs from other costs that would have been incurred, the Engineer will include the segregated costs in the contract adjustment.

(2) Time or Acceleration Costs. The Secretary will increase the Contractor's time for performance by the amount of time KDOT's temporary suspension delayed the Project's critical path. Alternatively, the Secretary will pay acceleration costs if the Engineer requires or permits the Contractor to accelerate the work at KDOT's expense rather than increasing the time for performance.

(3) Waiver. If the Contractor fails to submit its request for a contract adjustment within 7 calendar days after the suspension is lifted or the additional time the Engineer grants as provided in **subsection 104.7b.(3)**, the Contractor waives the right to a contract adjustment.

(4) **Subsections 104.8** through **104.10** do not apply to temporary suspensions.

104.8 NOTICE OF CONTRACT CHANGE AND REQUEST FOR CONTRACT ADJUSTMENT

a. Notice. After encountering a Contract Change, notify the Field Engineer of the Contract Change verbally without delay and in writing within 10 business days. In the written notice, describe the Contract Change and, if applicable, any potential claim for contract adjustment (additional time, money, or both). Explain how the

Contractor anticipates the Contract Change will impact the Contractor's operations, delay the Contractor's schedule, or otherwise increase the Contractor's costs.

(1) Such written notice of a Contract Change is necessary so the Field Engineer may record the costs the Contractor is incurring.

(2) Provide the written notice even if the Engineer orders the Contract Change. The Engineer may know the Contractor is performing the work but not that the Contractor expects a contract adjustment for the work.

(3) Never assume the Engineer knows the Contractor is performing a Contract Change for which the Contractor will be claiming a contract adjustment. The Engineer and Contractor may disagree that the work is a Contract Change.

(4) For differing site conditions, provide the written notice to the Field Engineer before beginning the work caused by the differing site conditions. Obtain the Engineer's approval of a preliminary or final contract adjustment before beginning the work caused by the differing site condition unless the Engineer allows otherwise in writing.

(5) For extra work, provide the written notice to the Field Engineer before beginning the extra work. Obtain the Engineer's approval of a preliminary or final contract adjustment before beginning the extra work unless the Engineer allows otherwise in writing.

(6) Notice to an Inspector does not meet the requirements of this provision.

b. Contract Adjustment Request. After providing the Engineer written notice of a Contract Change under **subsection 104.8a.**, submit a written request for any contract adjustment desired (time, money or both) without unreasonable delay but no later than 30 calendar days following the written notice of Contract Change.

(1) If the Contractor desires more than 30 calendar days to submit the request, obtain the Engineer's approval to submit the request for contract adjustment outside the 30 calendar day period provided.

(2) If the request involves a differing site condition or extra work, the Contractor must obtain the Engineer's approval of a contract adjustment before beginning the differing site condition work or extra work unless the Engineer allows otherwise in writing. If the Contractor needs to begin the work before the Contractor is able to submit a final contract adjustment request, obtain the Engineer's approval to submit a preliminary contract adjustment with an estimate of the requested time, money, or both. Then, submit the final request for contract adjustment within the 30 calendar day period provided or within any additional time the Engineer approves.

c. Failure to Provide Notice or Failure to Submit Request. If the Contractor does not provide notice of the Contract Change timely under **subsection 104.8a.**, or if the Contractor does not submit the contract adjustment request timely and in sufficient detail under **subsections 104.8b.**, **104.9** and **104.10**, the Engineer may:

(1) reduce the Contractor's request for contract adjustment by the amount of time, money, or both time and money the Secretary may have been able to save if the Contractor would have given more timely notice or a more timely contract adjustment request; and

(2) reduce the Contractor's request by amounts the Engineer was unable to substantiate with KDOT records; or

(3) deny the claim and consider the lack of timely notice as the Contractor's waiver of the claim.

d. Waiver of Contract Adjustment Request. Notwithstanding **subsection 104.8c.**, the Engineer will deny the claim and consider the lack of timely notice as the Contractor's waiver of the claim if the Contractor fails to provide notice of the Contract Change before the Engineer issues Notice of Acceptance of Contract under **subsection 105.16b**.

e. Certification of Contract Adjustment Request. The Contractor's authorized representative shall certify the contract adjustment request with one of the following statements, whichever applies to the specific contract adjustment request:

(1) The undersigned hereby certifies, under the penalty of law for perjury or falsification, that I am authorized to submit this contract adjustment request on behalf of the Contractor and to bind the Contractor, that the contract adjustment request is made in good faith and, to the best of the Contractor's knowledge and belief, is a true and complete statement of the estimated costs and time sought for the Contract Change and is authorized by the Contract. I further certify that no additional claims will be submitted related to this contract adjustment request, and the Contractor will maintain documentation that supports the contract adjustment request.

(2) The undersigned hereby certifies, under the penalty of law for perjury or falsification, that I am authorized to submit this contract adjustment request on behalf of the Contractor and to bind the Contractor, the contract adjustment request is made in good faith and, to the best of the Contractor's knowledge and belief, is a true

and complete statement of the actual costs and time incurred for the Contract Change and is authorized by the Contract. I further certify that no additional claims will be submitted related to this contract adjustment request, and the Contractor has documentation that supports the contract adjustment request.

f. Subcontractor/Supplier Pass Through Claims. Contract adjustment requests shall include pass-through claims of subcontractors and suppliers, if any, associated with Contract Changes. KDOT's consideration of these claims does not create privity of contract between KDOT and the subcontractors or suppliers or between the LPA and the subcontractors or suppliers. If the contract adjustment request includes the pass-through claim of subcontractors and suppliers, the Certification required under **subsection 104.8e.** shall include the following language for each subcontractor and supplier seeking a pass-through claim: "The claim being passed through to KDOT, the LPA, or both is passed through in good faith and is, to the best of the Contractor's knowledge and belief, a true and complete statement of the estimated or actual costs and time incurred by the named subcontractor/supplier for the Contract Change and is authorized by the Contract. I further certify that no additional related claims will be submitted on that subcontractor's/supplier's behalf, and the Contractor has or will have documentation that supports the pass-through claim." The Subcontractor's or Supplier's authorized representative shall certify the contract adjustment request with one of the statements provided in **subsection 104.8e.**, whichever applies to the specific contract adjustment request, except that the word "Contractor" shall be replaced with the word "subcontractor" or "supplier".

104.9 PRICING THE CONTRACT ADJUSTMENT REQUEST

a. Costs Included. Include in the contract adjustment request, submitted under **subsection 104.8**, all direct and indirect costs associated with the Contract Change including labor, materials, equipment, overhead, profit, impact costs, and other costs for which the Contractor claims compensation is owed. When applicable, provide reduction in costs attributable to the Contract Change. Do not include prohibited costs listed in **subsection 104.9c**.

(1) For Contractor-owned equipment charges, use the Rental Rate Blue Book for Construction Equipment (Blue Book) rates as calculated under **subsection 109.3d.** for both operating equipment (**subsection 109.3d.(1)**) and idle equipment (**subsection 109.3d.(3)**). Exception: if the contract adjustment request is for an amount equal to or greater than Two hundred fifty thousand dollars ($250,000.00), the Secretary's representative at any level of review may require the Contractor to provide actual equipment rates from the Contractor's cost accounting records rather than allowing the Contractor to use Blue Book rates. The lesser of Blue Book or actual equipment rates will be used for the contract adjustment request. When actual equipment rates are required instead of Blue Book rates, standby rates will be determined in accordance with **subsection 109.3d.(3)** except the calculation shall use the hourly ownership rate determined from the Contractor's cost accounting records in lieu of the hourly rental rate.

(2) For rented equipment, use the actual rental cost from invoice.

b. Acceleration Costs. On calendar day or calendar completion date projects, also include in the contract adjustment request all direct and indirect costs associated with required acceleration. Identify these costs separately from the other direct and indirect costs. If the Contractor determines circumstances make it impracticable or impossible to accelerate the work, notify the Engineer in the contract adjustment request.

c. Prohibited Costs. Do not include claim preparation costs, attorney's fees, loss of anticipated profit, and interest during the period in which the Contractor prepared the claim. Do not include loss of bonding capacity, loss of credit, loss of business, and similar items of consequential damages not specifically allowed in **subsection 104.9a**. These charges are not payable under the contract.

d. Impact Costs. If the Contractor is uncertain as to the amount of impact costs, write in the contract adjustment request the anticipated impact cost amount and specify that this is an anticipated amount which will be justified in detail upon completion. The Contractor waives the right to seek impact costs if the Contractor fails to include actual or anticipated cost in the contract adjustment request. In evaluating compensation for impact costs, the Engineer may take into account changes in schedule float that occur between the date of the Contract Change and the date the Contractor furnishes its actual or anticipated claimed impact costs.

e. Force Account Records. The Field Engineer may require the Contractor to keep force account records under **subsection 109.3**.

f. Omitted Contract Changes. Subsection 104.9 does not apply to changes in minor contract items quantities, eliminated items, or temporary suspensions; instead, see **subsections 104.3**, **104.4** and **104.7**.

104.10 TIME EXTENSIONS IN THE CONTRACT ADJUSTMENT REQUEST

a. Working Day Contracts. On working day contracts, include in the contract adjustment request, submitted under **subsection 104.8**, all additional days caused by a Contract Change and all working days disputed because of a Contract Change. Submit a detailed narrative describing the delay in operations and an updated progress schedule to support the claimed time extension.

b. Calendar Day or Calendar Completion Date Projects. On calendar day or calendar completion date projects, identify the additional time associated with a Contract Change. Submit a detailed narrative describing the delay in operations and describing the acceleration efforts necessary to overcome the delay. Submit an updated progress schedule that supports the claimed delay and that demonstrates acceleration. Anticipate receiving acceleration costs under **subsection 104.9b.** rather than a time extension. If the Contractor feels circumstances make it impossible or impractical to accelerate the work, notify the Engineer in the contract adjustment request. The Secretary may grant a time extension if KDOT finds it is impossible or impractical for the Contractor to meet the calendar completion date by acceleration or if KDOT determines acceleration costs are excessive.

c. Acts of God on Calendar Day or Calendar Completion Date Projects. Subsection 108.6 rather than **SECTION 104** governs time extensions for Acts of God and other unusually severe weather events unrelated to Contract Changes.

d. Proof of Delay. The Engineer will consider additional days and extensions under **subsections 104.10a.** and **104.10b.** only if the Contractor shows the Contract Change required additional days, shows delay to the CIOW, shows that the delay extends the Project Open Time, Cleanup Time, or other Contract Time, or a combination thereof.

e. Omitted Contract Changes. Subsection 104.9 does not apply to eliminated items or temporary suspensions; instead, see **subsections 104.4**, and **104.7**.

104.11 MAINTAINING AND PROTECTING THE WORK AND INFRASTRUCTURE

a. General. Maintain and protect from damage the work being constructed and all roads, detour routes, intersections, ramps, entrances, temporary approaches, crossings, and structures (infrastructure) within the Project limits. If traffic is being carried through construction, maintain all access routes. If performing work at night or during evening hours, provide lighting equipment so conditions compare favorably with daylight hours. Observe curing periods and legal load restrictions.

b. Detours. Unless shown otherwise in the Contract Documents, all detour routes except those over or through construction will be maintained by the Secretary.

If the detour is marked by the Contractor, the Contractor shall be responsible for maintaining such markings.

c. Maintain and protect the work and infrastructure within the Project limits until partial or final acceptance. Maintaining infrastructure includes temporary surfacing and repairs to pavement and other infrastructure necessary to safely move traffic through the Project.

d. During all temporary suspensions and winter shutdown periods, perform the following operations:

- store all materials so they do not impede or obstruct traffic or traffic safety;
- provide and maintain normal and adequate drainage;
- continue implementation of the SWPPP in accordance with **DIVISION 900**;
- erect and maintain temporary structures, signs, or other facilities;
- maintain newly established planting, seeding, and sod;
- protect new trees or other vegetative growth; and

- protect the work from damage and deterioration.

e. Snow Removal Responsibilities.
- Conduct snow and ice removal on closed roads to maintain access on all closed roads through the winter.
- The Secretary will conduct snow and ice removal on official detour routes and State highways opened to through traffic (including associated intersections and ramps) within the Project limits.
- For City and County Projects, the LPA will conduct snow and ice removal on official detour routes opened to through traffic (including associated intersections and ramps) within the Project limits.

104.12 REMOVING AND DISPOSING OF STRUCTURES AND OBSTRUCTIONS

Remove from the Project all:
- structures and obstructions that are going to be replaced under the contract;
- structures and obstructions unnecessary for constructing the Project;
- structures and obstructions useless to the completed Project; and
- trash.

If a new structure is replacing an existing bridge at the same location, remove the existing bridge.

The Secretary may remove or contract with third parties to remove from the highway right-of-way buildings and other improvements that need to be replaced or relocated. Private or public utilities will remove their utilities from the highway right-of-way or relocate within the highway right-of-way, unless the Contract Documents require the Contractor to do the relocation. The Contract Documents will specify which structures or obstructions third parties will be removing.

The costs of removing structures and obstructions is subsidiary to other work unless the contract has a separate bid item for removal of existing structures or unless the material falls within the limits of structure excavation.

104.13 LOAD RESTRICTIONS

a. Observe legal load restrictions when operating equipment, hauling equipment, or hauling materials on public roads; newly constructed/reconstructed base, pavement, and structures; and any existing base, pavement or structures that will remain in place. Assume responsibility for changes in legal load restrictions that occur after the Project was let. Obtain the District Engineer’s written approval and a special permit to exceed legal load restrictions on the State highway system and on newly constructed/reconstructed portions of the Project.

b. Protect roadways and structures within Project limits from damage. Observe curing periods before operating equipment or hauling loads on newly constructed pavement, reconstructed pavement, or structures. Do not haul loads of any size on pavement base, except when operations require equipment on pavement base to place material. Assume responsibility for damages to roadways and structures the Contractor causes when operating equipment or hauling loads.

104.14 OPENINGS IN HIGHWAY OR RIGHT-OF-WAY FOR THIRD PARTIES

Make no openings, entrances, or other access points in the highway or right-of-way for third parties unless shown in the Contract Documents or unless the third party has obtained a permit from KDOT. Construct all openings, entrances, and other access points according to KDOT’s standards. Maintain and repair all openings, entrances, and other access points until final acceptance.

104.15 THIRD PARTY PERMITS AND RESTORING WORK AREAS DAMAGED BY THIRD-PARTY PERMITS

a. The Secretary may issue to individuals or organizations permits for making an opening in the highway or using highway right-of-way.

b. The Secretary or other government authorities may issue to individuals or organizations permits for constructing or reconstructing utilities.

c. From the time the Notice to Proceed is issued until Final Acceptance, coordinate and accommodate third parties authorized to work within the Project limits. Do not allow individuals or organizations to perform work within the Project limits without a permit from KDOT or other government authorities.

- If the Engineer orders the Contractor to repair or restore work within the Project limits that these individuals or organizations damaged, the Engineer will pay for these repairs or restoration as extra work; and
- If these individuals delay the Contractor's operations, the Engineer will consider whether the delay entitles the Contractor to a contract adjustment as a differing site condition or extra work, whichever applies.

104.16 HANDLING TRAFFIC THROUGH CONSTRUCTION

Safely move traffic throughout the Project. Provide temporary surfacing, when required. Repair potholes and other pavement deficiencies. The Engineer's approval of the Contractor's method of operations does not lessen the Contractor's responsibility for the traveling public's safety.

Sequence work to provide 2-way travel of traffic whenever practicable.

Do not detour traffic if the Contract Documents state that traffic will be carried through construction.

Erect signs and traffic control devices as shown in the Contract Documents or traffic control plan, unless the Engineer directs otherwise. The Engineer will establish work zone speed limits. Confine restricted speed zones to the immediate vicinity of the work, and maintain speed zones over the minimum length of the Project. When the vicinity of the work changes, move the restricted work zone devices to the new area. Remove or cover signs that are unnecessary when no work is in progress.

Provide flaggers and equip flaggers to comply with **SECTION 805**.

The Engineer may shut down all or part of the work (temporary suspension) to handle traffic safely during periods of inclement weather or heavy traffic. The Contractor is not entitled to additional monetary compensation for these temporary suspensions except as provided in this **subsection 104.16**. The Contractor is entitled to working day relief under **subsections 108.5c.** and **d.** or a time extension under **subsection 108.6c.** if the Contractor proves the suspension for inclement weather or heavy traffic meets the conditions stated in these subsections. Exception: The Contractor may be entitled to additional monetary compensation under **subsection 104.7b.** if KDOT, any LPA, or both knew or should have known of the traffic restriction before the Letting.

Include in the Contractor's bid all costs associated with traffic restrictions identified in the Contract Documents. The Contractor is not entitled to additional time, money, or both for these traffic restrictions.

104.17 TRAFFIC CONTROL DEVICES

The Contractor's obligation to provide, erect, and maintain all traffic control devices is extremely important. The Engineer's failure to enforce the Contractor's duty to provide, erect, and maintain all traffic control devices does not lessen the Contractor's responsibility or liability to KDOT, any LPA, the public and workers for failing to provide, erect, or maintain these devices.

The Contractor's subletting of traffic control devices does not lessen the Contractor's responsibility or liability to the public and workers for failing to provide, erect, or maintain these devices. A subcontractor's delay in providing acceptable traffic control devices or a subcontractor's delay in repairing or replacing unacceptable traffic control devices does not excuse the Contractor's obligation to perform this work timely.

Obtain the Engineer's approval before erecting traffic control devices, changing traffic control devices, or removing traffic control devices except if an emergency situation requires immediate action. Comply with the Engineer's orders to change or remove traffic control devices.

Provide, erect, and maintain all traffic control devices necessary to protect the public and workers on the Project. Make sure that the quality, quantity, and placement of traffic control devices meet the most recent edition of the Manual on Uniform Traffic Control Devices (MUTCD) adopted by the Secretary, ATSSA standards, and **SECTION 805**. Traffic control devices that do not meet the MUTCD, ATSSA standards, or **SECTION 805** are unacceptable.

Inspect traffic control devices at least daily during the day, and when needed, at night. Immediately upon discovering or receiving notification of unacceptable traffic control devices, either repair or remove and replace the unacceptable traffic control devices. Record unacceptable traffic control devices and record when the condition has been corrected.

Provide, erect and maintain all traffic control devices until written, final acceptance of the Project including all temporary suspensions of work.

104.18 OPENING SECTIONS TO TRAFFIC AND MAINTAINING ROADWAYS AFTER OPENING SECTIONS TO TRAFFIC

a. The contract may require the Contractor to open to traffic designated sections of the Project before the Contractor has completed all work. Open to traffic and maintain these sections until partial or final acceptance. Include in the Contractor's bid the costs for maintaining these sections of traffic before partial or final acceptance.

b. During the Project, the Engineer may order the Contractor to open to traffic sections of the Project before the Contractor has completed all work or before the Contract Time expires. Open such sections to traffic. The Engineer will issue a partial acceptance of this section. The Secretary will maintain or pay the Contractor to maintain partially accepted sections open to traffic. Exception: the Secretary does not assume liability for damage the Contractor causes to partially accepted work.

104.19 RAILROAD PROVISIONS

a. Notice of Work. Notify the Railroad Company's Division Superintendent/Division Engineer/General Manager, in writing, of the date the Contractor anticipates beginning work on Railroad Company property. If there is no Contractor's Right of Entry or other document in the Contract Documents specifying the notice requirements, provide this initial notice a minimum of 10 business days before starting the work. If the work requires railroad protective services, provide an additional notice a minimum of 24 hours before starting the work.

b. Communication with Railroad. Maintain contact and liaison with the Railroad Company's Division Superintendent/Division Engineer/General Manager or that person's authorized representative. Obtain the Division Superintendent/Division Engineer/General Manager's approval of the time and manner of doing the work.

c. Allowed Clearances. The Contract Documents will show clearance distance from the nearest rail of any railroad track. Allow no structure, material, equipment, or other obstructions within this clearance distance except for permitted falsework.

d. Falsework on Grade Separation Structures. The Contract Documents will show falsework clearance for grade separation structures. Allow no obstructions within the clearance lines shown. After placing falsework, expedite work over the tracks to minimize the falsework duration. Construct falsework to protect the Railroad Company's tracks. Construct falsework to protect the railroad facilities and provide safe train operation. Once no longer necessary, remove falsework, protecting the Railroad Company's tracks and safe train operation. If, in the Railroad Company Chief Engineer's opinion, the Contractor fails to construct, maintain, or remove the falsework safely, thereby endangering the safety of railroad traffic, the Railroad Company may take over the falsework operations and bill the Contractor for expenses the Railroad Company incurs in assuming these obligations.

e. Working Around Railroad Tracks. At all times keep workers, materials, equipment, and machinery a minimum of 12 feet from the centerline of the Railroad Company's main track.

f. Crossings. Cross the Railroad Company's tracks only at existing, open public crossings or temporary crossings the Contractor has constructed with the Railroad Company's written approval (permit).

g. Prosecution of Work. Once begun, consistently pursue work near the railroad tracks, delaying completion only if conditions outside the Contractor's control prevent continued work.

h. Restoring Railroad Property. Upon completing construction, restore the Railroad Company's right-of-way and property to a condition substantially similar to the condition that existed before the Contractor began construction. Include in the Contractor's bid the anticipated costs for such restoration.

i. Obtaining Railroad Protective Services. Obtain from the Railroad Company the services of railroad flaggers, switch-tenders, pilots, and similar protective services required because of the Contractor's operations on the contract.

j. Payment for Railroad Costs.

(1) Using Railroad Property. Costs for using railroad property are subsidiary to other bid items.

(2) Restoring Railroad Property. Costs of restoring railroad property are subsidiary to other bid items.

(3) Obtaining Railroad Protective Services. Costs for obtaining railroad protective services are subsidiary to other bid items.

(a) Pay the Railroad Company directly for railroad protective services.

(b) The cost of railroad protective services includes labor, transportation, and travel expenses.

(c) Exception: The Secretary will reimburse the Railroad Company directly for railroad protective services required under force account work.

(d) Exception: If not included in the Contract Documents the Secretary will reimburse the Railroad Company directly for excess costs of railroad protective services required at detours and temporary crossings if:

- the detour or temporary crossing the Contractor constructed replaced an existing crossing for which the Railroad Company had maintained protective services; and
- the protective services required at the detour or temporary crossing are greater than the services that were required at the existing crossing. Only the excess costs are reimbursable.

(4) Adjusting Railroad Property. Costs necessary to adjust Railroad property for the Contractor's convenience (other than that shown on the Contract Documents) are subsidiary to other bid items.

k. Contractor's Right of Entry. If the Railroad requires the Contractor to execute a right of entry or other agreement directly with the Railroad as a condition to being on railroad right-of-way, KDOT will include a copy of that agreement in the Contract Documents through a Railroad Special Provision. The Contractor is responsible for knowing the requirements of the Railroad Special Provision and should be aware that the Railroad Special Provision may modify the requirements of **subsection 104.19**. If there is a conflict between the Railroad Special Provision and **subsection 104.19**, the Special Provision shall control.

104.20 LIABILITY FOR DAMAGE TO WORK/PROJECT

a. Work. For purposes of this **subsection 104.20**, the term "work" refers to the improvements to be constructed under the contract.

b. Damage Caused by Acts of God and Third Parties. Until Notice of Acceptance of Contract under **subsection 105.16**, protect the work from and assume liability for damages to the work caused by Acts of God, vandalism, malicious mischief, falling objects, explosions, and other acts of third parties except acts of the public enemy (**subsection 104.20d.**) and certain acts of the traveling public (**subsection 104.20h.**). Once damaged, the work is considered unacceptable work under **subsection 105.5**.

c. Damage caused by the Contractor and the Contractor's agents. Protect the work from and assume liability for damages to the work caused by faulty workmanship. Protect the work from and assume damages for the work caused by events within the control of the Contractor, Contractor's agents, subcontractors at any tier, suppliers at any tier, or any combination thereof. Once damaged, the work is considered unacceptable work under **subsection 105.5**.

d. Damage caused by Acts of Governmental Authorities or Acts of the Public Enemy. The Secretary assumes liability for damages to the work caused by acts of governmental authorities or acts of the public enemy. The Secretary also assumes liability for damages to the work that occur during unanticipated winter shutdown when acts of governmental authorities or the public enemy extend the Contractor's operations into the winter shutdown condition. If the Secretary requires the Contractor to restore, repair, remove, or remove and replace work damaged in this manner, the Engineer will pay for the work as extra work under **subsection 104.6**.

e. Damage to work that has been partially accepted. The Secretary assumes liability for damages to the work that occur after the Engineer has issued a partial acceptance of the work under **subsection 105.16a**. The Secretary assumes liability for damages to work that is complete and awaiting partial acceptance under **subsection 105.16a**. The Contractor has the burden to prove that the work is complete. Exception: The Secretary does not assume liability for such damages if the Contractor, the Contractor's agents, subcontractors at any tier, or suppliers at any tier caused the damage.

f. Damage to work during contract winter shutdown periods. Protect the work from and assume liability for damages to the work during contract winter shutdown periods except as provided in **subsection 104.20h**. Once damaged, the work is considered unacceptable work under **subsection 105.5**. Include in the Contractor's bid anticipated costs necessary to conduct repairs or replacement.

g. Damage to work during temporary suspensions of entire Project.

(1) Protect and assume liability for damages to the work that occur during temporary suspensions of the entire Project for which the Contractor is not entitled to a contract adjustment under **subsection 104.7**. Once damaged, the work is considered unacceptable work under **subsection 105.5**.

(2) The Secretary assumes liability for damage to the work that occurs during temporary suspensions of the entire Project if:

- the Contractor is entitled to a contract adjustment under **subsection 104.7** and the Contractor would have been completed with physical construction of the Project at the time the damage occurred had the Project not been temporarily suspended;
- acts of governmental authorities or acts of the public enemy caused the damage; or
- acts of the traveling public caused the damage as provided in **subsection 104.20h**.

If the Secretary requires the Contractor to restore, repair, remove, or remove and replace work damaged in this manner, the Engineer will pay for the work as extra work under **subsection 104.6**.

h. Damage to work caused by the traveling public. The Secretary assumes liability for damages to the work caused by the traveling public if:

(1) the roadway is open to travel by the traveling public (restricted or unrestricted traffic);

(2) the damage was caused by a vehicular accident;

(3) no negligent act or omission of the Contractor, the Contractor's agents, subcontractors at any tier, or suppliers at any tier caused or contributed to the vehicular accident; and

(4) the work damaged was in a finished condition, meeting plans and specifications, whether it qualifies for partial acceptance under **subsection 105.16a**.

104.21 PUNCH LIST AND FINAL CLEANUP

a. Punch List. A punch list is a list of incomplete work items or items needing corrective action to fulfill the contract requirements.

b. Final Cleanup. Final cleanup includes completing all work necessary to construct or reconstruct the Project and cleaning up the Project site, adjacent property the Contractor occupied, borrow sites, plant sites, and local material sources of all trash, weeds, brush, materials, temporary structures, and equipment.

c. Preparation of Punch List.

(1) Monthly Punch List. At each monthly progress meeting, the Field Engineer will provide the Contractor a punch list. KDOT's failure to include an item on a monthly punch list (as distinguished from the final punch list) does not relieve the Contractor's responsibility to complete or correct the item before acceptance of contract.

(2) Final Punch List. Within the Cleanup Time established in **subsection 108.4c.** or by special provision or within a different Contract Time established by special provision when the contract does not have separate Cleanup Time, request in writing for the Engineer to provide a final punch list for the Project. Include a summary of all known incomplete items to be finished for acceptance of contract. If not yet completed, include in the final punch list as-built construction plans as defined in and required by **subsection 802.3g**.

Identify the date the Engineer should provide the final punch list, allowing at least 5 business days for the Field Engineer to develop the final punch list, and allowing time for the Contractor to complete the punch list within the Cleanup Time or other Contract Time permitted.

Within the 5 business days allowed for KDOT to prepare the final punch list, the Contractor's superintendent shall meet with the Field Engineer, a KDOT Maintenance Representative, District Representative and an LPA, if any, to review, inspect the work, and develop the final punch list.

After the final punch list is developed and submitted to the Contractor, KDOT and any LPA representative waive the right to add items to the final punch list without paying for the added items as extra work under **subsection 104.6**. See **subsection 104.21d.(1)(c)**.

(3) Notice of Acceptance of Contract. After the Contractor has completed the final punch list and the final cleanup, the Field Engineer will issue Notice of Acceptance of Contract under **subsection 105.16b**. KDOT's failure to include an item on the final punch list constitutes a waiver of the Contractor's responsibility for that item except as provided in **subsection 108.12** (pertaining to breach of warranty, breach of guaranty, latent defects, fraud, or misrepresentation discovered after Notice of Acceptance).

d. Timely Completion.

(1) Complete the final punch list and final cleanup within the Cleanup Time permitted in **subsection 108.4c.** or by special provision or within the other Contract Time established by special provision.

(a) If the Engineer fails to provide the final punch list within the required 5 business days and the Contractor is performing no physical construction on the Project because the Project is in a state of completion:

- the Engineer will not charge time until the Engineer provides the final punch list.
- the Engineer will suspend charging time damages under **subsection 108.8** if the Project is in liquidated damages, disincentive assessments, or both until the Engineer provides the final punch list.

(b) The Engineer will resume charging time or associated damages, if any, on one of the following days, whichever occurs first:

- The day the Contractor resumes the punch list work.
- The 1st working day after the Contractor receives the final punch list.
- The 5th calendar day after the Contractor receives the final punch list if the Contractor had demobilized from the Project.

(c) If KDOT and any LPA representative, or both add items (except As Built construction plans, required by **subsection 802.3g.**) after the final punch list has been given to the Contractor and before Notice of Acceptance:

- the Engineer will pay for these items as extra work under **subsection 104.6** but the requirements of **subsection 104.6b.(1)** concerning a written agreement and **subsection 104.6b.(7)** concerning notice will not apply.
- the Engineer will not charge time while the Contractor is performing the extra work.
- the Engineer will suspend charging damages under **subsection 108.8** if the Project is in liquidated damages, disincentive assessments, or both until the Contractor completes the extra work.

(2) If the Contractor fails to complete the final punch list and final cleanup within the Cleanup Time or other Contract Time including adjustments in **subsection 104.21d.(1)**, the Secretary may do either or both of the following:

(a) Charge the Contractor liquidated damages per **TABLE 108-1** or as specified in a special provision.

(b) Declare the Contractor in breach of contract and exercise the Secretary's remedies for breach if the Contractor fails to cure as provided in **subsection 108.9**. These remedies include hiring a third party or using KDOT's maintenance forces to perform the final punch list or final cleanup after removing the Contractor from the Project, recovering damages charged to the Contractor, and recovering expenses the Secretary incurred because of the breach. Neither the Contractor nor

Surety can avoid liability under **subsections 104.21** and **108.9** by characterizing the failure to perform the final punch list or final cleanup as an immaterial breach of contract.

e. The Engineer will not issue Notice of Acceptance of Contract under **subsection 105.16b.** until the final punch list and final cleanup has been completed. Exception: if the remaining final cleanup involves a third party landowner, the Engineer will issue Notice of Acceptance if the Contractor/landowner agreement provides for cleanup at a future date.

SECTION 105

CONTROL OF WORK

105.1 STATE TRANSPORTATION ENGINEER'S AUTHORITY AND DISTRICT ENGINEER'S AUTHORITY

The State Transportation Engineer has final authority over issues concerning materials' inspection, testing and acceptance; quality of the work performed; payment for the work performed; suspension of work; acceleration of work; sequence of work; work progress; contract interpretation; and the Contractor's acceptable fulfillment of the contract. The State Transportation Engineer will use the Contract Documents and best general engineering and construction practices to resolve these issues.

The State Transportation Engineer has the authority over all agency personnel (other than the Secretary of Transportation) and the authority to delegate contract administration and construction matters to agency personnel. In addition to the Secretary, the State Transportation Engineer is the only other individual with the authority to declare a contract in breach according to **subsection 108.9**.

The State Transportation Engineer or District Engineer may order the Contractor to:

- postpone or suspend all or part of the work for any reason;
- accelerate all or part of the work for any reason; or
- change the sequence in which the Contractor plans on prosecuting the work.

105.2 FIELD ENGINEER'S AUTHORITY AND DUTIES

a. The Field Engineer administers the contract and has immediate charge of the engineering details of the contract. The Field Engineer has authority over the Project inspection staff. The Field Engineer has access to all parts of the work and the authority to inspect all work. Submit any required notices to the Field Engineer.

b. The Field Engineer may:

(1) order the Contractor to postpone, shut down, suspend, accelerate, or re-sequence all or part of the work if the Contractor is:

- working in unsafe site conditions;
- using unsafe work practices;
- failing to comply with the Contract Documents;
- producing unacceptable work; or
- performing unauthorized work

(2) reject unacceptable work.

(3) order the Contractor, before final acceptance, to uncover or remove finished work.

(4) order the Contractor to repair or remove and replace unacceptable work.

(5) order the Contractor to repair, restore, remove, or remove and replace unauthorized work. See **subsection 105.5**.

105.3 INSPECTOR'S AUTHORITY AND DUTIES

a. Inspection for KDOT's Benefit. KDOT hires its own employees and consultant employees (Inspectors) to perform inspection work for KDOT's benefit, not to ensure Contractor quality control. Inspection is not a substitute for the Contractor's obligation to deliver acceptable work.

b. Inspector's Authority. Inspectors may examine all work including the preparation, fabrication, and manufacture of all materials provided. Inspectors may test materials. In testing materials, the Inspector will follow the Contract Documents, manufacturer's specifications, or both. Inspectors may reject unacceptable work (including unacceptable materials). Inspectors may suspend all or part of the work if the suspension is necessary because of unsafe site conditions or unsafe work practices.

c. Limitation on Inspector's Authority. Inspectors are unable to alter or waive contract provisions, issue instructions contrary to the contract, or act as the Contractor's superintendent or foreman. Inspectors are unable to accept from the Contractor any notices required by the Contract Documents to be given by the Contractor to the Engineer. If the Contractor is not complying with the Contract Documents, the Inspector will notify the Field Engineer who has the authority and discretion to shut down the Project.

d. Claim for Excessive or Negligent Inspection. Without delay, notify the Field Engineer if an Inspector exceeds the scope of the Inspector's authority, fails to perform adequately the Inspector's duties, treats the Contractor unfairly, or otherwise acts contrary to the contract. The Contractor shall have no claim for additional time, additional money, or both under **subsections 104.9** and **104.10** if the Contractor fails to notify KDOT of the problem as outlined in **subsection 105.7b.** and within the time frame required in **subsection 104.8a.**, so that KDOT has the opportunity to correct the situation. It shall be no defense under this **subsection 105.3** that the Contractor is afraid the inspection staff will retaliate for the reported violations. If the Contractor encounters retaliation, immediately report the retaliation to the District Engineer.

105.4 INSTRUCTIONS TO THE CONTRACTOR

The Engineer will provide to the Contractor written instructions and other documentation by delivering the instructions personally to the Contractor's designated representative or by mailing, faxing, or e-mailing the instructions to the Contractor's business address.

105.5 CONFORMING WITH PLANS AND SPECIFICATIONS; UNACCEPTABLE WORK; UNAUTHORIZED WORK

a. Contractor's Obligation. Perform work to meet the Contract Documents. Plan dimensions and contract specification values are the benchmarks from which the Engineer will measure deviations.

b. **Acceptable Work.** Acceptable work is work that meets contract requirements. The Engineer will pay contract prices for acceptable work. Before final acceptance, if the Engineer or Inspector requires the Contractor to uncover completed work and KDOT determines the work is acceptable, the Engineer will pay for uncovering or removing the work and for recovering or replacing the work as extra work under **subsection 104.6**. Exception: if the work meets the contract requirements but is considered unauthorized under **subsection 105.5e.** for failing to give the Engineer advanced notice of the work to allow inspection of the work as required by **subsection 105.7b.**, then the Engineer will not pay for uncovering or removing the work or for recovering or replacing the work as extra work under **subsection 104.6.**

c. Reasonably Acceptable Work. Reasonably acceptable work is work that does not meet Contract Document requirements but that the Engineer determines is adequate to serve the design purpose and meet the public's needs. The Engineer may pay reduced contract prices for reasonably acceptable work. The Engineer will determine the price reduction by using pay adjustment factors included in the Contract Documents. If the Contract Documents do not contain pay adjustment factors, the Engineer and Contractor will negotiate the price reduction. If the Engineer and Contractor are unable to agree upon the price reduction, the price reduction will be treated as a claim and the subject of deductive change order.

d. Unacceptable Work. Unacceptable work is work that does not meet contract requirements and that the Engineer determines is inadequate to serve the design purpose or to meet the public's needs. Propose a remedy (repair, restore, remove, or remove and replace) for the unacceptable work and then implement the remedy the Engineer chooses at the Contractor's expense. The Engineer, not the Contractor, decides whether the Contractor shall repair the unacceptable work or remove and replace the unacceptable work. Before final acceptance, if the Engineer requires the Contractor to uncover completed work and KDOT determines the work is unacceptable, the Contractor shall pay for uncovering or removing the work as well as for recovering, repairing, or removing and replacing the work.

e. Unauthorized Work. Unauthorized work is work performed without the Field Engineer's approval, work performed outside the Project limits, work performed contrary to the Field Engineer's instructions, work performed without inspection, or work performed without a superintendent on the Project. Propose a remedy (repair, restore, remove, or remove and replace) for the unauthorized work and then implement the remedy the Engineer chooses at the Contractor's expense. The Engineer, not the Contractor, decides whether the Contractor shall repair, restore, remove, or remove and replace the unauthorized work.

f. Remedying Unacceptable or Unauthorized Work.

(1) For either unacceptable work or unauthorized work, the Field Engineer will give the Contractor:

- written notice of the remedy KDOT has selected (repair, restore, remove, or remove and replace); and
- A date for beginning and a date for completing this remedial work.

(2) If the Contractor fails to begin or prosecute the remedial work timely, the Field Engineer will inform the Bureau Chief of Construction and Materials who will inform the Secretary. The Secretary will notify the Contractor and Surety that the Contractor has failed to begin or prosecute the work timely and:

(a) declare the Contractor in breach of contract under **subsection 108.9**;

(b) provide the Contractor a final opportunity to cure by completing the remedial work within a specified time; and

(c) if the Contractor fails to cure:

- remove the Contractor from the Project and exercise the Secretary's remedies for breach under **subsection 108.9**; or
- hire a third party or use KDOT's maintenance forces to perform the remedial work rather than removing the Contractor from the Project.

(3) If KDOT hires a third party or uses its maintenance forces to perform the remedial work without removing the Contractor from the Project, the Field Engineer will deduct from future progress payment(s) the estimated costs of the remedial work. After determining the final costs for this work, the Field Engineer will adjust the next progress payment to reflect the actual remedial work costs. If contract funds are insufficient, the Engineer will bill the Contractor for the excess remedial costs. If the Contractor fails to pay these costs within 7 business days after billing, KDOT may notify the Surety of this default and seek payment from the Surety for remedial work costs not recovered from the Contractor without declaring the Contractor in breach of the entire contract under **subsection 108.9**.

(4) The Contractor shall have no claim or escape from liability under this **subsection 105.5**, because:

- the Engineer required one remedy rather than another;
- the Engineer/Inspector knew or should have known the Contractor was performing unacceptable work or unauthorized work;
- the Engineer/Inspector overlooked or failed to discover the unacceptable work or unauthorized work until final inspection; or
- the Secretary failed to provide adequate cure time under **subsection 105.5f.(2)**, it being understood that the amount of cure time specified depends on the nature of the remedial work and public's best interests.

105.6 COORDINATING CONTRACT DOCUMENTS

a. The exploratory work documents, standard specifications, plans, special provisions, project special provisions, and all other Contract Documents are essential parts of the contract. A requirement occurring in one document is as binding as though occurring in all documents. The Contract Documents describe and provide for a complete Project. Keep a copy of the Contract Documents on the Project site.

b. Discrepancies, Errors, Omissions, or Ambiguities in Contract Documents.

(1) Do not take advantage of any Contract Document discrepancies, errors, omissions, or ambiguities.

(2) If there is a discrepancy between or among the following Contract Documents, the governing ranking or order of precedence is:

Dimensions	Information
1. Plan	1. Information received at mandatory pre-bid
2. Calculated	2. Project Special Provisions
3. Scaled	3. Special Provisions
	4. Plans
	5. Standard Specifications

(3) If there is a discrepancy between the exploratory work documents and other Contract Documents, notify the Bureau of Construction and Materials upon discovering the discrepancy. Do not assume the Contract Documents listed above control over the exploratory work documents.

(4) If a Bidder discovers a discrepancy, error, omission, or ambiguity in any Contract Document before the Letting, notify the Bureau of Construction and Materials upon discovering the discrepancy, error, omission, or ambiguity. The Bureau will issue an addendum to all Bidders that obtained a Bidding Proposal Form from KDOT.

(5) If the Contractor discovers a discrepancy, error, omission, or ambiguity in any Contract Document after the Letting, notify the Field Engineer. The Field Engineer will issue a clarification. The Field Engineer will make a contract adjustment for resulting extra work if the Engineer determines that:

- a reasonable contractor would have failed to discover the discrepancy, error, omission, or ambiguity before the Letting;
- the Contractor has met the requirements of **subsection 104.6**; and
- in case of a discrepancy, the Engineer's clarification is inconsistent with the order of precedence, **subsection 105.6b.(2)**.

105.7 CONTRACTOR COOPERATION WITH ENGINEER AND INSPECTORS

a. Before beginning construction activities, discuss with the Engineer the Contractor's schedule to coordinate construction sequencing and traffic control sequencing. If **subsection 108.3** requires a written schedule, review with the Engineer the Progress Schedule/Network Schedule.

b. Cooperate with the Field Engineer and Inspectors to complete the Project timely and effectively. Provide advanced notice of Project work to be performed so the Engineer may coordinate the Inspectors' activities with the Contractor's work. Provide any required information and accommodations for KDOT and any LPA to make a complete and detailed inspection. Notify the Field Engineer of disputes with Inspectors verbally without delay, so the Field Engineer has the opportunity to resolve the situation with the least delay and cost impact to all parties. Disputes include an Inspector exceeding the scope of the Inspector's authority, failing to perform adequately the Inspector's duties, treating the Contractor unfairly, or otherwise acting contrary to the contract.

If the dispute involves the Field Engineer or if the Field Engineer takes no action to resolve the dispute between the Contractor and Inspectors, notify the District Engineer.

If the dispute involves the District Engineer or if the District Engineer takes no action to resolve the dispute between the Contractor and Inspectors, notify the Bureau Chief of Construction and Materials.

Make no claim for contract adjustment if notice was not given as provided above.

c. Allow any unit of government, railroad, or utility company having jurisdiction over, funding of, or another interest in part or the entire Project to inspect the work relevant to that entity's role or interest. Such inspection does not make these entities a party to the contract.

d. Employ a competent superintendent.

(1) The superintendent shall:

- be present on the Project site when work is being performed;
- have experience in the work being performed;
- have the skill, education, and experience to understand the Contract Documents;
- receive, respond to, and execute the Engineer's and Inspectors' instructions; and
- coordinate all of the Contractor's, subcontractors', and suppliers' activities.

(2) If the Contractor elects not to have its own superintendent, appoint a superintendent who is employed by an approved subcontractor to fulfill the requirements of **subsection 105.7d. (1)**.

(3) The superintendent shall not act as both a superintendent and a foreman or laborer without the Field Engineer's approval. In determining whether to allow a working superintendent, the Field Engineer will consider the nature and scope of the Project, the number of operations occurring, the number of people working on the Project, and the working superintendent's ability to fulfill the requirements of **subsection 105.7d.(1)**.

(4) The Field Engineer may suspend work if the Contractor fails to have a competent superintendent on the Project when work is being performed.

If the Contractor continues to fail to provide a competent superintendent on the Project when work is being performed, the Secretary or State Transportation Engineer may declare the Contractor in breach of contract under **subsection 108.9**.

105.8 CHARACTER OF WORKERS; METHODS, OPERATIONS, AND EQUIPMENT

a. Personnel.

(1) Employ/use the number and quality of workers needed to complete the Project in the Contract Time.

(2) Employ/use the number and quality of supervisory personnel required to manage the Project effectively.

(3) At the Engineer's request, remove disorderly, intemperate, or unqualified personnel, whether employed by the Contractor, subcontractors, or suppliers. Do not employ/use such persons on other KDOT projects without the Engineer's written approval.

b. Equipment.

(1) Use the amount, type, and quality of equipment needed to complete the Project in the Contract Time.

(2) Do not use equipment or operate equipment in a manner that damages the roadway, adjacent property, or other highways.

c. Method of Operations. Unless the contract specifies otherwise, select the method of operations needed to complete the Project in the Contract Time.

d. Changes in Equipment or Methods of Operations.

(1) If the contract specifies the method of operations or equipment, obtain the Engineer's approval to alter the method of operations, equipment, or both. If the Engineer decides the altered method of operations or alternative equipment does not meet contract requirements, the Engineer will order the Contractor to discontinue the altered method of operations or to stop using the alternative equipment.

(2) The Engineer will not increase the contract price or Contract Time based on a change in the method of operations or equipment, unless the change qualifies as extra work under **subsection 104.6**.

105.9 SUBLETTING CONTRACT

a. Do not sublet, sell, transfer, assign, or dispose of part of the contract work without the Engineer's written consent. Submit to the Engineer subcontractor approval forms to obtain approval for subletting part of the contract including lower-tier subletting. Assume responsibility for sublet work, at any tier, as if the Contractor were performing that work. The Secretary's approval of subcontractors is for KDOT's benefit and KDOT's need to be aware of the persons and entities operating within the Project limits. This approval is not a guaranty of the subcontractors' capabilities or a representation concerning the subcontractors' skills, abilities, and integrity to perform the work.

b. Do not subcontract with or hire a consultant to perform contractor construction staking, process control testing, or any other work that is the Contractor's responsibility on a Project, if KDOT or a LPA has already engaged that consultant to perform design engineering, construction engineering, or inspection services on the same Project.

c. With the Contractor's own organization, perform physical construction that equals at least 30% of the contract amount. For state-tied projects, the contract amount is the sum of the contract amounts for all tied projects.

d. The Engineer's consent under this **subsection 105.9** does not release the Contractor from liability for completing the contract and does not release the Contractor, the Surety, or both from their bond obligations. Exception: The Secretary may release the Contractor from liability under the contract and the bond if the Secretary, Contractor, and Surety execute a separate written agreement that allows the Contractor to assign the contract to a third party who has obtained bonding as described in **subsection 103.6**. Do not sell, transfer, assign or dispose of all of the contract work without the Secretary's written consent to the assignment of contract as provided in **subsection 103.6**.

105.10 PLANS AND WORKING DRAWINGS

a. Plans. The Secretary may provide plans showing lines, grades, roadway typical cross-sections, all structures, and a summary of contract pay items. Steel bridge plans show only general features. Keep one set of plans on the Project site.

b. Working Drawings. Submit an electronic copy of working drawings in Adobe PDF (Portable Document Format) file format, with a maximum internal page size of 17 inches by 11 inches. For each deliverable (falsework plans for a structure, shop drawings for structural elements which will be fabricated, etc.), submit the copy in one transmission, with the sheets consecutively numbered, and with no duplications of sheets.

c. Timely Submittal. Provide all working drawings to the Field Engineer or designated KDOT office at the time the Progress Schedule/Network Schedule identifies or at a date that allows the reviewing Engineers at least 15 business days to review the drawings. If the Contractor desires the drawings be reviewed in less than 15 business days, notify the Field Engineer or designated KDOT office that the time for review and approval is critical. While KDOT will attempt to accommodate the Contractor's time frame, KDOT makes no guarantee that KDOT will complete the review process in less than 15 business days.

d. Timely Review. Within 15 business days after the Contractor has provided initial or revised working drawings to the Field Engineer or designated KDOT office, the Field Engineer or designated KDOT office will review and either approve or reject the drawings. If rejected, correct and resubmit revised working drawings for the Engineer's approval. Allow the Field Engineer and other reviewing Engineers a reasonable time for subsequent review and approval. The Contractor assumes all risk of delay incurred for revisions and the Engineer's review of these revisions. If KDOT fails to accept or reject initial or revised drawings within 15 business days, the Contractor may seek compensation under **subsection 104.6** for additional time or acceleration costs.

e. Responsibility for Working Drawings. The Contractor has sole responsibility for the adequacy and accuracy of the working drawings. The Engineer's approval of the working drawings is for KDOT's benefit, not to ensure Contractor quality control. The Engineer's review and/or approval are not intended as an undertaking of the Contractor's duty to provide adequate and accurate working drawings.

105.11 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES AND COOPERATION WITH UTILITIES

a. General.

(1) The Contract Documents will identify the location of existing utility fixtures and appurtenances (utilities) that will be in place before construction begins and that will remain in place during construction. Anticipate minor deviations from plan locations.

(2) The Contract Documents will designate the utilities to be adjusted or relocated by utility owners, other third parties, or the Contractor during the construction.

(3) Notify Kansas One Call and arrange for utility locates in the anticipated work area before beginning excavation. Save utility locate markers as long as possible.

(4) Coordinate, schedule, and perform work to minimize interference with others who are adjusting or relocating the utilities. KDOT will not compensate for modifications to the Contractor's schedule to accommodate utility adjustments or utility relocations the Contract Documents identify for relocation during construction.

(5) Include in the Contractor's bid all costs (money and time) associated with the presence of identified utilities.

b. Contractor's Responsibility for Utility Property and Services.

(1) Use work procedures that do not damage utilities, utility property, or both within and adjacent to the Project limits.

(2) Coordinate and perform work to avoid interrupting utility service.

(3) Notify the utility owner of damage to or exposure of its utility or other property. Do not hinder the utility owner from restoring utility service.

(4) Work around fire hydrants only after the local fire authority approves this work and the Contractor has made provisions for continued service.

(5) Assume responsibility for damages to utilities arising from the Contractor's negligent acts or omissions if the utilities were designated in the Contract Documents and correctly located/relocated (having no or only minor deviations from the plan location/relocation). The utility owner will decide whether the Contractor shall pay the utility owner to repair the damage or whether the Contractor shall repair the damage. Repair the damaged utilities by restoring them to the condition existing before the damage occurred.

c. Contractor's Responsibility for Unidentified Utilities or Incorrectly-Relocated Utilities Found During Construction.

(1) Except as provided in **subsection 105.11c.(2)**:

(a) the Contractor assumes no responsibility for damages to or delays caused by utilities discovered at the site but unidentified in the Contract Documents (unidentified).

(b) the Contractor assumes no responsibility for damages to or delays caused by utilities identified in the Contract Documents but discovered in a location different than that identified and outside the industry-accepted tolerances (incorrectly relocated).

(c) the Contractor may be entitled to a contract adjustment (time, money, or both) under **subsection 104.5** for delay associated with unidentified or improperly-relocated utilities. See **subsection 104.8** for contract adjustment notification.

(2) Despite a utility being unidentified or incorrectly relocated, the Secretary will not pay for damages to the utility or compensate the Contractor for delays caused by the utility if:

(a) the Contractor failed to notify Kansas One Call and obtain field locates before excavating;

(b) the Contractor knew or should have known that the utility was in the location discovered; or

(c) the Contractor's negligent or intentional act or omission contributed to the physical damage or delay but only to the extent the damage or delay was caused by the Contractor's act or omission.

(3) The Engineer and utility will decide whether to adjust or relocate unidentified and incorrectly relocated utilities.

d. Contractor's Responsibility for Utility's Negligent Field Locates. The Contractor shall notify Kansas One Call and obtain utility field locates before excavating. The Contractor assumes responsibility for increased construction costs or delay damages caused by improperly-marked field locates. The Secretary may give the Contractor an extension of time under this **subsection 105.11d.** if the improperly-marked field locates increase the Contractor's time for performance.

e. Nothing in **subsections 105.11c.** or **d.** is intended to make the Contractor liable to any utility for physical damage to the utility beyond that allowed by an agreement between the Contractor and utility, the Kansas Underground Utility Damage Prevention Act, or any other law. Nothing in **subsections 105.11c.** or **d.** is intended to prevent the Contractor from seeking recovery or asserting defenses against the utility to the extent allowed by an agreement between the Contractor and utility, the Kansas Underground Utility Damage Prevention Act, or any other law.

105.12 COOPERATION AND CLAIMS BETWEEN CONTRACTORS

a. General.

(1) The Secretary may let several contracts under one Project. The Secretary may let contracts for multiple projects within the same physical Project limits, adjacent limits, or same vicinity. For purposes of this provision, the term "contractor" means an entity having an agreement with the Secretary, on KDOT's behalf or on behalf of a LPA, for improvement, construction, reconstruction, or maintenance of roads and/or bridges within the state of Kansas and that includes the Standard Specifications.

(2) Cooperate with other contractors in the same physical Project limits, adjacent limits, or same vicinity to avoid delaying these other contractors.

(3) Coordinate work sequencing with other contractors in the same physical Project limits, adjacent limits, or same vicinity to both anticipate and minimize delay to each other.

(4) Notify the Field Engineer if another contractor fails to cooperate or coordinate work sequencing.

(5) Include in the Contractor's bid all costs (money and time) associated with expected delays resulting from another contractor working in the same Project limits, adjacent limits, or the same vicinity.

b. Suits Between Contractors. Under KDOT-let contracts, the Contractor and other contractors working within the same Project limits or adjacent limits have the contractual right to sue each other for delay damages. These Contractors are considered third party beneficiaries of the contract between the Secretary and the Contractor allegedly causing the delay.

c. Suits Against the Secretary.

(1) Contractors working within the same Project limits or adjacent limits have no right to sue the Secretary for delay damages another contractor caused. If the facts causing the aggrieved contractor's damages are based upon another contractor's actions, this **subsection 105.12** applies regardless of the theory of liability the aggrieved contractor asserts against the Secretary.

(2) The aggrieved contractor agrees to seek relief first from the contractor causing the delay.

(3) If the aggrieved contractor sues the Secretary, the contractor causing the delay shall defend the suit and hold harmless the Secretary from such suit.

(4) If the aggrieved contractor is unable to collect an award or judgment from the contractor causing the delay after taking legal action to recover such judgment in a Kansas court, the Secretary will pay the judgment. The Secretary will proceed against the Surety to recover any monies the Secretary pays under this **subsection 105.12**.

(5) Because this **subsection 105.12** does not prevent an aggrieved contractor from recovering damages, this **subsection 105.12** is not a "no damages for delay" provision.

d. Claims Related to Contract Time.

(1) The Secretary may give the aggrieved contractor an extension of time for delays another contractor causes. This extension of time does not prevent the Secretary from recovering liquidated damages or other costs the Secretary incurs because of the contractor causing the delay. This extension of time may not relieve the contractor causing the delay from paying delay damages to the aggrieved contractor.

(2) If the Project is time critical and the Secretary is unable to extend Contract Time, the Secretary may pay the aggrieved contractor to accelerate the work and overcome the delay. If the Secretary makes such payment, the contractor causing the delay shall be responsible to the Secretary for such payment. The contractor causing the delay shall indemnify the Secretary for damages the Secretary incurs under this **subsection 105.12**. The Secretary will proceed against the contractor and the Surety to recover any monies the Secretary pays under this **subsection 105.12**.

e. Burden of Proof. Nothing in this **subsection 105.12** modifies the parties' obligations to prove their claims and defenses.

105.13 CLAIMS PROCEDURE

a. Claim. A claim is a written notice for more money, time, or both because of an act or omission of a KDOT representative, design consultant, inspection consultant, or other government entity that the Contractor believes violates the contract. A claim includes a contract adjustment request unresolved between the Contractor and KDOT at any level of review.

b. Levels of Review.

(1) <u>Field Engineer</u>. Submit a claim to the Field Engineer. The Field Engineer will issue a written decision within 21 calendar days, accepting or denying the claim, in whole or in part.

(2) <u>District Engineer</u>. If dissatisfied with the Field Engineer's decision, appeal the decision in writing to the District Engineer within 15 calendar days after receiving the Field Engineer's written decision. The District Engineer will issue a written decision within 30 calendar days after holding an informal settlement hearing with all parties.

(3) <u>Bureau Chief of Construction and Materials</u>. If dissatisfied with the District Engineer's decision, appeal the decision in writing to the Bureau Chief of Construction and Materials within 15 calendar days after receiving the District Engineer's decision. The Bureau Chief of Construction and Materials will issue a written decision within 45 calendar days after holding an informal settlement hearing with all parties.

(4) <u>State Transportation Engineer</u>. If dissatisfied with the Bureau Chief of Construction and Materials' decision, appeal the decision in writing to the State Transportation Engineer within 15 calendar days after receiving the Bureau Chief of Construction and Materials' decision.

(a) The State Transportation Engineer will hold a formal final administrative hearing or will appoint another hearing officer or a hearing panel to hold a formal final administrative hearing.

- The State Transportation Engineer has sole discretion to conduct the final administrative hearing or appoint another hearing officer or a panel for this purpose. Any hearing officer may be a KDOT employee or a non-KDOT employee. Any panel may consist of KDOT employees, non-KDOT employees, or a combination thereof.
- If the Contractor requests a non-KDOT hearing officer or panel and the State Transportation Engineer grants this request, both parties will share equally the expense of the outside hearing officer or panel.

(b) Final Agency Decision. The State Transportation Engineer will issue a final agency decision whether the State Transportation Engineer conducts the hearing or appoints a hearing officer or panel to conduct the final administrative hearing. If a hearing officer or a panel conducted the final administrative hearing, the State Transportation Engineer will issue the Agency's final decision after:

- reviewing the hearing officer's or panel's decision; and
- concurring in the decision or modifying the decision as the State Transportation Engineer deems best.

(c) The State Transportation Engineer's decision under **subsection 105.13b.(4)(b)** represents KDOT final agency action under the Kansas Judicial Review Act (KJRA) K.S.A. 77-601 et seq.

c. Hearing Procedures.

(1) Informal, settlement hearing. For purposes of **subsection 105.13b.**, the District Engineer or Bureau Chief of Construction and Materials may hold an informal hearing by document submission, by phone, or by meeting with all parties in person. These informal hearings are considered settlement negotiations. Documents submitted at these meetings and the KDOT representative's decision are part of the agency record; however, the discussions at these meetings are confidential. Parties may have Legal Counsel present. No formal rules of evidence apply.

(2) Final administrative hearing. The final administrative hearing will take the following form unless the parties agree otherwise in writing.

- Before the hearing, submit a written statement identifying the issues in dispute (questions of law and questions of fact);
- A court reporting service will record the hearing. A party may request a written transcript of the proceeding at that party's expense;
- All witnesses will testify under oath;
- A party may have Legal Counsel present. Counsel has the right to examine all witnesses;
- Formal rules of evidence do not apply. While hearsay is admissible generally, the hearing officer may require further substantiation or authentication of hearsay evidence;
- Legal Counsel may present a party's arguments; however, these arguments are not evidence. Thus, for the hearing officer to consider these arguments, Counsel's arguments must be supported by witness testimony, documentation provided to the hearing officer, or both; and
- The agency record will consist of the hearing transcript, all documentation submitted to the hearing officer or panel at the hearing, and all documentation the hearing officer or panel and State Transportation Engineer considered in reaching a decision.

(3) Supporting Documentation. Provide all documentation KDOT, the LPA, or both request to support a Claim. This documentation may include, without limitation, bid records; job cost reports; payment records for material, labor, and subcontract work; financial statements; records used in preparing the claim such as schedule analysis and production analysis; company records showing overhead and profit; records of subcontractors; and records of suppliers, among others. The Contractor shall identify and segregate those documents the Contractor claims are confidential or proprietary. KDOT, the LPA, or both will endeavor to protect such records from disclosure to third parties under the exemptions to the Kansas Open Records Act.

(4) Interest on Claims. Demonstrate entitlement to interest under Kansas law. If interest on a claim is due under Kansas law, the Secretary will pay an annual rate of interest that is equal to the judgment rate published by the Kansas Secretary of State (on his/her official website) for the applicable years in which interest is owed.

d. Time Period for Filing Appeals; Waiver. Except for appeals from the State Transportation Engineer's decision which are governed by the KJRA, K.S.A. 77-601 et seq., file all appeals within 15 calendar days or obtain the reviewing Engineer's approval to file the appeal outside the 15 calendar day period. If the Contractor fails to file the appeal within the required 15 calendar days or fails to obtain a time extension, the Contractor waives the right to appeal the claim and accepts the decision of the last reviewing Engineer.

e. Time period for KDOT Decisions; Delay. If the KDOT Field Engineer, District Engineer, or Bureau Chief of Construction and Materials fail to issue a decision within the calendar days permitted under **subsection 105.13b.** or within any additional time the Contractor and KDOT agree upon, the Contractor may treat the claim as denied and appeal to the next level of review.

f. LPA Projects. On projects funded with LPA and Federal-aid monies, the LPA may conduct its own claim resolution process or may require the Contractor to follow the claims procedure of **subsection 105.13b.** as modified in this **subsection 105.13f**. If the LPA requires the Contractor to follow **subsection 105.13b.**, submit a claim in the same manner as KDOT projects. The reviewing KDOT Engineers will involve the LPA representatives in the informal hearings. If the Area Engineer, District Engineer, or Bureau Chief of Construction and Materials are unable to resolve the claim, the claims procedure ends and the Contractor may seek other remedies. KDOT will not conduct a final administrative hearing or issue a final agency decision on LPA/Federal-aid funded projects. The Project agreement between the LPA and KDOT, as the administrator of federal funds, may identify whether the LPA is using KDOT's claims procedure. If the agreement between the LPA and KDOT does not identify a claims procedure, the Contractor and LPA may agree to a use KDOT's claims procedure or an alternate claims procedure. In the event of their failure to reach an agreement, then the Contractor may seek whatever remedies against the LPA that the law permits.

105.14 CONSTRUCTION STAKES, LINES AND GRADES

a. Contractor Construction Staking. Use construction stakes and benchmarks to establish the controls necessary to perform work. Comply with the Contractor Construction Staking requirements under **SECTION 802**. Preserve all stakes and benchmarks. Replace missing, damaged, or incorrectly-set stakes and benchmarks. Bear the cost of replacement unless KDOT disturbed or destroyed the stakes/benchmarks or Contract Document errors resulted in the incorrectly-set stakes/benchmarks.

b. KDOT Construction Staking. If KDOT provides the construction staking, KDOT will comply with the Contractor Construction Staking requirements under **SECTION 802**. Preserve all stakes and benchmarks. If the Contractor disturbs or destroys stakes or benchmarks requiring KDOT to re-stake, the Contractor shall be responsible for the cost to replace stakes and benchmarks. Notify the Field Engineer at least 10 business days before beginning work that requires staking. The Secretary will not be responsible for staking delays that occur because the Contractor failed to give KDOT this notice.

105.15 VALUE ENGINEERING OR COST REDUCTION PROPOSAL (Proposal)

a. If the Contractor wishes to modify the Contract Documents to reduce Project construction costs, the Contractor may submit to the Field Engineer a written value engineering proposal detailing such modification and the anticipated cost reduction.

- Value Engineering is a new method or product not previously used on KDOT projects. The proposed method or product must be equal to or greater than the quality specified in the Contract Documents.

b. If the Contractor wishes to modify the Contract Documents to reduce Project construction costs, submit to the Field Engineer a written cost reduction proposal detailing such modification and the anticipated cost reduction.

- Cost Reduction is applying previously proven methods or materials to reduce the Project cost. The proposed method or product must be equal to or greater than the quality specified in the Contract Documents.

c. Include the following items in the Proposal:

- Existing contract requirements and discussion of the advantages and disadvantages of these requirements;
- Proposed modifications (changes, additions, and deletions) to existing contract requirements and discussion of the advantages and disadvantages of these modifications;
- A complete set of proposed plans and specifications that show the modifications, including quantity variations in contract pay items among other things;
- Detailed cost estimate of the Proposal;
- Time frame within which the Engineer must make a decision on the Proposal; and
- Anticipated time impact (delay, acceleration, or none) on Project completion.

d. Acceptance/Rejection. The Field Engineer will transmit the Proposal to the District Engineer and the Bureau Chief of Construction and Materials.

(1) The Bureau Chief of Construction and Materials may accept all or part of the Contractor's Proposal if the Bureau Chief of Construction and Materials, exercising sole discretion, determines the proposal:

- contains the information required in **subsection 105.15c.**;
- generates a net savings in construction costs according to **subsection 105.15e.**; and
- is in the State of Kansas's best interests.

(2) The Bureau Chief of Construction and Materials, exercising sole discretion, will reject all or part of the Contractor's Proposal if the Proposal:

- impairs essential characteristics of the Project such as service life, economy of operation, ease of maintenance, desired appearance, design ability, design policies, and safety, among other things;
- requires excessive review, evaluation, investigation, or a combination of these items; or
- changes the basic bridge design, pavement thickness, pavement type, or a combination of these items.

e. Net Savings. To determine the net savings, the Bureau Chief of Construction and Materials will subtract the revised contract price from the original contract price and then deduct expenses KDOT will incur for reviewing and implementing the Proposal. For original contract costs, the Bureau Chief of Construction and Materials may disregard contract bid prices that do not reflect actual costs.

f. Change Order and Payment. If the Bureau Chief of Construction and Materials accepts all or part of the Contractor's Proposal, the parties will execute a change order. The change order will specify the net savings with both the Secretary and Contractor receiving 50% of the net savings. If payment is made through unit prices, KDOT will pay the Contractor its 50% share of the net savings on intermediate estimates as the units of work are completed. If payment is made on a lump sum basis, KDOT will pay the Contractor its 50% share of the net savings after KDOT has accepted the accepted Proposal work. KDOT will not pay the Contractor's expenses in developing, designing, and submitting the Proposal.

g. KDOT's Future Use of Value Engineering/Cost Reduction Proposal. If accepted, KDOT may adopt the Proposal for general use on other projects without further reimbursement to the Contractor. If KDOT does not adopt the Proposal for general use, KDOT will pay for the use of the Proposal on other projects for which the Contractor makes the Proposal and the Bureau Chief of Construction and Materials accepts the Proposal.

105.16 NOTICE OF ACCEPTANCE

a. Notice of Acceptance of a Portion of Contract (Partial Acceptance). The Contractor may request the Engineer to make final inspection of a completed unit or portion of the Project such as a structure, a roadway, or an interchange. If the Engineer determines the unit or portion of the Project complies with the Contract Documents and it is in the State's best interest to accept this work, the Engineer may issue a partial acceptance of this work.

(1) The Engineer may issue a partial acceptance for the following:

- Sections of pavement, bridges, and interchanges that are opened to traffic if traffic is in its final traffic configuration; or
- Portions of the Project completed and awaiting action by another Contractor under a separate contract such as grading the roadway surface for a separately-let surfacing project.

(2) The Engineer will not issue a partial acceptance for the following:

- Individual RCP's, RCB's, or span bridges;
- Grading balances;
- Portions of completed pavement not open to traffic or not in its final traffic configuration;
- Sign structures; or
- Completed, small parts of the Project.

The partial acceptance relieves the Contractor of further responsibilities for the accepted unit or portion of the Project except as noted in **subsection 108.12**.

b. Notice of Acceptance of Contract. After the Contractor notifies the Engineer that all work is complete, the Engineer will inspect the Project. If the Engineer determines work is incomplete or needs corrective action, the Engineer will provide the Contractor a punch list. After the Contractor completes the punch list and final cleanup **(subsection 104.21)**, the Engineer will again inspect the Project. Upon finding the Contractor has completed all work, the Engineer will issue a Notice of Acceptance of Contract.

(1) The Notice of Acceptance of Contract prevents the Contractor from making further requests for additional time, additional money, or both except for the following:

- Contract Changes under **SECTION 104** that arise within 10 business days before Notice of Acceptance. (See **subsection 104.8d.** for waiver of claims filed after Notice of Acceptance).
- Adjustments to prior and pending change orders for correction of quantities, measurements, or certifications allowed under **subsection 108.12**).

(2) The Notice of Acceptance of Contract relieves the Contractor of the responsibility to:

- perform physical construction on the Project except construction arising out of any breach of warranty, breach of guaranty, latent defects, fraud, or misrepresentation discovered after acceptance (see **subsection 108.12**).
- repair damage to the Project caused by Acts of God or third parties.
- maintain the Project.

(3) The Notice of Acceptance of Contract begins the statutory time for subcontractors and suppliers to file payment claims against the Contract Bond as permitted in K.S.A. 68-410.

SECTION 106

CONTROL OF MATERIALS

106.1 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS

a. Sources of Supply.

(1) Use sources of supply that will generate materials that meet quality requirements. Sources of supply include quarries, pits, borrow areas, fabrication plants, right-of-way, and other sources from which the Contractor may obtain material.

(2) Notify the Engineer, in writing, of proposed sources of supply or changes in existing sources of supply unless the Contract Documents designate the source of supply. Provide this notice at least 10 business days before either producing material from that source or delivering material to the Project. When applicable, include the land ties of the sources. Assume all costs of acquiring sources of supply, including any exploration and development costs.

(3) The Engineer or Inspector will inspect, test, and then approve or reject Contractor-furnished sources of supply that KDOT has not previously approved. Do not use a Contractor-furnished source of supply without the Engineer's written approval.

(4) If an approved source of supply fails to yield acceptable material:

(a) stop producing material from that source until the Engineer approves the source again;

(b) provide material from another approved source; or

(c) perform a combination of **subsections 106.1a.(4)(a)** and **(b)**

(5) If an approved source of supply that KDOT required in the Contract Documents fails to yield acceptable material, the Engineer will compensate the Contractor for extra work under **subsection 104.6**.

(6) Inspection, testing, and approval of Contractor-furnished sources of supply are for KDOT's benefit, not to ensure Contractor quality control (QC) results. This inspection, testing, and approval is not a substitute for the Contractor's obligation to provide acceptable sources of supply.

b. Quality Materials.

(1) Use only materials that meet the Contract Documents' requirements. Unless specified otherwise, use new materials.

(2) The Engineer or Inspector will inspect materials. The Engineer, Inspector, or Contractor will test the materials. See **subsection 106.3**.

- After inspection and testing, the Engineer or Inspector will approve or reject the materials at the source of supply, at the Project site, or both;
- The Engineer or Inspector may reject materials at the Project site even if the Engineer or Inspector previously approved the materials at the source of supply;
- The Engineer or Inspector may reject the materials if, at any time, the Engineer determines the materials do not meet the Contract Documents; and
- The Engineer or Inspector may reject materials during or after incorporation into the work if the material does not meet the Contract Documents requirements.

(3) If material that has not been inspected, tested, and accepted is used, the Engineer may decide the work is unacceptable, reasonably acceptable, or unauthorized and require the removal and replacement of the material, or accept a price reduction for the material. See **subsection 105.5**.

(4) Inspection, testing, and approval of Contractor-furnished materials are for KDOT's benefit, not to ensure Contractor QC results. This inspection, testing, and approval is not a substitute for the Contractor's obligation to provide acceptable material.

c. "Buy America" Materials.

(1) Current federal regulations require the use of domestic iron and steel on federal-aid projects with limited exceptions. On federal-aid projects, use only iron and steel that have been manufactured, produced and processed in the United States. This includes any federally non-participating items.

If an iron or steel product meets at least one of the following conditions:

- It is specifically listed below

- It is used in pavements, bridges, tunnels or other structures
- It is at least 90% steel or iron by weight
- It is not identified as a miscellaneous component or subcomponent

then the product is subject to Buy America.

A list of products that are subject to Buy America coverage (regardless of % steel or iron content) include, but are not limited to, the following:

- Steel or iron products used in pavements, bridges, tunnels or other structures, which include, but are not limited to, the following: fabricated structural steel, reinforcing steel, piling, high strength bolts, anchor bolts, dowel bars, permanently incorporated sheet piling, bridge bearings, cable wire/strand, prestressing/post-tensioning wire, motor/machinery brakes and other equipment for moveable structures;
- Guardrail, guardrail posts, end sections, terminals, cable guardrail;
- Steel fencing material, fence posts;
- Steel or iron pipe, conduit, grates, manhole covers, risers;
- Mast arms, poles, standards, trusses, or supporting structural members for signs, luminaires, or traffic control systems; and
- Steel or iron components of precast concrete products, such as reinforcing steel, wire mesh and pre-stressing or post-tensioning strands or cables.

The miscellaneous steel or iron components, subcomponents and hardware necessary to encase, assemble and construct manufactured products are not subject to Buy America coverage. These include, but are not limited to, cabinets, covers, shelves, clamps, fittings, sleeves, washers, bolts, nuts, screws, tie wire, spacers, chairs, lifting hooks, faucets, door hinges, etc.

(2) On all federal-aid projects, all iron or steel shall have been manufactured, produced, and processed in the United States. Manufacturing processes include any process which modifies the chemical content, the physical size or shape, or the final finish of the iron or steel. These processes include initial melting, mixing, rolling, machining, extruding, bending, grinding, drilling, and coatings applied to iron or steel (including epoxy coatings, galvanizing, painting, and any other coating that protects or enhances the value of the iron or steel used).

(3) Obtain the Engineer's written approval before using any iron or steel that has not been manufactured, produced, and processed in the United States as permitted in this **subsection 106.1c.(3)**. With the Engineer's written permission, foreign iron and steel may be used if:

(a)The combined total cost of all the foreign iron used, steel used, or the cost of both iron and steel used when both are required does not exceed 0.1% of the total cost of the Project or $2,500.00 dollars, whichever is greater. The cost of the foreign iron used, steel used, or both includes material costs, manufacturing costs, assembly costs, transporting costs, and testing costs associated with the foreign iron, steel, or both.

(b) The Federal Highway Administration has waived specific products or processes according to 23 CFR 635.410, for the duration of that waiver.

The Contractor:

- Assumes the risk of including any foreign iron or steel in the Contractor's bid.
- Incurs any costs needed to remove and replace with domestic iron and steel the amount of foreign iron, steel, or both that exceeds 0.1% of the total Project costs or $2,500.00, whichever is greater.
- Has the obligation to remove and replace foreign iron and steel that exceeds 0.1% of the total Project costs or $2,500.00 whichever is greater. The obligation is regulatory and is not excused by:
    - Errors the Contractor, subcontractors, suppliers, fabricators, or other third parties make in determining the costs of foreign iron and steel as defined above.
    - The Engineer's approval under **subsection 106.1c.(3)**. The Contractor shall make no claim for contract adjustment (additional time, money, or both) because of the use of foreign iron or steel.

(4) Companies providing iron or steel or performing any manufacturing processes on the iron or steel shall include a "Buy America" statement on test reports and material certifications submitted to KDOT, the Contractor, or both. The "Buy America" statement shall identify the source of the iron or steel and the location(s) of the

manufacturing processes. The statement shall certify that the company issuing the test report or material certification complies with all provisions of the Buy America Act.

(5) This **subsection 106.1c. and "Buy America"** requirements do not apply to temporary items (Example: temporary sheet piling, steel scaffolding, and falsework) on the contract, even if these items are left in place with the Engineer's approval.

(6) After work is completed on the Project, submit to the Engineer a certification stating the dollar amount of foreign iron used, steel used, or both. Include material costs, manufacturing costs, assembly costs, transporting costs, and testing costs in the dollar amount. Identify a zero dollar amount if no foreign iron or steel was used on the Project.

(7) This **subsection 106.1c.** and Buy America requirements do not apply to 100% state funded projects.

106.2 MATERIAL SOURCES

a. Contractor-Furnished Materials. Provide all materials and acquire all sources of supply required to complete the contract except for those materials and sources of supply that KDOT provides under the Contract Documents (or by contract adjustment). Provide test reports or product certifications for all Contractor-furnished materials. Obtain the Engineer's written approval to use all Contractor-furnished proposed sources of supply such as borrow sites and aggregate sources among others.

b. KDOT-Furnished Materials. At its own expense, KDOT may provide materials, sources of supply, or both for the Contractor's use in performing the work. In the Contract Documents, KDOT may designate materials, sources of supply, or both that the Contractor may use in performing the work. When designated, these materials and sources are acceptable for the Contractor's use. KDOT assumes responsibility for the quality of these materials and sources of supply unless the Contractor's acts or omissions affect the quality or source of supply. These materials become the Contractor's property once the Contractor takes control. From a designated source of supply, determine the amount of equipment and work required to produce a material that meets the contract requirements. Expect variations in material quality and do not assume the entire deposit is acceptable. The Engineer may order procurement of material from any portion of a deposit. The Engineer may reject portions of the deposit as unacceptable.

c. Site Selection and Restoration. Obtain the Engineer's approval to use KDOT designated sources of supply for plant sites, stockpiles, and haul roads. Obtain the Engineer's approval to use the Project right-of-way, other KDOT right-of-way, or other KDOT property (mixing strips) for plant sites, stockpiles, and haul roads.

Where practical, do not store equipment or materials (including soil stockpiles) within 50 feet of rivers, streams or other surface waters. Where such storage is necessary, obtain the Engineer's written approval and include in the Project SWPPP appropriate best management practices for the storage area.

Locate borrow areas, gravel pits, and quarry sites so they are not visible from the highway, unless the Engineer approves otherwise.

Before using private property to obtain material, store material, operate a plant site, or perform other construction activity, enter into a written agreement with the landowner. When using private property for borrow, obtain all permits and clearances required for compliance as shown in **subsection 107.2**, (which most commonly includes wildlife and archaeological clearances).

When requested, provide a copy of the Contractor's agreement with the landowner. Submit a reclamation plan to the Engineer for the Engineer's approval. After ceasing to use private property, reclaim the site(s) according to the approved reclamation plan(s). Leave sites in a neat condition. Provide a copy of the landowner's release of the Contractor from further obligation.

d. Rights In and Use of Materials Found on the Work. When approved by the Engineer, the Contractor may use on the Project such stone, gravel, sand or other material determined suitable by the Engineer which may be found in the excavation. The Engineer will pay for both the excavation of such materials at the corresponding contract unit price and for the contract pay item for which the excavated material is used.

No charge for the materials used shall be made against the Contractor.

Do not excavate or remove any material from within the highway location which is not within the grading limits, as indicated in the Contract Documents without written approval from the Engineer.

Replace any excavated material removed for use in embankments, backfills, approaches, etc. with acceptable material at own expense.

106.3 SAMPLING, TESTING, AND CITED SPECIFICATIONS

The Engineer, Inspector, or both may inspect, test, and approve or reject all materials before, during, and after incorporation into the work.

The Engineer or Inspector will take or direct the Contractor to take all samples, except the Contractor's process control and QC samples. Sample and test the process control and QC samples. Upon request, KDOT will provide copies of test results KDOT performed. When the Contract Documents refer to an undated specification, standard, or test method that AASHTO, ASTM, GSA, or another recognized national technical association has adopted, the reference means the most recent published (including interim or tentative) specification, standard, or test method in effect on the Letting date.

The Secretary will pay the cost of all inspection and testing the Engineer or Inspectors undertake.

The Contractor shall:

- pay the cost of all materials that KDOT or the Contractor uses for sample testing;
- pay the cost of all testing the Contractor performs on quality control/quality assurance (QC/QA) projects;
- include such costs in the QC/QA bid item; and
- pay the costs of testing KDOT performs on materials that exceed contract quantities and testing that is requested but the Engineer or Inspector deems unnecessary.

If the Contract Documents specify one manufacturer's product, the Contractor may request the use of a product of another manufacturer unless the Contract Documents prohibit substitution. Submit the request to the Engineer and include:

- a complete description of the item;
- an explanation of how the alternate product meets the same standards as the product the Contract Documents specify;
- copies of shop drawings, catalog cuts, or both; and
- test reports or other descriptive literature, completely illustrating such items.

The Engineer alone determines whether the alternate product is acceptable.

Provide the Engineer required test reports or certifications for all materials incorporated into the work.

The Engineer may waive the testing requirements of small quantities of materials if the material is incidental to the work, a recognized commercial brand, or obtained from sources having a history of adequate QC.

On projects where Buy America requirements apply, note on shop drawings and catalog cuts that steel and iron used meets Buy America, unless otherwise specified.

106.4 CONTRACTOR QUALITY CONTROL REQUIREMENTS FOR QUALITY CONTROL/QUALITY ASSURANCE (QC/QA) PROJECTS

This **subsection 106.4** outlines general requirements for all types of QC/QA projects. Consult the particular section or subsection to obtain detailed process and QC requirements for a particular type of construction.

a. General.

(1) Provide personnel and equipment that meet Part V QC testing procedures.

(2) Provide the Engineer all reports, records, and diaries developed during construction activities. These documents are KDOT's property.

b. Quality Control Plan.

(1) At the pre-construction conference, submit in writing a Quality Control Plan (QC Plan) that meets Part V testing procedures (partially detailed below) for the Engineer's review and approval.

(a) List the names and phone numbers of all individuals and alternates responsible for QC administration and inspection. For each particular type of construction, supply one or more individuals who have complied with the technical certification requirements detailed in "KDOT Policy and Procedure Manual for The Certified Inspection and Testing Training (CIT) Program Manual". Only certified technicians may perform testing used for materials acceptance.

- The certification requirement applies whether the personnel belong to the Contractor's QC organization or private testing firms.

- Obtain the "KDOT Certified Technician Manual" from the KDOT Bureau of Materials and Research.

(b) On the organizational chart, show the specified lines of authority for both mix design and QC operations during production.

(2) The Engineer's review and approval of the Contractor's QC Plan are for KDOT's benefit, not to ensure QC results. This review and approval is not a substitute for the Contractor's obligation to control quality.

c. Testing Facilities.

(1) Locate the QC testing facility either at the plant site or adjacent to the Project site and in a place that is readily accessible to the Project. Before beginning mixture production, obtain the Engineer's approval of the testing facility, including the facility's location and the testing equipment. Obtain the District Materials Engineer's approval to put the testing facility in a location other than the plant site or adjacent to the Project site. Provide the QC personnel the space and testing equipment needed to meet Part V.

(2) Calibrate and correlate the testing equipment with prescribed procedures and conduct tests according to Part V testing procedures.

(3) To facilitate communication between the Contractor and the Engineer, equip the QC testing facility with the following:

(a) A telephone with a private line for the QC personnel's exclusive use.

(b) A copying machine for the Contractor's, Engineer's, and Inspector's use.

(4) In the testing facility, post a copy of the organizational chart from the QC Plan.

(5) Allow the Engineer access to the testing facility to observe testing procedures, calculations, test documentation, and plotting of test results among other items.

(6) If the Contract Documents require one, locate the Field Office and Laboratory (Lab) near the Contractor's testing facility. See **SECTION 803**.

d. Testing, Recording, and Data Presentation Requirements.

(1) Take all test samples at random locations, at the frequencies designated in the approved QC Plan, and at the rates specified in the KDOT Sampling and Testing Frequency Chart, Part V. Provide the Inspector with the random locations or frequencies before going to the job site to sample or test. The Engineer reserves the right to generate the random locations, frequencies, or both. If KDOT generates the random locations or frequencies, KDOT will provide notification prior to the sampling time.

(2) Record all original documentation in a bound field book or other KDOT approved bound record and turn over to KDOT at the end of the Project. Record and document all test results and calculations on data sheets KDOT has approved. Record specific test results on a daily summary sheet KDOT has approved. Base moving averages on 4 consecutive test results. Include in the Daily Quality Control Summary Sheet a description of quality control actions taken. Post and keep current QC charts showing both individual test results and moving average values. As a minimum, plot the single test values and the 4-test moving average values, as applicable, on KDOT-approved control charts. Keep control charts current on an ongoing basis. Plot results and limits as follows:

- individual test results for each test point in black. Connect those points with a solid black line;
- moving average for each test variable in red. Starting with the fourth test, connect those points with a dashed red line;
- KDOT verification test results with green asterisks; and
- specification working range limits for single test results with a green ink dotted line and for the 4-point moving average results with a green ink solid line.

(3) Store and retain all QC and verification samples for 7 business days.

(4) Provide test data as specified in the appropriate QC/QA construction specification.

e. Inspection by KDOT.

(1) The Engineer and Inspector reserve the right to run any test at any time to determine contract compliance.

(2) The Engineer or Inspector will inspect aggregates at the point of production for approved deposits, ledges, and beds. Do not produce aggregates from non-approved deposits, ledges, or beds. Immediately remove from the stockpile aggregates obtained from non-approved deposits, ledges, or beds.

(3) The Engineer or Inspector may test aggregates for acceptance at the point of usage. Remove and replace, repair, or otherwise correct, at the Contractor's expense, work incorporating aggregates from non-approved sources.

106.5 CONTRACTOR'S PROCESS CONTROL FOR NON-QC/QA PROJECTS

a. General.

(1) Provide and maintain an adequate process control system.

- Perform all inspections and tests necessary to meet the Contract Documents; and
- Provide materials and formulate design mixes that meet the Contract Documents.

(2) Assume responsibility for the process control of all aggregate and aggregate combinations during production, handling, stockpiling, blending, mixing, and placing operations.

(3) Perform all tests by personnel certified under the Certified Inspection and Testing Training (CIT_2) Program. Personnel may be certified by another program with approval of the Engineering Technician Training Coordinator.

b. Process Control Plan.

(1) Before beginning material production, submit in writing a Process Control Plan for the Engineer's review and approval. In the Process Control Plan, include the following:

- Sampling and testing frequencies, sampling locations, sampling and testing methods, and other inspections required to maintain the Process Control Plan. Upon request, KDOT will provide a recommended process control sampling and testing frequencies chart;
- Procedures to determine gradation, plasticity index, and deleterious substance content of all aggregates the Contractor may use;
- Procedures for inspecting stockpiles for separation, contamination, or segregation;
- For cold feed bins, include calibration procedures for setting cold feeds including observation of cold feed operation for uniformity;
- For hot bins, include procedures to determine the gradation of aggregate in each bin. Determine the theoretical combined grading and calibrate the hot feed settings to provide the required material;
- For batch plants, determine the percent or weight to be used from each bin to assure compliance with the Approved HMA Mix Design or Approved Concrete Mix Design; and
- For continuous flow plants, establish a gate calibration chart for each bin. Determine gate settings for each bin to assure compliance with the Approved HMA Mix Design or Approved Concrete Mix Design.

(2) KDOT considers the guidelines set forth in s**ubsection 106.5b.(1)** as customary activities necessary to control the production of materials or mixes at an acceptable quality level. The activity KDOT requires depends on the type of process or materials the Contractor is producing. The frequency of these activities also varies with the process and the materials.

(3) The Engineer's review and approval of the Contractor's Process Control Plan are for KDOT's benefit, not to ensure Contractor quality processes. This review and approval is not a substitute for the Contractor's obligation to control processes.

c. Sampling and Testing. Use the same process control sampling, testing methods, and procedures that KDOT uses. Consult Part V for the Kansas Test (KT) Methods and for a Sampling and Testing Frequency Chart that the Contractor or producer may use as a material acceptance guide when developing the Process Control Plan. Advise producers supplying material for non-QC/QA projects to find the minimum required sampling and testing frequencies in Part V.

d. Test Reports. Maintain a file of all process control tests and provide this file to the Engineer at the Engineer's request.

e. Inspection by KDOT.

(1) The Engineer and Inspector reserve the right to run any test at any time to determine contract compliance.

(2) The Engineer or Inspector will inspect aggregates at the point of production for approved deposits, ledges, and beds. Do not produce aggregates from non-approved deposits, ledges, or beds. Immediately remove from the stockpile aggregates obtained from non-approved deposits, ledges, or beds.

(3) The Engineer or Inspector will test aggregates for acceptance at the point of usage. Remove and replace, repair, or otherwise correct, at the Contractor's expense, work incorporating aggregates from non-approved sources.

106.6 PLANT INSPECTION

a. When materials are inspected at the point of manufacture, the following apply:

(1) Cooperate with and assist the Engineer or Inspector and make sure the material producer cooperates with and assists the Engineer or Inspector.

(2) The Engineer or Inspector has full right of entry at all times to areas of the plant concerning the manufacture or production of the materials being provided;

(3) Provide and maintain adequate safety measures; and

(4) KDOT may retest materials delivered to the plant that were tested and approved at the source of supply. KDOT may reject materials that do not meet the Contract Documents requirements upon re-testing.

b. The Engineer may accept non-complying, plant-inspected material if all of the following conditions are met:

(1) The Engineer has satisfactory test results of both prior and subsequent material tests using the same source or sources as the non-complying material.

(2) The Engineer finds the incidence and degree of nonconformance with the specification requirements are within reasonable and practical limits.

(3) Demonstrates diligent, exercised material controls consistent with standard industry practices.

(4) The Engineer determines the non-complying material will not adversely affect the value or serviceability of the completed work.

106.7 STORAGE OF MATERIALS

Provide all space required to store stockpiled materials. Locate stored materials to facilitate prompt inspection. Do not use private property to store materials without the owner's or lessee's written approval. Provide copies of such written approval at the Engineer's request. The Engineer may approve portions of the right-of-way for storing materials. Restore all storage sites to their original condition at the Contractor's expense.

Store materials to preserve the materials' quality. The Engineer or Inspector may re-inspect and reject stored materials, even if the Engineer or Inspector previously approved the materials before storage.

106.8 APPROVED MATERIAL SIGNS

a. Provide, install, and maintain "Approved Material" signs at each major material stockpile site that contains both non-KDOT tested and KDOT-approved materials. Sites include the Contractor's or commercial batching areas, plant sites, and major stockpile sites.

b. Install and construct the signs using the material specified below and conforming reasonably to the details shown in **FIGURE 106-1**. Keep the signs clean and in good condition at all times.

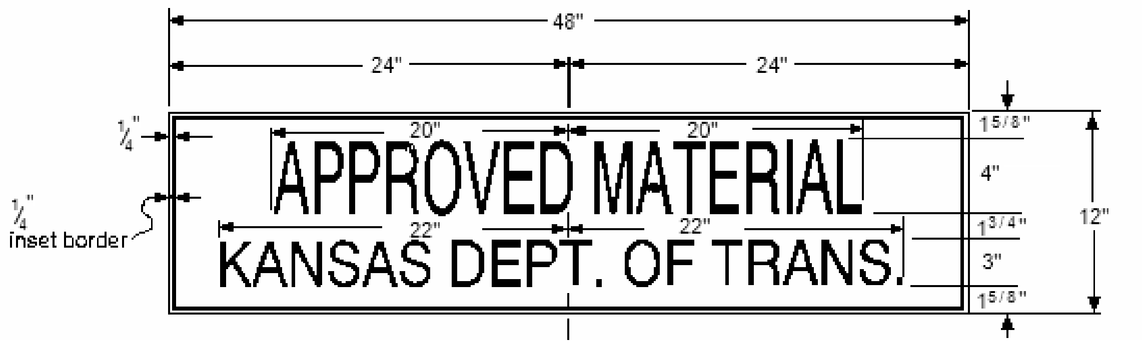
(1) Sign Face Details.

- Top Line 4-inch Standard Alphabet Series "B" Legend;
- Second Line 3-inch Standard Alphabet Series "B" Legend;
- I.D. Signs 2-inch Standard Alphabet Series "B" Legend; and
- Plain painted white background with black legend direct applied copy with ¼ inch inset border.

(2) Materials. Manufacture the signs from backing material composed of either metal (14 gauge steel or 0.100 inch thick flat sheet aluminum) or ¾ inch thick exterior type fir plywood and mounted on a suitable post.

(3) Sign Locations. Install the signs at stockpile locations the Engineer approves. Erect signs approximately 5 feet high measured from the bottom of the sign and visible to anyone observing the stockpile from a normal working area.

FIGURE 106-1: Details for Approved Material Signs.



c. If the Engineer requires, install identification signs for individual aggregate types and mixes (example SSG-1 for SM-12.5A) in locations where similar stockpile materials are being stored. Make these signs using "I.D. Signs 2 inch Standard Alphabet Series "B" Legend." Attach these signs to the "Approved Material" sign post.

d. Include in the Contractor's bid the cost of providing, erecting, and maintaining required materials signs.

106.9 HANDLING MATERIALS

Handle all materials to preserve their quality. Transport aggregates from the storage site to the work in tight vehicles, constructed to prevent loss, degradation, or segregation of materials during all operations.

106.10 DISPOSITION OF UNACCEPTABLE MATERIALS

Remove from the work site all unacceptable and rejected materials, unless the Engineer allows the Contractor to make the materials acceptable. Do not incorporate into the work previously rejected materials, until corrected and until the Engineer approves their incorporation into the work.

106.11 MATERIAL PROVIDED BY KDOT

When KDOT provides material, KDOT will deliver the material or make the material available at locations the Contract Documents specify. Coordinate delivery with KDOT. Pay any demurrage charges associated with the delivery of KDOT provided materials.

After KDOT delivers the material or the Contractor obtains the material, the Contractor assumes responsibility for the material as if the Contractor had provided the material. KDOT assumes responsibility for the quality of these materials unless the Contractor's, independent Contractor's, or subcontractor's acts or omissions affect the quality of the material.

SECTION 107

LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

107.1 LAWS TO BE OBSERVED

a. Observe and comply with all laws. Laws include Federal law, State law, Municipal law, Federal regulations, State regulations, Municipal ordinances, codes, and orders and decrees of courts, boards, or other tribunals having authority over the subject matter involved.

b. Protect KDOT and any LPAs from liability and indemnify these entities for damages caused by or fines levied for the Contractor's, subcontractors', or suppliers' violation of the law.

c. Immediately notify the Engineer of inconsistencies (ambiguities) between a law and the contract.

107.2 PERMITS, LICENSES, AND TAXES

a. Obtain all permits and licenses necessary to perform the work unless the Contract Documents state KDOT will obtain the permit or license.

(1) Contact KDOT's Bureau of Design, Environmental Services Section, for information regarding necessary environmental permits.

(2) Sources of permits include the U.S. Army Corps of Engineers (Corps), Kansas Department of Health and Environment (KDHE), Kansas State Board of Agriculture Division of Water Resources (DWR), Kansas Department of Wildlife and Parks (KDWP), Kansas State Historical Society (KSHS) and other governing authorities.

(3) Comply with all permit conditions and restrictions imposed by governing authorities.

b. Permits for Work in Waterways. If the Contractor's method of operation requires placing material in a waterway, obtain both a Corps' Section 404 permit and a KDHE 401 Certification (applicable when water flow exceeds 5 cubic feet/second).

c. Railroad Permits. Secure from the Railroad Company any permit, license, right-of-way easement, or right-of-access the Railroad Company requires for:

- constructing temporary crossings upon or over railroad right-of-way, tracks, or property; or
- using or traveling across railroad right-of-way, tracks, or property.

d. KDOT Obtained Permits. KDOT will obtain the U.S. Army Corps of Engineers' permit for design activity. Review any permit KDOT obtains at the District Office in which the Project is located or at the Bureau of Construction and Materials.

e. KDOT Provided Permits. Obtain a permit from the District Engineer if the Contactor needs an opening in the highway or right-of-way. See **subsection 104.14** for further obligations involving Third Party permits.

f. Notice and Timeliness. Request permits and licenses in a manner that prevents Project completion delays. Assume responsibility for delays of 30 calendar days or less in obtaining a permit or license. The 30 calendar day period begins on the date the Contractor submits an accurate, completed permit/license application or the date the Contractor submits a written request if a permit/license application is not required. Assume responsibility for delays in obtaining permits and licenses outside the 30 calendar day period specified if the additional delay was caused by the Contractor, the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, or a combination thereof.

g. Expenses. Pay all permit fees, license fees, charges, and taxes necessary to perform the work.

107.3 PATENTED DEVICES, MATERIALS, AND PROCESSES

Enter into all legal agreements necessary to use patented or copyrighted designs, devices, materials, processes, or trademarks. Protect KDOT, political subdivisions, and third parties from liability and indemnify KDOT, political subdivisions, and third parties for expenses these entities incur, damages these entities pay, or both for patent or copyright infringements. Assume this liability and pay these expenses and damages whether sought during construction or after Project completion. Make sure subcontractors at any tier and suppliers at any tier comply with the same requirements.

107.4 FEDERAL AID PROVISIONS

If a Project contains Federal aid funds, comply with all Federal laws, regulations, policies, and federally required contract provisions that are necessary for KDOT, LPAs, or both to receive Federal funding. These Federal laws, regulations, policies, and required contract provisions generally control over State laws, State regulations, Local ordinances, and codes.

The FHWA or other appropriate Federal agency may inspect and approve the work. This authority does not make the U.S. Government a party to the contract.

107.5 PROVIDING RIGHT-OF-WAY

The Secretary will secure all necessary rights-of-way before construction begins unless the Contract Documents identify a delay in obtaining the rights-of-way.

107.6 EMPLOYEE SAFETY

Make sure no Contractor employees or subcontractor employees are working in unsanitary, unsafe, or hazardous conditions. Provide all safety equipment and materials and take all other action the law, the contract, and the Engineer require to provide a sanitary, safe, and non-hazardous work environment. Admit to the work site and comply with the directions of OSHA inspectors, KDHE inspectors, or other regulatory agency inspectors involved with the Project. Nothing in this provision forces the Contractor to waive the right to demand that regulatory agency inspectors have an appropriate warrant if State or Federal law permits or requires a warrant. Admit to the work site KDOT safety personnel and KDOT environmental personnel, who will make any recommendations through the Field Engineer.

107.7 PUBLIC SAFETY

Public safety is critical. Move traffic safely through construction. Move traffic with the least, minimal traffic obstructions. Provide safe ingress and egress for residents living within the Project limits. Provide temporary surfacing, when required. Repair potholes and other pavement deficiencies. Maintain roadways according to the Contract Documents. See **subsections 104.11** and **104.16**.

Where practical, store vehicles, construction equipment, materials, tools, and debris either off the right-of-way or a minimum of 30 feet from the traveled way. If the Engineer approves storage of an item(s) within 30 feet of the traveled way, place appropriate signs, safety barriers, barricades, or a combination thereof around the item(s). Assume the costs of such devices.

107.8 STORING AND USING EXPLOSIVES

a. General. Store and use explosives safely, protecting against damage to life, property, and the Project. Assume liability for bodily injury, death, damage, and third party property damage caused by negligently storing or using explosives. Assume liability for Contractor's property damage and damage to the Project caused by storing or using explosives.

b. Storage. Store explosives a minimum of 1,000 feet from the traveled way, 1,000 feet from a place of human occupancy, or 1,000 feet from both unless the law requires a greater restriction. Follow the requirements of OSHA and other authorized, regulatory agencies, if any, in securing and marking stored explosives.

c. Use. Notify property owners and utility owners of intended explosives use in their property's vicinity. Notify railroads of intended explosives use if such use is within 200 feet of railroad tracks, railroad structures, or both. Provide this notice in advance of blasting, allowing these owners a reasonable time to monitor and protect their property. Include in the notice the date, time, and approximate duration of blasting operations.

107.9 PROTECTING PROPERTY, LANDSCAPE, AND THE ENVIRONMENT

a. Protect public and private property from damage until final acceptance. Install temporary fence if the Contractor's operations require temporary fence to protect adjacent property, animals, or both.

b. Disturb no land monuments or property marks before the Engineer or Contractor (whichever is responsible) verifies the location of these markers.

c. Cease construction operations upon encountering historical or archaeological artifacts. The Engineer will determine whether to suspend operations until third parties are able to extract the artifacts or the Contractor has approval to excavate the site. The Engineer may allow work to continue in other Project locations.

d. Prevent and avoid pollution and wildlife interference.

(1) Locate and protect all temporary storage facilities for petroleum products, other fuels, and chemicals to prevent accidental spills from entering streams, lakes, ponds, rivers, and reservoirs (water body) within the Project area. In 24 hours, clean up all such spills located within 1,500 feet of any water body.

(2) Do not dispose of the following on any land within the Project limits, in any water body, in any wetlands, or in any location in which runoff, flood, wind, or other natural forces could result in environmental pollution: cement sweepings, concrete washings, concrete wash water from concrete trucks and other concrete mixing equipment, treatment chemicals, grouting and other bonding materials, construction debris, or other waste materials.

(3) Protect wetlands in the Project vicinity from all activities that may result in draining or filling in wetlands.

(4) Use clean uncontaminated materials for fill to minimize excessive turbidity by leaching of fines and to preclude the entrance of deleterious and toxic materials into any water body by natural runoff or by leaching.

(5) Outside the immediate area of operation, excavate, dredge and fill in the water course to minimize increases in suspended solids and turbidity.

(6) During every phase of the Project, immediately remove and properly dispose of all debris to prevent the accumulation of unsightly, harmful, and toxic materials in or near any water body.

e. Erosion Control. Prevent erosion on the Project and Project related borrow areas according to **SECTION 901**. Use KDOT's Temporary Erosion Control Manual as a guide for the design, installation, and maintenance of temporary erosion control measures.

107.10 LIABILITY FOR BODILY INJURY AND PROPERTY DAMAGE CLAIMS; INSURANCE REQUIREMENTS

a. Bodily Injury Claims. Assume liability for bodily injury (including death) arising out of negligent acts or omissions that are:

- associated with contract performance; and
- caused by the Contractor, the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, or a combination thereof.

b. Property Damage Claims (other than damage to the Project/work itself). Assume liability for property damages (including loss of use resulting from property damage) arising out of negligent acts or omissions that are associated with contract performance and caused by the Contractor, the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, or a combination thereof. Restore damaged property to a condition similar or equal to that condition existing before the damage, pay to restore the damaged property to that condition, or pay to replace the damaged property.

(1) If government property, the Engineer will determine whether the Contractor's restoration sufficiently corrected the damage.

(2) If private property, the property owner will determine whether the Contractor's restoration sufficiently corrected the damage. After restoring damaged property or paying for damaged property as required, obtain a release from the property owner and submit the release to the Engineer. The Engineer will not issue final acceptance until the Contractor has obtained and submitted the required release unless the property owner acts unreasonably in refusing to issue a release.

(3) See **subsection 104.20** for the Contractor's liability for damage to the work/Project. Although the property damage claims and related insurance requirements of **subsection 107.10** do not encompass damage to the Project, the Contractor is responsible for Project damage under **subsection 104.20**.

c. Required Insurance Coverage and Limits.

(1) "Commercial General Liability" insurance in an amount a minimum of $1,000,000 each occurrence, $2,000,000 aggregate for bodily injury and property damage combined, and $2,000,000 aggregate for products and completed operations. The Secretary may increase these limits or require an umbrella policy on specific projects. As a minimum, the Commercial General Liability Policy shall contain the following coverages:

- Premises and Operations;
- XCU (explosion, collapse, and underground hazards);
- Products and Completed Operations;
- Contractual Liability (for the Contractor's indemnification obligations); and
- Contractual Liability--Railroads (through endorsement or otherwise) to provide coverage for Contractor's operations on Railroad right-of-way if Project involves work on Railroad right-of-way. This coverage is required in addition to Railroad Protective Liability insurance under **subsection 107.11**.

(2) "Automobile Liability" insurance in an amount a minimum of $1,000,000 each occurrence for bodily injury and property damage combined and that covers Owned, Hired, and Non-Owned vehicles.

(3) "Worker's Compensation" and "Employer's Liability" insurance that complies with K.S.A. 44-532, related statutes, and amendments thereto.

d. General Insurance Requirements.

(1) <u>Certificates of Insurance</u>. Before signing the contract, provide to the Secretary Certificates of Insurance showing the Contractor carries insurance in the amounts and type this **subsection 107.10** requires and showing the effective and expiration dates of such insurance. Such certificates shall identify any and all endorsements to the policy. Such certificates shall provide the insurance company endeavor to give KDOT, any LPA, or both, thirty days' notice of policy cancellation, policy non-renewal, or a material change in the policy. At the Engineer's request, submit copies of the Contractor's insurance policies. For projects involving work on Railroad right-of-way, the Certificates of Insurance shall show Railroad property as part of the designated job site.

(2) <u>Authorized Insurers and Approved Forms</u>. Obtain insurance only from insurers authorized to transact insurance business in Kansas as an authorized insurer (admitted insurers). For general liability, see K.S.A. 40-214. For automobile liability insurance, see K.S.A. 40-3103. For worker compensation insurance, see K.S.A. 44-532. If unable to obtain an admitted insurer under K.S.A. 40-214, request the Secretary's permission to use a non-admitted insurer authorized to write excess surplus lines coverage under K.S.A. 40-246e. Be prepared to demonstrate to the Secretary and Kansas Insurance Commission why the Contractor was unable to use an admitted carrier as required by State statute. Use only forms that the Kansas Insurance Commission has approved unless the Secretary has given permission to use a non-admitted insurer under K.S.A. 40-246e. Include any endorsements the Kansas Insurance Commission requires.

(3) <u>Duration.</u> Obtain and maintain all insurances this **subsection 107.10** requires until KDOT issues Notice of Acceptance of Contract under **subsection 105.16b**. Make sure Commercial General Liability Insurance coverage extends to claims made after Notice of Acceptance and before any applicable statute of limitations expires.

(4) <u>Additional Insureds</u>. If applicable and if the contract requires, make LPAs and Railroads additional insureds on the Commercial General Liability policy and Automobile Liability policy.

e. Subcontractors and Independent Contractors. Make sure subcontractors at any tier (including construction surveyors, materials testing services, or other service type providers) and independent contractors obtain and maintain the insurance this **subsection 107.10** requires. At the Engineer's request, submit copies of such subcontractors' and independent contractors' certificates of insurance or insurance policies.

107.11 LIABILITY FOR RAILROAD CLAIMS; RAILROAD INSURANCE REQUIREMENTS

a. Protect the Railroad from and assume liability for bodily injury (including death) to railroad workers and railroad passengers arising out of negligent acts or omissions that are associated with contract performance and caused by the Contractor, the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, railroad workers assigned to the Project, or a combination thereof.

b. Protect the Railroad from and assume liability for damage to railroad property and railroad right-of-way (including loss of use resulting from property damage) arising out of negligent acts or omissions that are associated with contract performance and caused by the Contractor, the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, railroad workers assigned to the Project, or a combination thereof.

c. Obtain a Railroad Protective Liability Insurance Policy (RPL) for the Railroad as the named insured for damages described in **subsection 107.11a.** and **107.11b.** on projects involving work at railroad crossings, work adjacent to railroad right-of-way that could damage railroad right-of-way, or work within 50 feet of the centerline of a railroad track. Comply with the following requirements and any additional requirements and modifications to the following requirements contained in a project special provision:

(1) RPL Limits. For each annual period, an amount of $2,000,000 each occurrence and $6,000,000 aggregate for bodily injury (including death), property damage, and physical damage to property combined.

(2) RPL Coverage. Contact the Railroad for those forms, endorsements, and exclusions the Railroad requires. If unable to comply with the Railroad's requirements, notify the Assistant Bureau Chief of Construction and Materials, Kansas Department of Transportation, Topeka, Kansas.

(3) Authorized insurers and Approved Forms. Obtain the RPL only from insurers authorized to transact insurance business in Kansas as an authorized insurer under K.S.A. 40-214. If unable to obtain an authorized, general liability insurer under K.S.A. 40-214, request the Secretary's permission to use a non-admitted insurer authorized to write excess lines coverage under K.S.A. 40-246e. Use only forms that the Kansas Insurance Commission has approved unless the Secretary has given approval to use a non-admitted insurer under K.S.A. 40-246e. Include any endorsements the Kansas Insurance Commission requires.

(4) Duration. Maintain the RPL **subsection 107.11** requires until KDOT issues final acceptance under **subsection 105.16b.** unless the Railroad and Secretary approve cancellation of the Policy before final acceptance.

(5) Subcontractors. If any work is sublet, make sure subcontractors at any tier provide the same insurance for the Railroad Company to cover the subcontractor's operations.

d. RPL Submittal and Approval.

- Provide the Bureau Chief of Construction and Materials, Kansas Department of Transportation, Topeka, Kansas, the original and 1 copy (Original for Carrier, copy for KDOT) of the RPL on the Railroad Company's behalf;
- Submit the RPL within 15 calendar days after receiving notice of award of the contract. Obtain Railroad approval of the RPL before beginning construction on or near the railroad or railroad right-of-way. The Railroad Company approves the RPL, including coverage provided and the underwriter. (The Railroad typically requires 30 business days to issue its RPL approval.);
- The Engineer may delay issuing the Notice to Proceed until the Contractor has obtained the railroad's approval of the RPL. Alternatively, if the Contractor has submitted the RPL to KDOT, the Engineer may issue the Notice to Proceed, restricting the Contractor's operations to locations outside the railroad right-of-way until the railroad has approved the RPL; and
- Assume the risk of delays in submitting the RPL Policy. Assume responsibility for delays of 45 calendar days or less in obtaining the Railroad's approval. The 45 calendar day period begins on the date the Contractor submits the RPL to KDOT. Assume responsibility for delays in obtaining the Railroad's approval outside the 45 calendar day period specified if the additional delay was caused by the Contractor, the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, or a combination thereof. NOTE: Railroad permits are subject to **subsection 107.2c**.

e. Sample Form. If desired, request from the Assistant Bureau Chief of Construction and Materials, Kansas Department of Transportation, Topeka, Kansas, a sample Standard Form Railroad Protective Liability Policy.

107.12 INDEMNIFICATION

a. Defend KDOT and any LPA and hold KDOT and any LPA harmless from bodily injury claims, (including death), intellectual property claims, other personal injury claims, property damage claims (other than damage to the project-work itself), and associated expenses (including attorney's fees and defense costs) that are associated with contract performance and that are caused by the negligent acts or omissions of the Contractor, the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, or a combination thereof. If KDOT, the LPA, or both defend against a bodily injury claim, intellectual property claim, other personal injury claim, or property damage claim (other than damage to the Project-work itself), indemnify KDOT, the LPA, or both for expenses they incurred (including attorney's fees and defense costs), amounts they paid (including interest), or both but only if the claim was associated with contract performance and only to the extent caused by the negligent acts or omissions of the Contractor, the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, or a combination thereof. The fact that KDOT, any LPA, or both share liability with the Contractor does not release the Contractor's obligations to defend, hold harmless, and indemnify KDOT, any LPA, or both; however, the Contractor's obligation to indemnify does not include that part of the claim (including that share of expenses) caused by the negligent acts or omissions of KDOT, the LPA, or both.

b. If the Project requires work on Railroad right-of-way, defend the Railroad and hold the Railroad harmless from bodily injury claims (including death), personal injury claims, property damage claims, and associated expenses (including attorney's fees and defense costs) that are associated with contract performance and that are caused by the negligent acts or omissions of the Contractor, the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, railroad workers assigned to the Project, or a combination thereof. If the Railroad defends against a bodily injury claim, personal injury claim, or property damage claim, indemnify the Railroad for expenses the Railroad incurred (including attorney's fees and defense costs), amounts the Railroad paid (including interest), or both but only if the claim was associated with contract performance and only to the extent caused by the negligent acts or omissions of the Contractor, the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, railroad workers assigned to the Project, or a combination thereof. The fact that the Railroad shares liability with the Contractor does not release the Contractor's obligations to defend, hold harmless, and indemnify the Railroad; however, the Contractor's obligation to indemnify does not include that part of the claim (including that share of expenses) caused by the negligent acts or omissions of Railroad employees not assigned to the Project and Railroad contractors, agents, independent contractors, subcontractors at any tier, and suppliers at any tier.

c. The indemnification obligations in **subsections 107.12a.** and **b.** do not affect other indemnification rights or obligations that may exist as to a party or person described in **subsection 107.12**.

107.13 UNKNOWN HAZARDOUS MATERIALS

Upon encountering unknown hazardous materials or unknown potentially hazardous materials, immediately:

- stop work within the contaminated or potentially contaminated area;
- remove workers from the contaminated or potentially contaminated area;
- exercise extreme caution at all times;
- notify the Engineer; and
- continue working on other unaffected areas unless the Engineer prohibits such work.

With KDHE and possibly other environmental agencies, the Secretary and any LPA will identify the hazardous materials and form a cleanup plan for the hazardous materials. The Secretary and any LPA will arrange for a third party to perform the cleanup. The Secretary will treat the discovery and cleanup of unknown hazardous materials as a differing site condition under **subsection 104.5**.

Nothing in **subsection 107.13** limits the Contractor's responsibility for cleaning up, at the Contractor's expense, known hazardous or potentially hazardous materials, including those materials identified in the Contract Documents and those materials the Contractor brings to the Project.

107.14 LIABILITY OF PUBLIC OFFICIALS

a. The Secretary's authorized representatives assume no personal or other liability in exercising their contractual authority. They act only as the Secretary's employees or agents.

b. The LPAs authorized representatives assume no personal or other liability in exercising their contractual authority. They act only as the LPAs employees or agents.

107.15 LPAs AND OTHER THIRD PARTY OWNERS

The Secretary is the principal contracting party on construction contracts for the State highway system as defined by K.S.A. 68-406.

The Secretary is the agent on construction contracts entered into on behalf of disclosed principals such as counties, cities, political subdivisions, or other authorized persons, firms, or corporations.

These LPAs and other third parties have the right to:

- enter the property;
- inspect and approve work;
- be protected by and receive the benefits of bonding, and insurance; and
- along with KDOT, enforce construction contract terms and accept the Project.

The agreement(s) made between the Secretary and a disclosed principal(s) on a Project is incorporated by reference into the construction contract for the Project. The Secretary will provide a copy of any agreement upon request.

107.16 THIRD PARTY BENEFICIARY

Except as provided in **subsection 105.12** and **subsection 107.12**, the parties do not intend to confer third party beneficiary rights on any person or entity that is not a party to this contract.

Respecting third parties, the parties to this contract have only the duties, obligations, and responsibilities the law imposes.

SECTION 108

PROSECUTION AND PROGRESS

108.1 NOTICE TO PROCEED

a. General. For each Project, the Engineer will issue to the Contractor a Notice to Proceed, a written notice to the Contractor to begin the contract work including, when applicable, the date from which the Engineer will start charging Contract Time. The Notice to Proceed will be issued and the Contract Time will begin within the earliest and latest starting dates established for the Project. (see **subsection 102.6**). Without the District Engineer's permission and for good cause only, the Engineer cannot give a Notice to Proceed date earlier than the earliest starting date or later than the latest starting date established for the Project. To move the earliest and latest start date by more than 30 calendar days, the District Engineer will obtain the approval of the Bureau Chief of Construction and Materials. Perform no work on the Project site until the Engineer issues the Notice to Proceed. Begin work on the Project site on or shortly after the Engineer issues the Notice to Proceed. If, for any reason, the Contractor has not received the Notice to Proceed on or before the latest starting date, the Contractor shall notify the Engineer of the omission.

b. Railroad Protective Liability Policy. Typically, the Engineer will not issue the Notice to Proceed without an approved, railroad protective liability policy. If the Engineer agrees to issue the Notice to Proceed before the Contractor has obtained an approved, railroad protective liability insurance policy, do not perform work within the railroad right-of-way until the railroad has approved this policy.

c. Restricted Site Access. The Engineer may issue the Notice to Proceed even if the Contractor has restricted site access. Include in the Contractor's bid all costs (money and time) associated with restricted site access identified in the Contract Documents or observed by site examination.

108.2 PRE-CONSTRUCTION CONFERENCE AND PROJECT PROGRESS MEETINGS

a. Pre-Construction Conference. KDOT will hold a pre-construction conference for the Project. If held at a facility, attend and bring to the pre-construction conference all documentation the Engineer requires. If conducted by phone, submit the required documentation to the Field Engineer.

b. Project Progress Meeting. At least once a month, hold a Project progress meeting with the Engineer, Inspectors, and any other government owners involved in the Project. Invite subcontractor personnel as well as other third parties which may affect the Contractor's progress. If necessary, hold Project progress meetings weekly or bi-weekly. These meetings allow the parties to discuss upcoming work, discuss anticipated problems, determine inspection requirements, review schedules, and review punch list items (see **subsection 104.21**) among other things. Notify the District Engineer if KDOT personnel are not attending Project progress meetings.

108.3 PROGRESS SCHEDULE OR NETWORK SCHEDULE (SCHEDULE)

a. Definitions.

(1) Progress Schedule: A chronologically-sequenced bar chart identifying the following:

- activities, sequence of activities, and duration of activities; and
- dates for drawing submittals and desired approval.

(2) Network Schedule: A chronologically-sequenced bar chart and associated reports sorted by activity and earliest/latest start dates. The bar chart shall identify the following:

- activities, sequence of activities, duration of activities, and resources (Major Equipment, Materials, Labor) expected to be devoted to the work at the various stages;
- dates for drawing submittals and desired approval; and
- interdependence of all activities.

b. Schedule.

(1) Unless the Project has less than 30 working days, submit either an accurate Progress Schedule or a Network Schedule. Submit the Schedule either at the pre-construction conference or within 10 business days before the anticipated beginning of work on the Project.

(2) It is the Contractor's responsibility to determine the most feasible order of work consistent with the contract requirements. Plan and organize work to produce the least interference with traffic, businesses, and home owners and to minimize the use of planned detours. Plan and organize work to meet the Contract Time and any interim Contract Times. If the Schedule reflects completion of parts or all of the work earlier than the Contract Time (early completion), the Secretary shall not be liable for additional costs the Contractor incurs to achieve early completion or liable for delays that prevent the Contractor from achieving early completion.

(3) Provide enough detail so the Schedule reflects the Controlling Item of Work (CIOW) and other activities that affect the Contract Time.

(4) The Engineer will request the Contractor to submit a revised Schedule if the Engineer believes the Schedule is unworkable.

c. Controlling Item of Work (CIOW). The Engineer will use the Schedule to identify the Controlling Item of Work and all activities that extend the Contract Time. If the Engineer is unable to identify the CIOW from the Schedule, the Engineer will request a revised Schedule that shows the CIOW and all activities that extend the Contract Time. If the Contractor fails to provide a revised Schedule or if the Contractor's revised Schedule fails to show the CIOW, the Engineer will determine the CIOW.

d. Notification. Notify the Engineer of Schedule changes, delays, or both regardless of whether the Contractor is seeking additional time or money. The Engineer may notify the Contractor that the contract is behind schedule. This notice is not an order to accelerate the project.

e. Updated Schedule. (For projects requiring a Schedule).

(1) Update Schedules when a Contract Change or other act or omission:

- alters the sequence of activities;
- changes the time for performing an activity; or
- requires the Contractor to increase or decrease major equipment, material, or labor to meet the Schedule.

(2) Submit an updated Schedule to the Engineer within 5 business days after one of the following events occur:

- a Contract Change that affects the Schedule by 10 working days;
- a contract delay that affects the Schedule by 10 working days;
- work falls behind the latest Schedule by 10 working days (Working Day Projects); or
- work falls behind the latest Schedule by 14 calendar days (Calendar Completion Date or Calendar Day Projects).

(3) Update schedules accurately by adjusting the Schedule to reflect the resources the Contractor plans to devote to the work. If using a Network Schedule, identify the resources in the updated Schedule.

(4) Identify any planned acceleration or planned sequencing change required to complete the work within the Contract Time.

f. Payment for Schedules. Include in the Contractor's bid the cost of preparing and submitting the original Schedule and anticipated updates. The cost for the Schedule is subsidiary to other work.

g. Use of Network Schedules. Provide a Network Schedule instead of a Progress Schedule when:

(1) the Contract Documents requires a Network Schedule;

(2) the Engineer requires a Network Schedule because:

- the Engineer is unable to determine from the Progress Schedule the CIOW;
- the Engineer is unable to determine from the Progress Schedule the activities that extend the Contract Time;
- the Contractor has not submitted updated progress schedules; or

- the Contractor's other acts or omissions cause a need for a Network Schedule to monitor the Project.

108.4 CONTRACT TIME-GENERAL

a. Contract Time. The Contract Time is the time set forth in the Contract Documents for completion of the work on the Project. Timely performance is an essential part of the contract. Complete all of the work within the Contract Time. For the Contract Time, the Secretary may establish:

(1) working days, calendar days, or a calendar completion date to complete all work; or

(2) A combination of working days, calendar days, or calendar completion dates, to perform all work necessary to open the Project to unrestricted traffic (Project Open Time) and then to complete all remaining work for Project construction completion (Cleanup Time).

b. Project Open Time. During the Project Open Time, the Contractor shall perform all work necessary to open the Project to unrestricted traffic and may perform any other work necessary to complete physical construction or reconstruction of the Project. "Unrestricted traffic" means that all roadways (lanes, turn lanes, ramps, side roads, medians, shoulders etc.) within the Project limits are open to unobstructed continuous traffic flow with temporary or permanent striping, temporary or permanent signing, and required safety features such as guardrail and traffic control devices in place and operational. "Unobstructed continuous traffic flow" means traffic is following the final lane configurations required by the plans and there are no lane closures. The Engineer, not the Contractor determines when the Contractor may open the Project to unrestricted traffic.

c. Cleanup Time. The Cleanup Time is the number of working days, calendar days, or calendar completion date available to the Contractor after the Project Open Time expires for the Contractor to complete remaining, unfinished contract pay items, subsidiary items, incidental work, final cleanup, and final punch list.

(1) Determine the number of cleanup days on working day contracts according to **TABLE 108-A**.

TABLE 108-A: DETERMINING CLEANUP DAYS ON A WORKING DAY PROJECT

Project Open Time in Working Days-Range	Number of Cleanup Working Days
1 to 50	10
51 to 100	20
101 to 200	30
200+	40

(2) If the Engineer adjusts the Project Open Time from one range to another because of a Contract Change, the Engineer will apply the cleanup working days corresponding to the new range in **TABLE 108-A**.

(3) On calendar day or calendar completion date contracts, the Secretary will identify the number of cleanup working days, cleanup calendar days, or the cleanup calendar completion date in a project special provision.

(4) Project Open Time and Cleanup Time are separate periods of time.

- Even if the Project is not open to unrestricted traffic, the Engineer will begin charging Cleanup Time the day after the Project Open Time expires.
- If the Project is open to unrestricted traffic but the Project Open Time has not expired, the Engineer will not begin charging Cleanup Time until the Project Open Time has expired.
- Once begun, the Engineer will continue charging Cleanup Time until all work is complete and the charging of Cleanup Time will not be suspended on days in which the Contractor is being assessed liquidated damages, a disincentive assessment, or both for restricting traffic.

d. Provide the Engineer at least 24-hour notice when the Contractor or subcontractors intend to work on Saturday. Obtain the District Engineer's approval to work on Sundays, Kansas Civil Service holidays, Governor-proclaimed holidays, Saturdays following a Friday holiday, and Saturdays preceding a Monday holiday.

e. Resume work promptly after temporary suspensions and winter shutdown.

f. Interim Contract Times. The Secretary may set Interim Contract Times in which the Contractor shall complete certain parts of the Project. Interim Contract Times may be stated in working days, calendar days, calendar completion dates, or a combination thereof.

108.5 WORKING DAY CONTRACTS (Also, see **subsection 108.4.**)

a. Complete all work necessary to open the Project to unrestricted traffic within the original contract working days and any additional working days allotted to the contract (Project Open Time). Complete all remaining unfinished contract pay items, subsidiary items, incidental work, extra work, final cleanup, and final punch list within the working days remaining in the Project Open Time, if any, and the Cleanup Time permitted under **subsection 108.4c**.

b. The Engineer will begin charging working days on the date of the Notice to Proceed.

c. The Engineer will assess a working day or cleanup working day for:

(1) Every weekday on which weather does not prevent the Contractor or a subcontractor from performing the Controlling Item of Work (CIOW) for at least 50% of the Contractor's normal workday (regardless of whether the Contractor or subcontractor performs work).

(2) Every Saturday on which the Contractor or a subcontractor chooses to work and is able to work on the CIOW (regardless of whether the Contractor or subcontractors perform work on the CIOW).

(3) Every Sunday or legal holiday on which the District Engineer allows the Contractor or a subcontractor to perform work requiring inspection (regardless of the type of work or the time spent working).

(4) Every weekday the Contractor or a subcontractor is unable to perform the CIOW because of an act or omission for which the Contractor, subcontractor, or supplier is responsible under the contract.

(5) Every weekday the Contractor or a subcontractor is unable to perform the CIOW because of plant failures, equipment failures, delivery delays, inefficient operations, personnel problems, material shortages (other than national shortages meeting **subsection 108.5d.(5)**), financial difficulties, and work on another project(s). The Contractor assumes the risk of delay associated with these matters, even though these matters may not be foreseeable. The Contractor assumes the risk of delay associated with these matters, even though these matters may be outside the Contractor's control or outside the control of the subcontractor's or suppliers at any tier.

(6) Exception: If weather prevents the Engineer from assessing a working day or cleanup working day under **subsection 108.5c.(1)**, the Engineer will not assess a working day or cleanup working day for a reason listed in **subsections 108.5c.(2)** through **(5)**.

d. The Engineer will not assess a working day or cleanup working day for the following:

(1) Recovery Days. Recovery days are days the Contractor needs to restore the site to the approximate condition that existed before weather prevented the Contractor from performing the CIOW.

(2) States Delay Days. States delay days are days in which the Contractor or subcontractors cannot work on the CIOW because of a Contract Change or other act or omission for which KDOT, any LPA, or another government entity is responsible. State's delay days include days on which the Contractor is awaiting a final punch list under **subsection 104.21** when the final punch list is the CIOW and the 5 business days allowed to prepare the final punch list has expired.

(3) Piling Delivery. The Engineer will not charge working days on days the Contractor or subcontractor awaits the arrival of permanent piling if:

- the contract requires test piles;
- the bridge Contractor or subcontractor ordered the permanent piling immediately after driving the test piles; or
- piling installation is the CIOW.

(4) Winter Holiday Period. The Engineer will not charge working days or cleanup working days during the Winter Holiday Period regardless of whether the Contractor or subcontractors perform work. The Winter Holiday Period begins December 23 and ends January 3.

(5) National Material Shortages. The Engineer will not charge working days under **subsection 108.5c.(5)** if there is a national material shortage unless:

- the national material shortage was foreseeable at the time of bid; or
- the national material shortage does not prevent the Contractor from performing the CIOW.

(6) Winter Shutdown Period. The Engineer will not charge working days or cleanup working days during a Winter Shutdown Period identified in or added to the Contract Documents. KDOT may add a Winter Shutdown Period to the contract when the District Engineer and Contractor agree to suspend the Project because winter conditions prevent the Contractor from making progress on the CIOW for at least 50% of the Contractor's normal work week or winter conditions make it commercially impractical for the Contractor to make progress on the CIOW.

e. Concurrent Delay. The Engineer will not assess a working day or cleanup working day under **subsection 108.5c.** if **subsection 108.5d.** prevents the Engineer from assessing a working day or cleanup working day on that same day.

f. Notification of Working Day Charges. Weekly, the Engineer will provide the Contractor a Notification of Working Day Charges, identifying the working days, cleanup working days, or both that were charged during the previous week.

g. Disputing Working Day Charges.

(1) Notify the Engineer, in writing, of any contested working days or cleanup working days charged within 10 business days after receiving the Notification of Working Day Charges. In the written notice, provide the reasons for contesting the days charged. If the Contractor fails to give this notice in writing or fails to give this notice within 10 business days, the Contractor waives the right to dispute the working days or cleanup working days charged in that Notification of Working Day Charges. Notice to the Inspector is not sufficient under this **subsection 108.5g**.

(2) If the Contractor disputes the working days or cleanup working days charged because of a Contract Change, comply with **subsections 104.8** and **104.10** and identify in the contract adjustment request which working days or cleanup working days the Contract Change has affected. The 10 day notice period in **subsection 108.5g.(1)** does not apply to working days or cleanup working days disputed because of a Contract Change.

h. Additional Working Days. Working days will be added to a contract only when **SECTION 104** allows additional time and when a written contract adjustment (Change Order) has received final approval.

108.6 CALENDAR DAY AND CALENDAR COMPLETION DATE CONTRACTS (Also, see **subsection 108.4.**)

a. The Engineer will issue a Notice to Proceed on the date the Contractor begins work or the date the Contract Documents specify.

b. Complete all work necessary to open the Project to unrestricted traffic within the calendar days allotted in the Contract Documents or before the calendar completion date expires, including authorized time extensions (if any). Complete all remaining, unfinished contract pay items, subsidiary items, incidental work, extra work, final cleanup, and final punch list within the calendar days remaining (if any), within the days remaining before the calendar completion date expires (if any), and within the Cleanup Time set by the project special provision.

c. The Secretary will increase the number of calendar days, extend the calendar completion date, or pay the Contractor to accelerate the Project if the Contractor proves one of the following:

(1) The Contractor is entitled to a contract adjustment under **SECTION 104** and complies with **subsection 104.10b**.

(2) Unusually severe weather delayed the Project completion as provided in this **subsection 108.6.c(2)**. Unusually severe weather is adverse weather that at the time of year in which it occurred is abnormal for the place in which it occurred. For unusually severe weather to delay Project completion and warrant additional time under **subsection 108.6.c(2)**, the Contractor must have a schedule showing the CIOW and delay to the CIOW at the time of the unusually severe weather. In addition, the Contractor must show unusually favorable weather at other times of the year failed to diminish, mitigate, or overcome the delay caused by the unusually severe weather.

(3) An Act of God delayed the Project completion.

d. The State Transportation Engineer has sole discretion to determine whether to give a time extension or pay acceleration costs under **subsection 108.6c**.

e. Interim Contract Times. The project special provision may require the Contractor to perform specified work within Interim Contract Times (working days, calendar days, or calendar completion dates) designated in the Project Special Provision.

108.7 COMPLETING WORK EARLY-INCENTIVE AWARD

a. The Secretary may offer the Contractor an incentive award for completing some or all of the work before the specified hourly periods, working days, calendar days, or calendar completion date expires (incentive award).

b. Seek no additional money for completing a Project before the Contract Time unless the parties have agreed, in writing, to an incentive award under this **subsection 108.7**. Seek no additional money for completing parts of a Project before interim Contract Times, unless the parties have agreed, in writing, to an incentive award under this **subsection 108.7**.

c. The Contractor may request the Secretary to add an incentive award to a contract. It is in the Secretary's sole discretion to include or add an incentive award to a contract.

d. The Secretary will pay the incentive award only if the Contractor completes the work early, according to the Contract Documents.

108.8 FAILURE TO COMPLETE WORK TIMELY-LIQUIDATED DAMAGES AND DISINCENTIVE ASSESSMENTS

a. If the Contractor fails to complete the work within the Contract Time and within Interim Contract Times, if any, the Secretary may charge:

(1) liquidated damages under this **subsection 108.8**;
(2) liquidated damages under a Project Special Provision;
(3) a disincentive assessment(s) under a Project Special Provision; or
(4) any combination of the foregoing.

b. Excluding Sundays and legal holidays, the Engineer will charge liquidated damages, a disincentive assessment, or both for each calendar day, or part thereof, that:

(1) The Project remains incomplete after the Contract Time has expired.
(2) The Project is not open to unrestricted traffic after the Project Open Time has expired.
(3) The Contractor obstructs the unrestricted traffic flow to perform work after the Project was opened to unrestricted traffic and the Project Open Time has expired.
(4) Specified work is not complete after Interim Contract Time(s) expire.
(5) The Project remains incomplete after Cleanup Time expires.

If the District Engineer permits the Contractor to work on Sundays or legal holidays during liquidated damages or disincentive assessment periods, the Engineer will charge liquidated damages, disincentive assessments, or both for all Sundays and legal holidays worked, including the Winter Holiday period. The Engineer will not stop charging liquidated damages, disincentive assessments, or both until the Contractor completes the required work unless the Engineer suspends damages under **subsection 108.8c**.

c. Exceptions warranting suspension of damages and resumption of damages.

(1) Extra Work. The Engineer will suspend liquidated damages, disincentive assessments, or both if the Engineer orders extra work after the Contract Time has expired and this work becomes the CIOW, affects the CIOW, or otherwise extends the Project completion time. The Engineer will resume charging and deducting liquidated damages, disincentive assessments, or both when the extra work ceases to be the CIOW, stops affecting the CIOW, or no longer extends the Project completion time.

(2) Final Punch List. The Engineer will suspend liquidated damages, disincentive assessments, or both on days the Contractor is awaiting a final punch list under **subsection 104.21** when the final punch list is the CIOW and the 10 business days allowed to prepare the final punch list has expired.

The Engineer will resume charging and deducting liquidated damages, disincentive assessments, or both on one of the following days, whichever occurs first:

- The day the Contractor resumes the final punch list work.
- The 1st working day after the Contractor receives the final punch list.
- The 5th calendar day after the Contractor receives the final punch list if the Contractor had demobilized from the Project.

(3) Specified Winter Conditions.

(a) Suspension of Damages. On working day, calendar day, or calendar completion date projects, if the roadway is open to traffic and in its final traffic configuration for winter, the Engineer will suspend liquidated damages, disincentive assessments, or both:

- during a Winter Shutdown Period identified in the Contract Documents;
- during a Winter Shutdown Period the parties negotiate;
- once seasonal limitations prevent the Contractor from performing the CIOW on pay items restricted by these limitations such as permanent pavement markings and seeding; or
- when winter conditions prevent the Contractor from making progress on the CIOW for at least 50% of the Contractor's normal work week or winter conditions make it commercially impractical for the Contractor to make progress on the CIOW.

(b) Resuming Damages after Suspension for Weather Conditions. On working day, calendar day, or calendar completion date projects that have been suspended for weather conditions under **subsection 108.8c.3(a)**, the Engineer will resume charging and deducting liquidated damages, disincentive assessments, or both on whichever of the following days occurs first:

- the day after the winter shutdown period expires.
- the day the Contractor resumes work on its own.
- May 31st of the year following the suspension for weather conditions.

d. Amount of damages.

(1) On working day contracts, the Secretary will determine the amount of liquidated damages using **TABLE 108-1**.

TABLE 108-1: TABLE OF LIQUIDATED DAMAGES			
Original Contract Amount Range		**Amounts of Liquidated Damages to be Deducted for Each Day Over Contract Time, Project Open Time or Cleanup Time**	
		Condition at End of Working Days, Calendar Days, Calendar Completion Date, Cleanup Time	
		Project Not Complete after Contract Time Expires under 108.4a.(1) or Project Not Open to Unrestricted Traffic after Project Open Time Expires under 108.4a.(2)*	**Project Open to Unrestricted Traffic, but not Completed after Cleanup Time Expires under 108.4a.(2)**
		(A)	**(B)**
$0.00	$500,000.00	$800.00	$400.00
$500,000.01	$1,000,000.00	$1,000.00	$500.00
$1,000,000.01	$2,500,000.00	$1,200.00	$600.00
$2,500,000.01	$5,000,000.00	$1,500.00	$750.00
$5,000,000.01	$10,000,000.00	$2,000.00	$1,000.00
$10,000,000.01	$25,000,000.00	$2,500.00	$1,250.00
Over $25,000,000.01		$3,000.00	$1,500.00

*Or Not Available to the Next Contractor, when applicable.

Application of **TABLE 108-1 when Contract Time includes Project Open Time and Cleanup Time**:

- Multiply the number of days (under **subsection 108.8b.**) that the Project was not open to unrestricted traffic after the Project Open Time expired by the amount in (A) to obtain an amount of Liquidated Damages.
- Multiply the number of days (under **subsection 108.8b.**) that the Project was open to unrestricted traffic but not complete after the Cleanup Time expired by the amount in (B) to obtain an amount of Liquidated Damages.
- Combine these 2 liquidated damage amounts to obtain a Total Liquidated Damages amount.

(2) On calendar day projects, calendar completion date projects, or projects with an Interim Contract Time(s), the Secretary will designate in a Project Special Provision the amount of liquidated damages, disincentive assessment, or both. If a Project Special Provision does not address the amount of liquidated damages, disincentive, or both, apply **TABLE 108-1**.

(3) If the Contractor placed temporary rather than permanent striping, the Project will no longer be considered open to "unrestricted traffic" on days the Contractor replaces the temporary striping with permanent striping. If the Contractor placed temporary rather than permanent signing, the Project will no longer be considered open to "unrestricted traffic" on days the Contractor replaces the temporary signing with permanent signing, if the replacement obstructs continuous traffic flow. In either situation, the Engineer will calculate the liquidated damages on these days using the amount in column A of **TABLE 108-1**.

e. The Secretary assesses liquidated damages to recover the Secretary's additional engineering costs, administration costs, supervision cost, and inspection costs for the Contractor's failure to complete the work within the Contract Time or Interim Contract Times. The Secretary assesses disincentive assessments to recover some of the public's user costs or other public expenditures that are unique to the Project and caused by the Contractor's failure to complete the work within the Contract Time or Interim Contract Times. The Secretary may combine the liquidated damages and disincentive costs into one amount and label the amount as liquidated damages. These damages are not considered a penalty but rather as an agreed upon alternative to calculating the actual damages incurred by the Secretary and users for Project delay.

f. Liquidated damages and disincentive assessments assessed under this **subsection 108.8** do not relieve the Contractor from liability for any damages or costs resulting from: claims between Contractors under **subsection 105.12**, third party claims, and deducts for construction work that failed to meet contract requirements such as asphalt smoothness and erosion control violations, among others.

g. Permitting the Contractor to continue working after the Contract Time or Interim Contract Times expire does not constitute a contract time extension or prevent the Secretary from declaring a breach of contract under **subsection 108.9** for the Contractor's failure to complete work timely.

h. Nothing in this **subsection 108.8** or any Project Special Provision providing for liquidated damages, disincentive assessments, or both prevents the Secretary from declaring a breach of contract under **subsection 108.9** for the Contractor's failure to complete work timely.

i. The Contractor, not the Secretary, shall pay for traffic control during liquidated damages periods, disincentive assessment periods, or both incurred for the Contractor's failure to meet the Contract Time. This provision shall not apply to damages incurred for failing to meet Interim Contract Times.

j. Administering Damages. For purposes of this **subsection 108.8**, the term "damages" means liquidated damages, disincentive assessments, or both.

The Engineer will deduct the damages from contract funds owed to the Contractor. If damages exceed contract funds, pay KDOT for remaining damages owed. Issue this payment within 10 business days after receiving notice to pay.

If the Contractor fails to pay, the Secretary may collect the amount owed from the Surety after declaring a breach of contract under **subsection 108.9**.

The Engineer will continue to assess damages even after the Secretary or Surety takes over the contract after the Contactor's breach. Both the Contractor and Surety are liable for the damages assessed.

Only the Secretary or State Transportation Engineer may waive all or part of the damages. As each situation and project is different, no damage waiver in one instance dictates a future waiver of damages on the same or another project.

108.9 CONTRACTOR'S BREACH OF CONTRACT

a. Causes for Breach. The Secretary (or State Transportation Engineer) may declare the Contractor has breached the contract if the Contractor:

- fails to comply with the contract;
- fails to pay legal judgments within 30 days after the judgment becomes final;
- assigns contract proceeds to creditors without the Secretary or Surety's consent;
- becomes insolvent or is declared bankrupt; or
- commits a fraudulent act on this Project or another project.

b. Notice and Opportunity to Cure. If the Secretary declares a breach of contract for failing to comply with the contract, the Secretary will notify the Contractor and Surety, in writing, of the breach, specifying the particular cause. Except as provided in this **subsection 108.9**, the Secretary will give the Contractor and Surety 10 business days to cure the breach by complying with the contract. If the Secretary determines it is commercially or physically impossible for the Contractor or Surety to cure the breach within the 10 business days allowed, the Secretary will determine whether it is in the State's best interest to extend the cure time or to follow through with the breach of contract. The Secretary has sole discretion to extend the cure time. The Secretary's failure to extend the cure time will not give rise to a breach of contract claim, lack of good faith claim, or other claim. The Secretary may give the Contractor and Surety less than 10 business days to cure the failure to perform remedial work timely (see **subsection 105.5f.**).

c. Determination of and Remedies for Breach.

(1) If the Contractor or Surety does not cure the breach within the 10 business days or any allowed extension, or if the Contractor or Surety has not been allowed to cure the breach, the Secretary will declare the Contractor in breach and remove the contract from the Contractor. After removing the contract from the Contractor and determining which action is in KDOT's best interests, the Secretary may:

- Hire another Contractor to complete the contract work;
- Require the Surety to complete the contract according to the original contract terms;
- Use KDOT forces to complete the contract work; or
- Employ a combination of the above or other methods to complete the contract work.

(2) The Secretary, Surety, or third party completing the contract or contract work may appropriate and use all materials on the Project site and all materials paid for and stored off site.

(3) If the Secretary hires a third party or uses the Secretary's own forces to complete the contract work, the Contractor and Surety are liable to the Secretary for extra costs the Secretary incurs to complete the contract work. These costs include construction costs that exceed the original contract price and administrative costs that rise from the Contractor's breach. The Secretary will deduct these costs from the contract funds. If the costs exceed the amount of contract funds, the Contractor and Surety shall pay the Secretary the deficit. If the costs are less than the contract funds remaining, the Secretary will pay the Contractor or Surety the balance.

d. Set-off. Nothing in **subsection 108.9** prevents the Secretary from exercising the Secretary's set-off rights under K.S.A. 75-6201 et seq.

108.10 OWNER'S BREACH OF CONTRACT

a. Causes for Breach. The Contractor may assert the Secretary has breached the contract if a Contract Change, act, omission, or combination thereof, for which the Secretary is responsible under the contract, fundamentally changes the scope of the original contract.

b. Notice. If the Contractor believes the Secretary has breached the contract, give the Secretary notice, in writing, of the breach, specifying the particular Contract Change, act, or omission. Provide this notice within 10 business days after the Contract Change, act, or omission.

This notice is necessary so the Secretary may determine whether to modify, defer, or cancel the contract. If the Contractor fails to give the Engineer this notice, the Contractor waives the right to seek damages, a time extension, or both outside the contract terms and may seek only a contract adjustment under the contract.

108.11 DEFERRING OR CANCELLING A CONTRACT

a. Reasons for Deferring or Cancelling Contract. The Secretary may defer a contract or cancel a contract for one or more of the following events:

- Executive orders of the President of the United States of America or Governor of Kansas;
- National emergencies;
- Injunctions (temporary restraining orders, preliminary injunctions, permanent injunctions);
- Other court orders;
- Major design changes;
- Site changes;
- Insufficient appropriations to continue the Contract or make payments for charges under the Contract; Other conditions making deferment or cancellation in the State's best interests.

The Secretary's discretion to defer or cancel a contract exists even if the Contractor has partially or substantially performed the work.

b. Notice. The Secretary will provide the Contractor a written Notice of Deferment or Notice of Cancellation.

c. Deferment. The Secretary and Contractor will enter into a written agreement stating the terms and conditions of deferment. If the parties cannot agree on these terms, the Secretary either will cancel the contract or will keep the original contract in force.

d. Cancellation.

(1) When the Secretary cancels a contract or the remainder of a contract and the Contractor, its subcontractors, or its suppliers did not cause the cancellation, the Secretary will pay the following costs:

- contract prices for work completed;
- idle equipment time if the Engineer stops work before the cancellation date;
- mobilization and demobilization not already included;
- bidding and Project investigative costs relative to amount of work completed;
- material costs for materials the Contractor obtained but were not yet incorporated in the work and that the Contractor is unable to sell or return;
- overhead expenses attributable to the cancelled Project;
- legal and accounting charges for claim preparation associated with cancellation;
- idle labor cost if the Engineer stops work before the cancellation date;
- guaranteed payments for private land usage associated with the Project; and
- other reasonable costs the Contractor incurs because of cancellation, but excluding loss of anticipated profits.

(2) Cancellation does not modify or eliminate the Contractor's or Surety's responsibility for the work performed.

e. Eliminated Items. This **subsection 108.11** does not apply to eliminated items which are covered by **subsection 104.4** even though the eliminated item(s) causes the Contractor to cancel a subcontract or supply contract.

108.12 TERMINATION OF CONTRACTOR'S LIABILITY AFTER NOTICE OF ACCEPTANCE AND EXCEPTIONS

a. Liability to Secretary.

(1) The Notice of Acceptance of Contract under **subsection 105.16** releases the Contractor and Surety from further liability to the Secretary for:

- physical construction on the Project (except construction arising out of any breach of warranty, breach of guaranty, latent defects, fraud, or misrepresentation discovered after Notice of Acceptance);
- physical damage to the Project caused by Acts of God and third parties after Notice of Acceptance (except for physical damage caused by the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, or a combination thereof); or
- Maintenance of the Project.

(2) The Notice of Acceptance of Contract under **subsection 105.16** does not release the Contractor and Surety from the obligation to complete final paperwork or to accept cost adjustments for the work performed. Release of these obligations (with exceptions) occurs after Final Payment as provided in **subsection 109.9**.

b. Liability to Third Parties.

(1) The Notice of Acceptance of Contract under **subsection 105.16** does not release the Contractor from liability to third parties for personal injury (including bodily injury and death) and property damage claims associated with the contract and arising out of the negligent acts or omissions of the Contractor, the Contractor's agents, independent contractors, subcontractors at any tier, suppliers at any tier, or a combination thereof. Nothing in this **subsection 108.12** extends the Contractor's liability for these claims beyond that established by law.

(2) The Notice of Acceptance of Contract under **subsection 105.16** does not release the Contractor and Surety from liability to subcontractors and suppliers for work performed or materials supplied on the Project. Nothing in this **subsection 108.12** extends the Contractor's liability for these claims beyond that established in the contract between the Contractor and subcontractor or supplier or beyond that established by law. Nothing in this **subsection 108.12** extends the Surety's liability for these claims beyond that established in the Contract Bond and by law.

SECTION 109

MEASUREMENT AND PAYMENT

109.1 MEASUREMENT OF QUANTITIES

a. General.

- Measure all work using the United States Standard Measure or using the International System of Units (SI), whichever the Contract Documents specify;
- Use generally recognized methods of measurement and computations conforming to good engineering practices; and
- Measure structures according to neat lines shown on the plans or that the Engineer alters.

b. Temperature Corrections.

(1) Correct all measurements to 60ºF, unless the Contract Documents show otherwise.

(2) For asphalt materials:

- Correct asphalt volume to 60ºF using ASTM D1250 or using tables the Asphalt Institute publishes for emulsified asphalt temperature-volume corrections; and
- Measure tar according to ASTM D 633.

c. Measurement by Length.

- Measure items such as pipe culverts, guardrail, underdrains, and similar items by the linear foot parallel to the base or foundation; and
- Measure Stations horizontality by the 100 linear feet.

d. Measurement by Area or Volume.

- Make longitudinal measurements for area computations horizontally;
- Do not deduct for fixtures having an area less than 9 square feet; and
- Make transverse measurements for area computations using neat dimensions shown on the plans, unless the Contract Documents show otherwise.

e. Measurement by Weight.

(1) Equipment. Provide and maintain weighing devices according to **SECTION 152**.

(2) Weight.

- Measure ton as short ton consisting of 2,000 pounds avoirdupois;
- Measure aggregate weight in the saturated surface dry condition;
- For asphalt materials, accept certified scale weights as adjusted for loss from the car or waste;
- Adjust asphalt material weight for loss from foaming; and
- Accept asphalt material weight shipped directly from the refinery if measured with temperature compensating meters.

(3) Weighing Procedures.

- Weigh on accurate and approved scales (see **subsection 152.2**);
- Zero balance scales every day before beginning weighing operations. Make a minimum of 2 random zero balances during the day and record the results;
- Check scales and record results a minimum of 2 times per week. In checking scales, use a roller, motorgrader, or loaded truck and weigh on 2 different scales in the same vicinity. The difference in the 2 scales must not exceed 0.25%. If the difference exceeds 0.25%, recertify the scales according to **subsection 152.2**;
- Make sure the scale operator obtains and records in bound field book a minimum of 2 tare weights each day. (Exception: This is not required if scale operator uses an electronic scale system with an automatic print-out to weigh materials);
- Use either KDOT Form No 251A or Contractor-furnished materials receipts (including print-outs) in quadruplicate including the following required information:
    - Type of material;

- KDOT Project Number;
- Date;
- Truck Number;
- Gross Weight;
- Tare Weight;
- Net Weight;
- Deductions for Moisture (M), Soft friable material (SFM), Wash (W) graduation under 4.00, if applicable;
- Pay Quantity;
- % Total Moisture;
- Location for initials of Scale Inspector; and
- Location for initials of Road Inspector; and

- Complete and sign the KDOT Form No 251A or Contractor-furnished materials receipts.
  - Give original and first copy to the truck driver. Make sure truck driver gives both the original and copy to the designated Inspector. The Inspector will document receiving the tickets by initialing both receipts, retaining the original, and returning the copy to the truck driver;
  - Retain one copy for the Contractor; and
  - Leave the third copy with the scale documentation.

(4) Scale Operators. Do not change scale operators except in circumstances beyond the Contractor's control and after the Engineer approves the change.

f. Other Weight Conditions.
- The Engineer will use weight tickets to initially accept and pay for stored materials shipped by rail or truck. (Final payment will be based on actual weight measured on the Project.); and
- The Engineer will not use truck or rail car weights for materials passed through mixing plants.

g. Materials Measured by Volume.
- Measure volume at point of acceptance;
- Use any size vehicle within the legal weight constraints if volume can be readily determined;
- Load vehicles to their water level capacity;
- At the point of delivery, the Engineer may require the load to be leveled in the vehicle before acceptance; and
- Before the Contractor begins delivering a volume pay item, the Engineer may convert the volume of materials to weight of materials. The Engineer and Contractor shall determine and agree to the weight to volume conversion factors. Use KT methods, when applicable.

h. Miscellaneous Materials Measurements.
- Wire Gage or Gage means the wire size number specified in AASHTO-M32;
- Measure timber by the thousand foot board measure (M.F.B.M.) incorporated into the structure based on nominal width and thickness and the extreme length of each piece; and
- Unless the Contract Documents specify otherwise, the Engineer will accept manufacturer's measurements for standard manufactured items such as fence, wire plates, rolled shapes, and pipe conduit that are identified by gage, unit weight, or section dimensions.

i. Computed Quantities.
(1) Use the following methods to compute volumes of excavation:
- average end area method;
- photogrammetric measurements and computer calculations with the Engineer's approval; or
- other methods the Bureau of Construction and Materials accepts to compute volumes of excavation.

(2) Use standard engineering calculations to compute areas and volumes from measured dimensions.

109.2 SCOPE OF PAYMENT

a. Pay Items. The Secretary will pay unit prices or lump sum prices (contract prices) for the various contract pay items as designated in the Contract Documents.

b. Original Contract Work. Accept payment of the contract prices in the "Schedule of Prices" as full compensation for performing all work necessary to construct or reconstruct the Project and for accepting all risk, loss, damage, and expense for which the Contractor is responsible under the contract.

c. Subsidiary and Incidental Work. The Secretary will not consider subsidiary and incidental items for separate payment. Include costs for subsidiary and incidental work in the contract unit prices or lump sum prices.

d. Price/Pay Adjustment Factors, Damages, and Bonuses. Accept adjustments to contract prices and accept contract deducts, damages, bonuses, incentives, or any combination of these items the Contract Documents specify.

e. Contract Changes. Accept payment for Contract Changes under **SECTION 104**.

109.3 FORCE ACCOUNT PAYMENT

If the parties are unable to agree upon the amount of compensation for extra work, the Secretary may require the Contractor to perform specific work on a force account basis. Compute force account costs as follows:

a. Labor.

(1) Wages.

(a) The wage rate agreed upon in writing before beginning the force account work for the number of hours all workers and foremen are actually engaged in such work.

(b) Contractor’s overhead and profit: The sum of 20% plus the percentage for bond, insurance, and taxes calculated under **subsection 109.3b.** multiplied by the sum of the wages calculated under **subsection 109.3a.(1)(a)**.

(2) Fringe Benefits.

(a) Costs paid for, health and welfare benefits, pension fund benefits, or other such benefits but only if the law, collective bargaining agreement, written employment contract, or Contractor’s written company policy requires payment for such costs.

(b) Contractor’s overhead and profit: 15% of the sum of the allowances in **subsections 109.3a.(2)(a)**.

(3) Subsistence and Travel Allowances.

(a) The actual daily cost per worker paid for subsistence and travel allowances (allowances) agreed upon in writing before beginning the force account work for the days all workers and foremen are actually engaged in such work. If a worker performs the force account work for more than 60% of the worker’s day, KDOT will pay 100% the worker’s daily allowance. If a worker performs the force account work for 60% or less of the worker’s day, KDOT will pay 50% of the worker’s daily allowance.

(b) Subsistence and travel allowances costs are only paid if the law, collective bargaining agreement, written employment contract, or Contractor’s written company policy requires payment for such costs.

(c) Contractor’s overhead and profit: 15% of the sum of the allowances in **subsections 109.3a.(2)(a)** and **(b)**.

b. Bond, Insurance, and Taxes. The rate (shown as a percentage) the Secretary establishes and adjusts periodically for bond costs, unemployment insurance contributions, social security taxes, medicare and insurance premiums (property damage, comprehensive liability, automobile liability, and worker’s compensation) that the force account work causes.

c. Materials.

(1) The actual costs of materials the Engineer approves and the Contractor uses or consumes in the force account work.

(2) Contractor's overhead and profit: 15% of the sum of the material costs calculated under **subsection 109.3c.(1)**.

d. Equipment.

(1) Before beginning the force account work, provide equipment information so that equipment may be identified in the Rental Rate Blue Book for Construction Equipment (Blue Book). The rate to be paid will be the monthly rate set forth in the Blue Book. The Blue Book rate is calculated by dividing the monthly rate for the equipment by 176 and adjusting that rate by Blue Book age and regional adjustment factors before adding in the Blue Book estimated hourly operating cost. The hourly operating cost includes costs for repairs, fuel, and lubricants used or consumed in the force account work.

(2) Transportation costs to and from the site of the work if:

- the equipment is obtained from the nearest approved source;
- the return charges do not exceed the delivery charges;
- haul rates do not exceed the established rates of licensed haulers; and
- the equipment is not already available on the Project.

(3) Standby rates for idle equipment (hourly rental rate minus the hourly operating cost) times 0.5 for equipment not operating during normal working hours if:

- the equipment is used in the force account work; and
- the Engineer orders the Contractor to keep the equipment on the Project.

(4) Contractor's overhead and profit: No allowance will be made for overhead and profit on the items in **subsections 109.3d.(1)**, **(2)** and **(3)**.

e. Limitation on Compensation. The Secretary will not pay superintendents, the use of small tools, or other costs for which no specific allowance is provided in this **subsection 109.3**.

f. Required Verification and Documentation.

(1) Daily, the Contractor's representative and the Engineer shall compare and agree upon the records of labor, equipment, and materials used for the force account work.

(2) To receive payment, provide itemized statements of the costs of such force account work detailed as follows:

- name, classification, date, daily hours, total hours, wage rate, and extensions thereof for each worker and foreman;
- quantities of materials, prices, and extensions thereof and transportation costs for materials. Attach invoices for all materials used or consumed. If the Contractor takes the materials from its own inventory, provide an affidavit certifying that:
  - the material was taken from inventory;
  - the quantity claimed was actually used; and
  - the price and transportation costs claimed represent the Contractor's actual costs; and
- designations, dates, daily hours, total hours, rental rates, and extensions thereof for each unit of equipment and transportation costs for equipment.

(3) If the Engineer cannot verify the itemized statement from KDOT's Project records, KDOT may conduct a complete audit of the Contractor's force account records.

g. Payment of Force Account Work or Negotiated Work Performed by Subcontractors, Leased Trucking, or other Trucking.

(1) The term "work" in this **subsection 109.3g.** means either force account work or work performed on a negotiated price basis, whichever applies.

(2) When all or a portion of the "work" is sublet to a highway industry subcontractor or the Contractor hires subcontractors, leased trucking, or other trucking, the Contractor shall receive overhead in the amount shown in **TABLE 109-1**. The "Dollar Amount of Work" shall be the total amount determined for the subcontractor or leased trucking using the requirements shown in **subsections 109.3a.** through **109.3f.** or the subcontractor's or leased trucking's negotiated price.

TABLE 109-1: ADD ON FOR CONTRACTOR'S OVERHEAD FOR FORCE ACCOUNT WORK OR NEGOTIATED WORK USING HIGHWAY SUBCONTRACTORS, LEASED TRUCKING AND OTHER TRUCKING	
Dollar Amount of Work	**Add on for Overhead to compensate Contractor for administrative expenses incurred in additional subcontract work and additional trucking**
$0 to $50,000	5%
$50,000 to $100,000	$2500 plus 3% for any amount over $50,000
Over $100,000	$4000 plus 1.5% for any amount over $100,000

109.4 STORED MATERIALS PAYMENTS

a. Request payment for properly stored nonperishable materials when the value of the stored material is a minimum of $5,000.00 for each individual item of material, unless otherwise approved by the Engineer. Only include the actual material and shipment costs in the request. Do not include any testing fees, stockpiling costs, sales tax, etc.

- When requesting payment for stored materials, verify the quantity of materials stored and the value of the material. Identify the contract line item numbers (bid items) representing the stored materials and the quantities of stored materials assigned to each designated contract line item number. Provide required certification for all stored materials according to the Contract Documents;
- As the materials are incorporated into the work, the Engineer will measure actual quantities and adjust the stored materials payment by the actual quantities incorporated. Upon receiving each payment voucher (progress payment), verify the accuracy of the stored materials paid for to date and advise the Engineer of any discrepancy; and
- After receiving payment for the stored materials, pay subcontractors and suppliers according to **subsection 109.6**.

b. The Engineer will pay stored materials for nonperishable material the Contractor manufactures using its own forces. Before payment, the Contractor and Engineer shall agree upon and verify the delivery amount and storage location. The Engineer may pay for materials stored properly at a fabricator's or manufacturer's facility if the material is specifically identified for a KDOT Project.

c. The value of stored materials shall not exceed 90% of the contract price for the item of work in which these materials will be incorporated.

d. Assume liability for stored materials lost by deterioration, waste, theft, or other natural or man-made actions.

e. Stored materials payment requests will not be accepted if the material is scheduled for use within 30 days of the request.

109.5 PROGRESS PAYMENTS

a. Work Accomplished. The Engineer will make an approximate estimate of the work accomplished (considering price and pay adjustment factors) and pay for this work (progress payment) at intervals not to exceed one calendar month. Request progress payments at more frequent intervals, if desired. The Engineer may withhold from progress payments liquidated damages, reimbursement for remedial work under **subsection 105.5f.**, excess costs for breach of contract, final cleanup work expenses, and other deducts the Contract Documents specify.

b. Contract Proceeds. Obtain the Engineer's and Surety's written consent to assign contract proceeds to creditors.

c. Payment for Contract Bond. If requested and upon receiving an invoice, KDOT will make payment for the premium amount of the Contract Bond. The payment will be made with the following conditions:

- The premium shall be greater than $5,000.00;

- The invoice shall list the premium for each Project when the invoice includes multiple projects;
- Payment will be shown as "Contract Bond" on intermediate payments; and
- When the Contractor has earned 50% of the "Original Contract Amount", the Engineer will remove the payment for "Contract Bond" from future progress payments.

  Note: The Percent of Original Contract Amount = the amount earned by the Contractor* divided by the total dollar value of the original contract (all bid items).

  *Do not include monies earned for "Contract Bond", "Mobilization", "Traffic Control (Lump Sum)", "Contractor Construction Staking" and "Stored Materials".

109.6 PAYMENTS TO SUBCONTRACTORS & SUPPLIERS

a. Definitions. For purposes of **subsections 109.6** and **109.7**, use the following definitions:

- "subcontract" means a contract for supplies, materials, services, or a combination thereof between a Contractor and a subcontractor; and
- "subcontractor" means an entity that provides the Contractor supplies, materials, services, or a combination thereof to complete the contract.

b. Progress Payments.

(1) Prior to the first progress payment, submit to the Engineer bid item price sheets for 1st tier subcontractors providing services and a copy of materials purchase orders for 1st tier subcontractors providing materials. This information is needed for the Engineer to verify proper payment.

(2) Within 10 calendar days after receiving payment from the Secretary for approved, subcontract work, pay subcontractors for their work.

(3) Within 15 calendar days after receiving payment from the Secretary, submit to the Engineer a "Certificate for Subcontract Work and Payment", KDOT Form No. 1010, containing the following representations:

"I certify that the Contractor received payment from the Secretary on _(date)__ and, within 10 calendar days after this date, paid the subcontractors named below for the work those subcontractors completed on or before the payment voucher's "Paid To Date"." [Signed by Contractor's representative].

Note: More than 1 subcontractor may be shown on KDOT Form No. 1010.

c. Retainage.

(1) Bonded Subcontractors. Withhold no retainage from bonded subcontractors.

(2) Unbonded Subcontractors. Withhold from unbonded subcontractors the percentage of retainage, if any, the Contractor feels is necessary to protect itself. Withhold this retainage until the unbonded subcontractor has completed all its subcontract work and has provided an affidavit that the subcontractor has paid all indebtedness for supplies, materials, and labor used in performing its subcontract work. The unbonded subcontract work is considered completed when KDOT pays the Contractor 100% of the items subcontracted. After the unbonded subcontractor has provided this affidavit, pay all retainage owed within the next 5 business days.

(3) No subcontract provision shall permit the Contractor to delay subcontractors' retainage payments until the Project's final acceptance or final payment.

d. Good Cause Exception. If the Contractor has "good cause" to withhold a subcontractor's progress payment (bonded or unbonded subcontractors) or retainage (unbonded subcontractors), identify the cause for withheld payment, the payment amount, and the anticipated payment date, writing this information on the "Certificate for Subcontract Work and Payment", KDOT Form No. 1010. If the Engineer determines the Contractor has "good cause" for a withheld payment, the Engineer will not impose sanctions on the Contractor. A Contractor's lack of funds to pay is not "good cause" for withheld payment.

109.7 SANCTIONS FOR FAILURE TO PAY PROMPTLY

a. If a Contractor fails to comply with the payment requirements of **subsection 109.6** without good cause, pay an interest penalty to the affected subcontractor. Compute the interest penalty at the rate of 1.5% per month on the amount of money owed the subcontractor. The interest assessment will begin on the day after payment is due under **subsection 109.6** and will continue until the Contractor has paid the amount of money owed the subcontractor.

b. If a Contractor fails to comply with the certification requirements of **subsection 109.6**, the Secretary may impose liquidated damages of $50.00 per calendar day per subcontractor for each day certification is late.

c. If a Contractor submits a certification stating payment has been made but knowing payment has not been made as **subsection 109.6** requires (false certification), the Secretary may impose liquidated damages of $50.00 per calendar day per subcontractor for each day the certification remains false.

d. If a Contractor fails to comply with the payment requirements without good cause, submits a false certification, or repeatedly fails to comply with the certification requirements of **subsection 109.6b.**, the Secretary may adjust a Contractor's qualification rating, declare the Contractor is not a responsible Contractor, suspend a Contractor from bidding, or debar a Contractor from bidding.

e. For each violation of **subsection 109.6**, a Contractor may receive one or more of the sanctions provided.

109.8 PROVISION FOR LOWER-TIER SUBCONTRACTORS

a. Definitions.

- Lower-tier subcontract means a contract for supplies, materials, service, or a combination thereof between a subcontractor and a party other than the Contractor; and
- Lower-tier subcontractor means an entity that provides a subcontractor supplies, materials, services, or a combination thereof to complete a subcontract.

b. Progress Payments. Include in all subcontracts a provision that requires the subcontractor to pay all lower-tier subcontractors within 10 calendar days after the subcontractor receives payment from the Contractor. Include a good cause exception clause to such prompt payment similar to the one contained in **subsection 109.6d**.

c. Retainage. Include in all subcontracts a provision similar to **subsection 109.6c.** that prohibits the subcontractor from withholding retainage from bonded lower-tier subcontractors and requires the subcontractor to release retainage to all unbonded lower-tier subcontractors.

d. Administration. The Contractor is responsible for administering this provision. KDOT will not monitor prompt payments to lower-tier subcontractors. KDOT may investigate payment complaints lower-tier subcontractors make to KDOT.

109.9 FINAL PAYMENT AND CORRECTIONS AFTER FINAL PAYMENT

a. Final Payment. Final payment will reflect the contract amount adjusted by approved contract adjustments (Change Orders) minus all previous payments and deductions. The Secretary will issue final payment after the following events occur:

- the Engineer issues Notice of Acceptance of Contract under **subsection 105.16b.**;
- the Engineer prepares a final estimate of the value of all work;
- the Contractor signs the final estimate;
- the Contractor submits an Affidavit of Contractor, swearing that the Contractor has paid all debt the contract requires;
- the Surety executes a Release of Final Estimate; and
- the Bureau of Construction and Materials reviews the final paperwork, including the signed final estimate.

b. Release of Secretary. By accepting the final payment, the Contractor releases the Secretary from all claims arising out of the work except for claims caused by correction of errors in quantities, measurements, or certifications (payment corrections) discovered after final payment. The Secretary is not released from liability for payment corrections until 3 years from the date of final payment. Nothing in **subsection 109.9** permits the

Contractor to file claims under **SECTION 104** for additional time, additional money, or both after final payment rather than at Notice of Acceptance as provided in **subsection 105.16b**.

c. Release of Contractor and Surety. By issuing final payment, the Secretary releases the Contractor and Surety from further costs necessary to construct the Project except for costs incurred due to latent defects; costs incurred because of the Contractor's breach of warranty, breach of guaranty, fraud, or misrepresentation; and costs resulting from correction of errors in quantities, measurements, or certifications (payment corrections) discovered within 3 years from the date of final payment. See **subsection 108.12** for the Contractor's and Surety's release of liability from further construction obligations after Notice of Acceptance of Contract.

d. Field Audit Corrections. The Contractor and Surety understand that the KDOT Bureau of Fiscal Services audits the Project after final payment rather than before final payment. Despite final payment, the Secretary will correct quantity, measurement, or certification errors discovered during a final audit. If the correction is favorable to the Contractor, the Secretary will pay the Contractor the amount owed. If the correction shows KDOT overpaid the Contractor, pay the Secretary the amount owed. If the Contractor fails to pay the amount owed, the Surety shall pay the amount owed. Neither party nor the Surety has obligations under this **subsection 109.9** after 3 years from the date of final payment. The Surety shall have no claim or defense that KDOT's alleged negligence in computing quantities, computing measurements, or reviewing quantities, measurements, or certifications during construction and before final payment prejudiced the Surety's rights or voided the Surety's obligations under this **subsection 109.9**.

109.10 RESPONSIBILITY FOR PAYMENT

The Secretary will pay for work with warrants as state law allows.

SECTION 151

COMPACTION EQUIPMENT

151.1 GENERAL

Use rollers and compaction equipment of standard manufacture. Use self-propelled rollers capable of reversing direction without backlash. Use rollers with positive, accurate steering control. Use adequately powered trucks or tractors for towed-type rollers. Equip rollers with self-cleaning devices that prevent material from adhering to the wheels, drums or tamping surfaces.

If a numerical density is specified, the Engineer may waive the roller weight requirement if the roller compacts the material to the specified density. If a numerical density is not specified, the Engineer may waive the roller weight requirement, if the roller performed satisfactorily on a previous KDOT project.

151.2 TAMPING (SHEEPSFOOT) ROLLERS

Use either towed or self-propelled tamping rollers that can obtain the required compaction.

Additional requirements for non-vibratory, tamping rollers:

- A metal roller, drum or shell with tamping feet projecting a minimum of 6 ½ inches from the surface of the roller, drum or shell;
- The cross-section area of each tamping foot, measured perpendicular to the axis of the tamping foot, shall be 4 to 12 square inches;
- Tamping feet spaced 6 to 12 inches, measured diagonally center to center; and
- If the tamping roller is used to obtain Type B compaction, the weight is such that the load on each tamping foot is a minimum of 200 pounds per square inch.

151.3 PNEUMATIC-TIRED ROLLERS

Use either towed or self-propelled pneumatic-tired rollers that can obtain the required compaction. Equip with scrapers to remove material buildup from drum surface. Provide the Engineer with a suitable gauge to check the tire pressure of pneumatic-tired rollers.

Additional requirements for pneumatic-tired rollers:

a. Light Pneumatic-Tired Rollers

- Tires with wide, smooth treads and uniform air pressure;
- Tires on the front and rear axles staggered to provide complete coverage of the area the roller travels over; and
- Sufficient weight to provide a minimum of 225 pounds per inch of tire width.

b. Heavy Towed-Type Pneumatic-Tired Rollers

- Tires with wide, smooth treads and uniform air pressure;
- Single axle rollers; and
- A weight of 10 to 50 tons.

c. Heavy Self-Propelled Pneumatic-Tired Rollers

- Tires with wide, smooth treads and uniform air pressure;
- Tires on the front and rear axles staggered to provide complete coverage of the area the roller travels; and
- A weight of 8 to 30 tons.

151.4 SMOOTH-FACED STEEL ROLLERS

Use either towed or self-propelled smooth-faced steel rollers that can obtain the required compaction.

Additional requirements for smooth-faced steel rollers:

a. Smooth-Faced Steel Trench Rollers

- Smooth faces on all steel rollers;

- Equip with water tanks and sprinkling devices to wet the rollers;
- Equip with scrapers to remove material buildup from drum surface; and
- Sufficient weight to provide a minimum of 300 pounds per inch of steel roller width.

b. Towed-Type Smooth-Faced Steel Rollers
- Smooth faces on all steel rollers;
- A minimum of 48 inches effective steel roller width;
- Equip with water tanks and sprinkling devices to wet the rollers;
- Equip with scrapers to remove material buildup from drum surface; and
- Construct so that the weight can be varied from 200 to 300 pounds per lineal inch of steel roller width.

c. Self-Propelled Smooth-Faced Steel Rollers
(1) Two-Axle Tandem Smooth-Faced Steel Rollers
- Smooth faces on all steel rollers;
- Equip with water tanks and sprinkling devices to wet the rollers;
- Equip with scrapers to remove material buildup from drum surface; and
- A weight of 8 to 12 tons.

(2) Three-Axle Tandem Smooth-Faced Steel Rollers
- Smooth faces on all steel rollers;
- Equip with water tanks and sprinkling devices to wet the rollers;
- Equip with scrapers to remove material buildup from drum surface; and
- A minimum weight of 12 tons.

(3) Three-Wheeled Smooth-Faced Steel Rollers
- Smooth faces on all steel rollers;
- Equip with water tanks and sprinkling devices to wet the rollers;
- Equip with scrapers to remove material buildup from drum surface; and
- A weight of 8 to 12 tons.

151.5 SELF-PROPELLED VIBRATORY ROLLERS

Use vibratory rollers that can achieve the required density. Operate the vibratory roller at the frequency and amplitude necessary to achieve the desired compaction without causing objectionable undulations, fracturing of aggregates or surface defects. If pneumatic tires are used on the vibratory roller, equip the roller with smooth tires.

Provide vibratory rollers for use on earthwork and aggregate bases meeting the speed and frequency ranges (vibrations per minute) shown in **TABLE 151-1**. Operate rollers at high amplitude, unless otherwise directed. Coordinate the roller speed and the vibrations per minute to achieve a minimum of 6 impacts per linear foot.

TABLE 151-1: AGGREGATE BASE AND EARTHWORK
Impacts per Linear Foot

Roller Speed MPH (ft./Min)	Vibrations Per Minute							
	1000	1200	1400	1600	1800	2000	2200	2400
1.0(88)	11.4	13.6	15.9	18.2	20.5	22.7	25.0	27.3
1.5(132)	7.6	9.1	10.6	12.1	13.6	15.2	16.7	18.2
2.0(176)	--	6.8	8.0	9.1	10.2	11.4	12.5	13.6
2.5(220)	--	--	6.4	7.3	8.2	9.1	10.0	10.9
3.0(264)	--	--	--	6.1	6.8	7.6	8.3	9.1
3.5(308)	--	--	--	--	--	6.5	7.1	7.8
4.0(352)	--	--	--	--	--	--	6.3	6.8
4.5(396)	--	--	--	--	--	--	--	6.1

On hot mix asphalt pavement, operate the vibratory rollers at a speed and frequency range to provide a minimum of 10 impacts per linear foot, as shown in **TABLE 151-2**. Provide amplitude adjustable rollers. Operate rollers at low amplitude, unless otherwise directed. Provide rollers with a minimum of 1800 vibrations per minute (VPM) and a static force on drums of 135 pounds per linear inch (PLI) of roller width.

TABLE 151-2: HOT MIX ASPHALT PAVING
Impacts per Linear Foot

Roller Speed MPH (ft./Min)	Vibrations Per Minute											
	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000
1.0(88)	20.5	22.7	25.0	27.3	29.5	31.8	34.1	36.4	38.6	40.9	43.2	45.5
1.5(132)	13.6	15.2	16.7	18.2	19.7	21.2	22.7	24.2	25.8	27.3	28.8	30.3
2.0(176)	10.2	11.4	12.5	13.6	14.8	15.9	17.0	18.2	19.3	20.5	21.6	22.7
2.5(220)	8.2	9.1	10.0	10.9	11.8	12.7	13.6	14.5	15.5	16.4	17.3	18.2
3.0(264)	6.8	7.6	8.3	9.1	9.8	10.6	11.4	12.1	12.9	13.6	14.4	15.2
3.5(308)	5.8	6.5	7.1	7.8	8.4	9.1	9.7	10.4	11.0	11.7	12.3	13.0
4.0(352)	5.1	5.7	6.2	6.8	7.4	8.0	8.5	9.1	9.7	10.2	10.8	11.4
4.5(396)	4.5	5.1	5.6	6.1	6.6	7.1	7.6	8.1	8.6	9.1	9.6	10.1
5.0(440)	4.1	4.5	5.0	5.5	5.9	6.4	6.8	7.3	7.7	8.2	8.6	9.1

Operate rollers at a speed and frequency range above the bold line.

151.6 MECHANICAL AND HAND TAMPERS

Use mechanical or hand operated tampers of standard manufacture that can obtain the required compaction in small, irregular areas where the use of conventional equipment is impracticable.

SECTION 152

HAULING AND WEIGHING EQUIPMENT

152.1 HAULING EQUIPMENT

a. Aggregate Hauling Equipment. Use vehicles with dump bodies of standard manufacture, designed for dumping materials in windrows or into spreader boxes. Use vehicles with bodies constructed and maintained to prevent loss of materials during the hauling operations. Equip the vehicles with dump controls operated from the driver's seat.

b. Hot Mix Asphalt Hauling Equipment. Use vehicles with dump bodies of standard manufacture, designed for dumping materials in windrows or into spreader boxes. Use vehicles with smooth metal bodies constructed and maintained to prevent loss of materials during the hauling operations. Equip the vehicles with dump controls operated from the driver's seat.

During the hauling operations, apply a thin coat of an approved material to prevent the hot mix asphalt from adhering to the beds. The Engineer must approve the coating material before it is used. Do not use petroleum derivatives for coating the beds. Remove any excess coating material before loading the hot mix asphalt into the bed.

Equip each vehicle with a tarpaulin to protect the hot mix asphalt from the weather. Use tarpaulins that are waterproof and free of holes and tears. Use tarpaulins large enough to cover the top of the load and extend down over the sides and tailgate of the vehicle. Use enough tie-down points to secure the tarpaulin to the vehicle and prevent flapping in the wind, during the hauling operations. The Engineer may approve alternate methods of securing the tarpaulin, provided the hot mix asphalt is completely covered, and the tarpaulin is secured.

c. Water Hauling and Distributing Equipment. Use pneumatic-tired water equipment (calibrated tanks of 1000 gallon capacity or larger) equipped with spray bars and pressure pumps to haul and distribute water. Equip all water tanks with control valves that are operated from the driver's seat. Provide the Engineer with the means to verify the calibration of the water tanks.

The requirement for the pressure pump may be waived on force account projects, subgrade modification projects and fly ash treated subgrade projects.

Water may also be transported by pipelines equipped with calibrated meters placed as close to the point of delivery as possible. Provide the Engineer with the means to verify the calibration of the water meters.

152.2 WEIGHING EQUIPMENT

Use and maintain weighing devices (mechanical or electronic) at locations approved by the Engineer. Have the weighing devices tested and certified by a licensed service company.

Have the licensed service company test and certify the weighing devices according to:

- all applicable laws for commercial weighing and measuring devices;
- the appropriate Examination Procedure Outline (EPO) prescribed by the Kansas Department of Agriculture, Division of Weights and Measures; and
- the weighing devices shall be accurate to within 0.25% throughout the range of use.

Have the weighing devices tested and certified:

- after each setup and before being used on the project (except for small units such as 3 sack mixers which are moved frequently);
- at 6 month intervals during the life of the project;
- when the weighing devices are repaired; and
- at any other time deemed necessary by the Engineer.

Arrange the beams, dials, platforms and other scale equipment for safe and convenient viewing by the operator and the Engineer. Provide and maintain scale houses as necessary. Install and maintain vehicle scales with the platform level, and rigid bulkheads at each end. Use a platform of adequate length to weigh (in 1 operation) the longest truck or truck-trailer combination used on the project. Maintain the approaches to the scale platform.

Provide certified test standards (a minimum of 500 pounds) for use on the project.

For weighing procedures and scale operator requirements see **SECTION 109**.

SECTION 153

MIXING PLANT FOR STABILIZED BASE AND SHOULDERS

153.1 CENTRAL MIXING PLANT

Use a stationary mechanical mixing plant designed to blend component aggregates and distribute the required moisture uniformly throughout the mixture. Provide the Engineer with the means to verify the calibration of the plant.

153.2 TRAVELING MIXING PLANT

Use a traveling mechanical mixing plant designed to blend component aggregates and distribute the required moisture uniformly throughout the mixture without damaging the subgrade. Provide the Engineer with the means to verify the calibration of the plant.

SECTION 154

CONCRETE PAVEMENT AND CONCRETE STRUCTURE EQUIPMENT

154.1 CONCRETE BATCHING AND MIXING EQUIPMENT

a. Batching Equipment. Use standard manufacture batching equipment consisting of bins, weighing hoppers and weighing devices. Use batching equipment designed and constructed to discharge freely, thus eliminating accumulation of materials in bins or weighing hoppers. Use batching equipment with bins that have separate compartments for each size of aggregate.

Use weighing devices that are tested and certified according to **subsection 152.2**. If the cement (or fly ash) is measured by weight, use a weighing device and weighing hopper separate from those used for other materials. Equip the cement or fly ash weighing hopper with a sealed and vented cover to prevent dusting during operation.

b. Central and On-Site Concrete Mixers. Use standard manufacture concrete mixers capable of combining aggregate, cement (or fly ash) and water (and admixtures, if any) into a uniform mixture within the specified mixing period. Use mixers capable of discharging the concrete without segregating the mixture.

Additional requirements for central and on-site concrete mixers:

- A manufacturer's plate attached to the mixer listing the capacity of the drum (volume of mixed concrete) and the speed of rotation of the mixer drum or blades;
- A timing device that automatically locks the discharge lever when the drum is charged, and releases it at the end of the mixing period;
- A warning device, either audible or visible, that signals the release of the discharge lever (end of the mixing period);
- An automatic water-measuring device (measured either by weight or volume, accurate within 1% of the quantity required) capable of discharging the desired quantity of water into the mixer drum; and
- A semi-automatic, air-entraining agent measuring device capable of discharging the desired quantity of air-entraining agent into the flow (of the mixing water) of the water discharge line.

Provide the Engineer with the means to verify the calibration of the concrete mixers.

Clean the mixers at suitable intervals. Periodically examine the concrete mixers for changes in condition. Acceptable concrete mixers shall consistently produce well mixed, uniform concrete.

c. Truck Mixers and Truck Agitators.

(1) Truck Mixers. Use standard manufacture truck mixers capable of combining aggregate, cement (or fly ash) and water (and admixtures, if any) into a uniform mixture within the specified number of revolutions. Use truck mixers capable of discharging the concrete without segregating the mixture.

Unless the truck mixer is equipped with automatic measuring and dispensing devices for water and air-entraining agent, use central measuring and dispensing equipment as specified in **subsection 154.1b**.

Additional requirements for truck mixers:

- A drum of such size that the rating (volume of concrete) does not exceed ⅔'s of the gross volume (disregarding the blades) of the mixer;
- For truck mixers with automatic water measuring devices, use a water measuring device (accurate within 1% of the quantity required) capable of discharging the desired quantity of water into the mixer drum;
- A manufacturer's plate attached to the mixer listing the manufacturer's recommended operating speed for mixing or agitating. If the mixer is used both for mixing and for agitating, the maximum speed for agitation shall be less than the minimum mixing speed; and
- A revolution counter that indicates the number of revolutions of the drum or the blades.

(2) Truck Agitators. Use standard manufacture truck agitators capable of agitating and discharging the concrete without segregating the mixture.

Additional requirements for truck agitators:

- A drum of such size that the rating (volume of concrete) does not exceed 80% of the gross volume (disregarding the blades) of the agitator;

- A manufacturer's plate attached to the agitator listing the manufacturer's recommended operating speed for agitating; and
- A revolution counter that indicates the number of revolutions of the drum or the blades.

(3) Provide the Engineer with the means to verify the calibration of the truck mixers and agitators.

Clean the truck mixers and truck agitators at suitable intervals. Periodically examine the truck mixers and agitators for changes in condition. Acceptable truck mixers (agitators) shall consistently produce (deliver) well-mixed, uniform concrete. If the Engineer questions the performance of a truck mixer (or truck agitator), slump tests from samples taken at the beginning, the mid-point and the end of the load, may be conducted. If the results of the slump tests vary more than ½ inch when the average slump is 3 inches or less, or more that 1 inch when the average slump is greater than 3 inches, the Engineer will reject the truck mixer (or truck agitator) until it is cleaned and repaired.

d. Continuous Volumetric Concrete Mixers. Use standard manufacture continuous volumetric concrete mixers capable of combining aggregate, cement (or fly ash) and water (and admixtures, if any) into a uniform mixture within the specified mixing period.

Additional requirements for continuous volumetric concrete mixers:

- A capacity to carry (in separate compartments for each ingredient) enough of each individual ingredient to produce a minimum of 6 cubic yards of concrete;
- The capability of producing a thoroughly mixed uniform concrete that complies with the consistency requirements of **DIVISION 400**;
- A recording meter capable of measuring the cement as it is introduced into the mixture.
- An adjustable flow control valve capable of controlling the flow of water and admixture as they are introduced into the mixture;
- A water flow meter capable of indicating to the nearest 0.10 gallons, the quantity of gallons used; and
- The capability of being calibrated to automatically proportion and blend all components of the concrete mixture on a continuous or intermittent basis, as required.

Calibrate the continuous volumetric concrete mixer according to the manufacturer's recommendations. Provide the Engineer with the means to verify the calibration of the continuous volumetric concrete mixer.

The Engineer will allow operation of the continuous volumetric concrete mixer, provided the concrete produced is within the limits of the specifications.

e. Small-Quantity Concrete Mixers. Use standard manufacture small-quantity concrete mixers capable of combining aggregate, cement (or fly ash) and water (and admixtures, if any) into a uniform mixture. Use self-powered concrete mixers capable of mixing a volume of concrete that requires 1 sack (minimum) of cement.

The Engineer must approve the mixer before it is used. Clean the mixers at suitable intervals. The Engineer will periodically examine the concrete mixers for changes in condition. Acceptable concrete mixers shall consistently produce well mixed, uniform concrete.

f. Non-Agitating Units. Use standard manufacture, non-agitating units capable of transporting and discharging the concrete without segregating the mixture. Use non-agitating units that have smooth, watertight bodies with rounded corners.

Clean the non-agitating units at suitable intervals. The Engineer will periodically examine the non-agitating units for changes in condition. Acceptable non-agitating units shall consistently deliver and discharge non-segregated concrete.

g. Continuous Blending Concrete Plants. Use a plant that continuously blends materials by volume in a continuous mixer.

Additional requirements for continuous blending concrete plants:

- The capability of producing a thoroughly mixed uniform concrete that complies with the consistency requirements of **DIVISION 400**;
- A recording meter capable of measuring the cement and aggregate as they are introduced into the mixture.

- A flowmeter to measure the rate of water added to the mixture. The rate shall be adjustable to control consistency of the mix.
- A flowmeter to measure the rate of admixture added to the mixture.
- The capability of being calibrated to automatically proportion and blend all components of the concrete mixture on a continuous or intermittent basis, as required.

Calibrate the continuous blending concrete plant according to the manufacturer's recommendations. Provide the Engineer with the means to verify the calibration of the continuous blending concrete plant. Provide the Engineer with documentation from the admixture supplier on the compatibility of adding the admixture in a continuous blending concrete plant.

The Engineer will allow operation of the continuous volumetric concrete mixer, provided the concrete produced is within the limits of the specifications.

154.2 VIBRATORS

a. General. Provide the proper testing equipment to determine the frequency of the impulses of the vibrators. See **subsection 154.5** for vibrator monitoring systems used in slip form paving.

b. Vibrators Used With Epoxy Coated Reinforcing Bars. In addition to the vibrator requirements for different uses, when epoxy coated reinforcing steel is involved, use vibrators with heads of rubber or other resilient material. Rubber covers securely fastened over steel heads are acceptable. The requirement does not apply to dowel bars and tie bars for pavement.

c. Vibrators for Structures. Use internal type (spud or tube) vibrators. Use vibrators with frequencies of vibration of a minimum of 8000 cycles or impulses per minute under load, and with adequate amplitude to consolidate the concrete. Use vibrators that can enter the forms and operate around the reinforcing bars.

Do not use vibrators designed for use on the forms or the reinforcing bars.

Use of any internal type vibrator is contingent upon its ability to properly consolidate the concrete.

d. Vibrators for Bridge Decks. Use a mechanical device on which internal type (spud or tube) vibrators (of the same type and size) are mounted with maximum spacing of 12-inch centers. Mount the vibrators so that the vibrators enter the concrete in a vertical position under the influence of their own weight, with enough flexibility to work themselves around the reinforcing bars. The mechanical device may be mounted on the finishing machine or on an independent framework pulled along the grade rails.

Additional requirements for vibrators for bridge decks:

- The diameter of the head of the vibrator shall be 1 ¾ to 2 ½ inches;
- The frequency of vibration under load shall be 8,000 to12,000 vibrations per minute;
- The average amplitude shall be 0.025 to 0.05 inch; and
- The minimum radius of action shall be a minimum of 7 inches.

To verify compliance, provide the Engineer with a copy of the manufacturer's specifications for each type and brand of vibrator used on the project.

e. Vibrators for Rigid Pavement. Use either internal type (spud or tube) vibrators or surface type (pan or screed) vibrators. Use vibrators mounted on the concrete spreader, the finishing machine or a separate carriage. Use vibrators capable of vibrating the full depth of the rigid pavement without coming in contact with the joint, load transfer device, subgrade or forms. Vibrators should operate only when the machine the vibrators are attached to is moving.

Additional requirements for vibrators for rigid pavement:

- The frequency of vibration of surface, pan or screed vibrators shall be a minimum of 3,500 cycles per minute;
- The frequency of vibration of immersion tube vibrators attached to the paving machine shall be a minimum of 5,000 cycles per minute; and
- The frequency of vibration of immersion spud vibrators (both hand operated and gang mounted) shall be a minimum of 8,000 cycles per minute.

154.3 SUBGRADE TRIMMERS

a. Fixed Form Subgrade Trimmer. Use a standard manufacture subgrade trimmer that rides on the fixed forms. Use a subgrade trimmer capable of cutting (with a continuous cutting edge) the subgrade to the specified cross-section. Do not use subgrade trimmers with spikes or teeth (scratch planers).

b. Slip Form Subgrade Trimmer. Use a standard manufacture subgrade trimmer that is automatically controlled (from a reference system) in regard to both line and grade.

154.4 FIXED FORM PAVING EQUIPMENT

a. Concrete Spreader. Use equipment to uniformly spread the concrete while maintaining a head of concrete.

b. Concrete Finishing Machine. Use a standard manufacture self-propelled concrete finisher capable of spreading and consolidating the concrete to the specified cross-section. The concrete finisher may be mounted on the same carriage as the concrete spreader.

The use of any concrete finishing machine is contingent upon its performance. If any finishing machine fails to produce the specified cross-section or consolidation, the Engineer may require adjustment, repair or replacement of the machine.

154.5 SLIP FORM PAVING EQUIPMENT

Use standard manufacture, slip form paving equipment capable of spreading, consolidating, screeding and float finishing freshly placed concrete in one pass. Use slip form equipment capable of producing a homogeneous pavement to the specified cross-section, profile and density.

Use slip form paving equipment that is automatically controlled (from a reference system) in regard to line and grade.

Use an automated electronic vibrator monitoring system on all mainline paving. (This system is not required on shoulders, if a separate paver is used strictly for shoulders.) Use a system capable of displaying the operating frequency of each individual internal vibrator. Equip the monitoring device with a readout display near the operator’s controls visible to the paver operator and the Inspector. Operate the monitoring device continuously while paving, and display all vibrator frequencies with manual or automatic sequencing among all individual vibrators.

Use slip form paving equipment equipped with traveling side forms. The traveling side forms shall trail behind the paver a sufficient distance to prevent edge slump of the concrete pavement. The top finishing edge of the traveling side forms shall have a maximum radius of ¼ inch.

Use all the component parts recommended by the manufacturer of the slip form paving equipment (paving train).

If any unit of the paving train shall operate on adjacent pavement, protect the adjacent pavement.

154.6 LONGITUDINAL FINISHER

Use a standard manufacture, longitudinal finisher capable of producing a smooth surface to the specified cross-section. The longitudinal finisher may operate either mechanically or manually.

Adjust and operate the longitudinal finisher (in conjunction with the finishing screed) so that a small roll of mortar is carried ahead of the float.

154.7 CONCRETE PAVEMENT TEXTURING EQUIPMENT

a. Burlap Drag. Use a drag consisting of a seamless strip of damp burlap, artificial turf or cotton fabric. Use a drag that produces a uniform, gritty texture when pulled longitudinally along the full width of the pavement.

Use only drags that are clean and free of encrusted mortar.

b. Transverse Grooving Equipment. Use standard manufacture transverse grooving equipment capable of transversing the width of the pavement in a single pass. Use transverse grooving equipment with a metal comb that is capable of producing a uniform pattern of transverse grooves approximately 3/16 inch wide, spaced at ¾ inch centers and ⅛ to ¼ inch deep.

The Engineer may accept transverse grooving equipment with a fluted float (instead of a metal comb) provided the fluted float produces transverse grooves similar in dimension to the requirements of the metal comb.

Small or irregular areas may be grooved by hand methods.

c. Longitudinal Grooving Equipment. Use standard manufacture, longitudinal grooving equipment capable of covering the width of the pavement in a single pass. Use longitudinal grooving equipment with a metal comb that is capable of producing a uniform pattern of longitudinal grooves approximately 3/16 inch wide, spaced at ¾ inch centers and ⅛ to ¼ inch deep.

The Engineer may accept longitudinal grooving equipment with a fluted float (instead of a metal comb) provided the fluted float produces longitudinal grooves similar in dimension to the requirements of the metal comb.

Small or irregular areas may be grooved by hand methods.

154.8 CONCRETE CURING COMPOUND DISTRIBUTOR

Use standard manufacture concrete curing compound distributors capable of continually mixing and uniformly spraying liquid membrane-forming compounds at the minimum rate of 1 gallon per 150 square feet of surface. Use concrete curing compound distributors capable of spraying both the surface and the edges of the slab at the same time.

154.9 CONCRETE SAWING EQUIPMENT

Use standard manufacture concrete sawing equipment capable of making cuts to the specified dimensions. Use concrete saws with either water-cooled diamond-edge blades or abrasive wheel blades.

Other sawing devices are based on acceptable performance, and with the approval of the Engineer.

Keep at least one stand-by saw and an adequate supply of blades on the project during the sawing operations.

SECTION 155

ASPHALT SURFACING AND ASPHALT RECYCLING EQUIPMENT

155.1 EQUIPMENT FOR HEATING ASPHALT MATERIALS

a. Use equipment for heating asphalt materials at project asphalt plant sites by one of the following methods:

- Circulate steam, hot gases or hot oil through coils of a tank.
- Circulate the asphalt material around a system of heated coils or pipes.
- Circulate the asphalt material through a system of coils or pipes enclosed in a heated jacket.
- Other approved means subject to the requirements of this specification.

Construct the heating device to prevent direct flame from striking the surface of the coils, pipes or jacket through which the asphalt material is circulated. Operate the heating device in a manner that shall not damage or change the characteristics of the asphalt material.

b. Railroad tank cars or truck tankers that have defective coils, or from which the coils have been removed, shall be rejected by the Engineer, unless the Contractor can provide satisfactory auxiliary means for heating the asphalt material without contamination and introducing moisture. Do not use a tanker connection or any other equipment by means of which free steam can be introduced directly into the asphalt material as a means of agitation or auxiliary heating.

155.2 ASPHALT DISTRIBUTOR

a. Use equipment for the distribution of asphalt materials equipped with the following:

- Tachometers;
- Pressure gauge;
- Adjustable length spray bars;
- Separate power unit and pump on the distributing system or hydrostatic drive system;
- Heating coils and burner;
- Thermometer well and accurate thermometer;
- Measuring sticks; and
- Quick opening gate in the dome.

Mount all distributors and supply tanks on trucks or trailers equipped with pneumatic tires. Design the units so that no rutting or other injury to the road surface shall result. Provide sufficient power to maintain the desired speed of the equipment during operation.

The tachometer designating the speed of the truck shall be a separate operating unit attached to the truck. Equip the tachometer with a large gauge approximately 5.5 inches in diameter and graduated in units so the speed of the truck can be determined within limits of approximately 10 feet per minute. Locate the gauge so that it can be easily read at all times by both the driver and the Engineer.

Equip the distributor with either a tachometer attached to the pump shaft and calibrated to indicate revolution per minute, or a pressure gauge placed in the distributing system and calibrated to indicate pounds per square inch or gallons per minute by which the flow of asphalt materials can be regulated.

The spray bars and nozzles shall be constructed to accomplish the following:

- Permit adjustment for length in increments of 1 foot for any length up to 16 feet;
- Permit vertical adjustment of all nozzles to the desired height above the road surface and conforming to the roadway crown;
- Permit lateral shifting of the entire spray bar during operation;
- Prevent clogging of the nozzles; and
- Provide positive and immediate cut-off when distribution of asphalt material ceases.

The power unit and pump distribution system requirements are as follows:

- Capacity of a minimum of 250 gallons per minute;

- Equipped with a bypass into the supply tank;
- Capable of distributing a uniform and constant flow of asphalt material through all nozzles at a pressure between 30 to 50 pounds per square inch; and
- Capable of being calibrated and adjusted to accurately distribute asphalt material within 0.01 gallon per square yard for any quantity from 0.1 to 1 gallon per square yard.

b. Calibrate and check all distributors before using on a KDOT project. The calibration of the tank and preparation of the certificate shall be performed by the DME in the District in which the distributor is first used. Provide all equipment, materials and assistance necessary for the calibration.

The DME will give a certificate of approval to the distributor operator indicating the record of the calibration and check. Keep this certificate in the distributor at all times and make it available to the Engineer in charge on each project on which the distributor is used. Failure to present the certificate shall require a re-check, and if deemed necessary, a re-calibration of the distributor before it may be used on a project. The certificate may be revoked at any time due to unsatisfactory performance of the distributor. It shall be returned only when satisfactory repairs or adjustments have been made.

Each subsequent year, the operation of the distributor must be checked by the Engineer the first time it is used. When the operation is found to be satisfactory, the distributor may be used. The Engineer making the check will sign and date the certificate.

155.3 STORAGE OR SURGE BINS

a. When a storage or surge bin is used with any type of plant, the following items are required as a minimum.

(1) Design, equip and use the bin to prevent segregation.

(2) Protect the belt leading from the drum discharge to the bin to prevent heat loss due to wind blowing on the material.

(3) Use a “Gob-Hopper” or other type of device approved by the Engineer to help prevent segregation of the mix as it falls into the bin or silo.

(4) Use a Tel-Tale device located at the top of the tapered portion of the bottom of the bin to indicate when the level of the asphalt mixture in the bin has been lowered to that point. In the case of special designed bins (such as full length tapered bins), locate the device at the point designated by the Engineer. Do not lower the mixture below this point except to clean out the bin, when plant operations are being terminated at the end of the day and such other times as deemed necessary by the Engineer.

Interconnect the Tel-Tale device with the controls of the gate in the bottom of the bin to close the gate automatically when the mixture in the bin has been lowered to the level of the Tel-Tale device. Provide a means of over-riding these controls solely for the purpose of cleaning out the bin at the termination of plant operation. The material in the bottom of the bin below the device may be used when the bin is cleaned out, provided the Engineer approves the material.

(5) Do not keep hot asphalt mixtures in storage or surge bins longer than 3 hours without prior approval by the Engineer.

b. See **subsection 155.6a.(6)** for use of surge or storage bins.

c. If the Engineer determines that segregation is occurring, use of storage or surge bins may be prohibited.

155.4 ASPHALT PAVER

Acceptable asphalt pavers are self-contained, power-propelled units, equipped with an automatically controlled activated screed or strike-off assembly, and heated if necessary. They are capable of spreading and finishing courses of asphalt material in lane widths applicable to the specified section and thickness shown in the Contract Documents. Pavers used for shoulders and similar construction shall be capable of spreading finishing courses of asphalt material to the width shown in the Contract Documents.

Equip the paver with an approved automatic screed control system capable of grade reference and transverse slope control. The automatic controls shall include a system of sensor operated devices that sense and follow a reference line or surfaces on one or both sides of the paver as required. Maintain the screed at the proper elevation at each end by controlling the elevation of one end while automatically controlling the transverse slope, or by controlling the elevation of each end independently.

With the screed or strike-off assembly, produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture.

Equip the paver with a receiving hopper having sufficient capacity for a uniform and continuous spreading operation. Equip the hopper with a distribution system to place the mixture uniformly in front of the screed. Pickup attachments used to feed the hopper may not exert any vertical load on the paver and shall be capable of picking up and loading substantially all of the material on the surface.

When laying mixtures, the paver shall be capable of being operated at variable forward speeds consistent with satisfactory laying of the mixture.

155.5 MATERIAL TRANSFER DEVICE

Mobile conveyors, shuttle buggies, material transfer vehicles, materials transfer paver and pick-up devices are considered material transfer devices. Provide a self-propelled material transfer device, capable of moving independent of the paver or attached to the paver. Equip the materials transfer device to perform additional mixing of the material, and then deposit the mixture into the paver at a uniform temperature and consistency.

Paver hopper inserts shall be required when spillage of the HMA occurs during transfer of the material.

155.6 HOT MIX ASPHALT (HMA) PLANTS

Plants used for the manufacture of HMA shall consist of a drum mix plant, batch plant or continuous mix plant. Provide equipment complying with the requirements specified below, having capacity to adequately handle the proposed asphalt construction, and meeting the approval of the Engineer.

Continued use of any hot mix plant is on the condition that the Contractor is fully responsible for producing material that complies with contract requirements.

a. Requirements for All HMA Plants.

(1) Uniformity. Design, coordinate and operate the plants to produce a uniform mixture.

(2) Proportioning Equipment. The Engineer may require locking or sealing of any automated proportioning equipment that can be manually manipulated.

(3) Heating and Storage Tanks for Asphalt Material. Use storage tanks for asphalt material that have sufficient capacity to provide for continuous operation. They shall be capable of uniformly heating and holding the asphalt material at the required temperature range without damaging or changing its characteristics. Direct flame against the tanks is prohibited. Design the circulating system to obtain proper and continuous circulation during the operating period. Provide an accurate procedure for determining the amount of asphalt material in the tanks at any time. Document and substantiate the calibration data. Situate and construct the tanks so the level of material can be safely and accurately measured at any time. Set the tanks as nearly level as possible. Include a means of obtaining samples of asphalt material from the delivery line to the plant in the system.

(4) Cold Feed Aggregate Bins. Provide separate cold feed bins for each aggregate size used, unless blending is permitted by methods approved by the Engineer. Use cold feed bins with sufficient capacity to maintain a continuous flow of material. Construct the bins to prevent any spilling or leakage from one bin to another. Each bin shall have a belt feeder equipped with an adjustable gate or an adjustable drive, or both, that can be calibrated and controlled. Provide a uniform distribution of aggregate on the conveyor belt. Equip each bin with a device that shall detect any reduction or interruption of aggregate flow and actuate a visual or audible signal at locations approved by the Engineer.

(5) Thermometric Equipment. Equip the plant with a sufficient number of thermometric instruments to control the temperature of the aggregate and the asphalt material. Use instruments capable of recording temperature on a chart over each 24-hour period with a maximum chart gradation of 15 minutes and 10ºF. Use a 24-hour clock or designate AM and PM on the chart. The Engineer shall retain all temperature records as part of the contract records. Install the units separate from the plant in a readily accessible location.

Locate the actuating unit for recording temperature either in the storage tank or in the feed line between the pump and the discharge valve.

Locate the actuating unit for recording aggregate temperature and HMA as specified for each type of plant.

(6) Use of Storage Bins and Batchers. When used with a storage bin, design and operate these plants so the transfer of HMA from the drum to the storage bin shall not cause segregation of the mix, and the batcher can be operated according to **subsection 602.4a.(3)(d)**.

Equip all storage bins with controls capable of maintaining a specified minimum level or amount of HMA in the bin at all times during production.

If the amount of HMA in the bin can be determined by reading the output of load cells or other approved sensors, the Engineer shall specify the minimum amount of material in tons. Otherwise, the minimum level of HMA is the top of the tapered portion of the bin or at the point designated by the Engineer on special designed bins.

Set the controls to close and lock the bin gate when the specified minimum amount or level is reached. Override of the lock is permitted only to clean out the bin at the end of a production run.

Equip every storage bin with a batcher at the top, located so the HMA is discharged vertically from the batcher into the center of the bin. The Engineer may approve other equipment such as a rotating chute. Do not load the storage bin directly from a belt or other conveyor. Cover the belts carrying HMA to prevent excess heat loss.

Establish control of the batcher gates so the batcher shall operate as specified in **subsection 602.4a.(3)(d)** throughout the output range of the plant.

(7) Dust Collectors. Equip the plant with an approved dust collector, bag house or other type of collector that complies with limit particulate emissions standards.

Dispose of all waste material in a suitable manner.

Equip the plant to prevent particulate leakage.

(8) Air Emission Permit. Provide a copy of an Air Emission Permit issued by the Kansas Department of Health and Environment (KDHE) to the Engineer before installing a hot mix plant. It is the Contractor's responsibility and expense to satisfy the KDHE requirements.

(9) Safety Requirements. Provide adequate and safe access to sampling points and other locations where checking of plant operations is necessary. Thoroughly guard and protect all gears, pulleys, chains, sprockets and other dangerous moving parts. When required by the Engineer, provide access to the top of truck bodies by a platform or other suitable device to enable the Engineer to obtain samples and temperature data.

b. Requirements for Drum Mix Plants.

(1) General. Specifically design the plant for drum mixing and to be capable of satisfactorily heating, drying and mixing the HMA.

(2) Cold Aggregate Feed System. Use belt scales for positive weight measurement of the combined cold aggregates. Continuously record the amount of cold aggregate using a non-set-back recorder. The belt scale shall be accurate within 2% by weight of the material being measured over any given period of time. Calibrate the belt scales at intervals as directed by the Engineer. Provide a weight system automatically coupled with the asphalt flow to maintain the required proportions.

(a) Sampling. Provide safe, adequate and convenient facilities for obtaining representative samples of the combined cold aggregate. Provide a sampling device capable of producing a sample of proper size (large enough to be representative, but small enough to be carried safely by 2 people) from the full width of the combined aggregate flow, while the plant is operating at regular production rate.

(b) Recycled Material Conveyor. If the plant is used for recycling, a weighing system is required to control delivery of virgin aggregate and recycled material components to the drum. Equip the system with interlocking mechanisms that shall accurately deliver virgin aggregates, Reclaimed Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS) in proper proportions. Belt scales for the RAP and RAS shall comply with **subsection 155.6b.(2)**.

(c) Moisture Compensation. Include a moisture compensation device in the cold feed system to correct for the moisture in the aggregate passing over the belt scales.

(d) Weather Protection. Protect belt scales from the effect of wind and weather.

(3) Asphalt Material Feed System. Supply asphalt material to the mixing drum through a continuously registering cumulative indicating meter by a pump specifically designed for drum mix plants. Locate the meter in the asphalt material so it shall register the discharge to the drum. Provide a means to divert the flow into a container for calibration. Supply the meter with a non-set-back register accurate within 2% by weight of the material measured in any given period of time. The register shall record only material delivered to the drum.

(4) Mineral Filler Feed System. Introduce and uniformly disperse fly ash and similar mineral fillers into the drum mixer at the point of introduction of the asphalt without loss to the dust collector system. Use a non-set-back register to record the quantity of mineral filler discharged into the mixer. Equip the delivery system with

variable speed to interlock with the aggregate weigh belt so the total aggregate weight including the mineral filler is indicated to the asphalt proportioning system. Provide a device to indicate that mineral filler is being delivered uniformly to the drum that shall activate a visible or audible signal to the plant operator if the flow is reduced or interrupted.

(5) Calibration of Feed Systems. Enable easy calibration of the aggregate weighing system and the asphalt material meter system. The calibration methods are subject to approval by the Engineer, who may require a schematic diagram of the system.

(6) Mixing Drum. Equip the drum with automatic burner controls to prevent damage to the aggregate or asphalt material. Keep the discharge temperature of the mixture within the range specified in **DIVISION 600** for the type of asphalt material being used. Install the activating unit for recording the asphalt mixture temperature in the discharge chute of the drum mixer.

Use a rate of flow through the drum such that the aggregate and asphalt material form a homogeneous mixture with all particles uniformly coated. Do not exceed the manufacturer's rated capacity.

c. Requirements for Hot Mix Batch Plants.

(1) Dryer. Include one or more dryers in the plant that continuously agitate the aggregate during the heating and drying process. Use dryers that dry and heat all aggregate to specified requirements.

(2) Aggregate Temperature. Install the actuating unit for recording the aggregate temperature where the hot materials flow over it during the proportioning operation.

(3) Hot Aggregate Storage Unit. Configure the unit so the aggregate shall not be segregated and can be discharged into the weigh hopper in a manner that shall not affect the accuracy of weighing.

(4) Weigh Box or Hopper. Include a means for accurately weighing the aggregate in a weigh box or hopper suspended on scales, and of ample size to hold a full batch without running over. The gate shall close tightly so no material is allowed to leak into the mixer while a batch is being weighed.

(5) Asphalt Control. The weigh bucket shall be non-tilting with a loose sheet metal cover. Make the length of the discharge opening or spray bar greater than ¾ the length of the mixer, and make it discharge directly into the mixer. Heat the asphalt material bucket, its discharge valve or valves and spray bar. Provide an asphalt material bucket with a capacity a minimum of 15% in excess of the weight of asphalt material required in any batch. Have a heated quick-acting, non-drip, charging valve located directly over the asphalt material bucket.

Locate a scale dial with a capacity of a minimum of 15% in excess of the quantity of asphalt material used in a batch in full view of the mixer operator. Automatically control the flow of asphalt material to begin when the dry mixing period is over, and all of the asphalt material required for one batch shall be discharged in less than 15 seconds after the flow has started. If an approved metering device is used to control the amount of asphalt material, provide a valve and outlet for checking the meter in the section of line between the charging valve and the spray bar.

(6) Scales. Scales may be of the beam, springless dial or electronic type that complies with **subsection 152.2**. Equip beam scales with a Tel-Tale dial that shall start to function when the load being applied is within 100 pounds of that required. The dials shall be compounding, with full complements of index pointers. Do not place dials to give excessive parallax errors. Locate all dials to be plainly visible to the operator at all times.

(7) Control of Mixing Time. Equip the mixer:

- with an accurate time lock to control the operations of a complete mixing cycle;
- to lock the weigh box gate after charging the mixer until the mixer gate closes at completion of the cycle; and
- to lock the asphalt material bucket throughout the dry mixing period and lock the mixer gate throughout the dry and wet mixing periods.

The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the start of introduction of asphalt material. The wet mixing period is the interval of time between the start of introduction of asphalt material and the opening of the mixer gate.

Perform the setting of time intervals in the presence of the Engineer. The Engineer will then lock the case covering the timing device until such time as a change is to be made in the timing device.

(8) Mixer. Use an approved type of batch mixer capable of producing a uniform mixture.

If not enclosed, equip the mixer box with a dust hood to prevent loss of dust.

The clearance of blades from all fixed or moving parts may not exceed 1 inch, if the maximum size of the aggregate is less or equal to 1 inch. The clearance may not exceed 1 ¼ inches, if the maximum size of the aggregate in the mix exceeds 1 inch.

155.7 SELF-PROPELLED AGGREGATE SPREADER

Use a spreader that is supported by a minimum of 4 wheels with pneumatic tires on 2 axles. Equip the spreader with a means of applying the larger cover coat materials to the surface ahead of the smaller cover coat material so that the required amount of material is deposited uniformly over the full width of the asphalt material.

155.8 SURFACE RECYCLE EQUIPMENT

a. Pre-Heating Unit. Use a self-propelled heating unit, adjustable in width, with ports permitting fuel and forced air injection for proper combustion without excessive smoke. The unit shall be under a closed or shielded hood, capable of heating asphalt pavement to a temperature that allows milling or scarifying to the specified depths. Equip each unit with a water spray system used to wet the adjacent vegetation.

b. Heating Milling Unit. Use a self-propelled unit capable of milling, heating and windrowing the asphalt pavement that is being processed, and meeting **subsection 155.8a**. In addition, equip this unit with automatic grade controls to mill the desired depth of material to be processed.

c. Heating Scarifying Unit. Use a self-propelled unit capable of heating and scarifying the asphalt pavement that is being processed, and meeting **subsection 155.8a**.

d. Tunnel Heater. Use a self-propelled unit capable of heating the underlying pavement while shielding the previously milled material from direct flame, preventing the material from catching on fire and meeting **subsection 155.8a**. The tunnel heater may be equipped with a milling unit. In this case, the tunnel heater shall also meet **subsection 155.8b**.

e. Distributor-Paving Unit. Use a single unit that uniformly distributes the rejuvenator at the stipulated rate onto the scarified or milled material and mixes them together using a minimum of 2 telescopic milling heads. This equipment also screeds and finishes the scarified or milled material similar to an asphalt paver specified in **subsection 155.4**.

f. Milling-Mixing-Paving Unit. Use a unit complying with **subsection 155.8b**. The rejuvenator shall be added uniformly at the stipulated rate onto the scarified or milled material and mixed with a minimum of 2 telescopic milling heads. Alternatively, the rejuvenator may be added directly to the milling heads provided the applied rate is uniform across the width of the HIR material. This equipment shall also screed and finish the scarified or milled material similar to an asphalt paver specified in **subsection 155.4**. Alternatively, a self propelled independent paver complying with the asphalt paver specification in **subsection 155.4** may be used after the mixing operation.

155.9 COLD RECYCLED ASPHALT PAVEMENT EQUIPMENT (LIME SLURRY/FLY ASH)

a. General. Provide a self-propelled machine capable of cutting and removing the asphalt pavement (to the dimensions specified in the Contract Documents) in one pass. Equip the cutting machine with automatic controls capable of maintaining a uniform grade and cross slope.

Equip to pulverize the reclaimed asphalt pavement (RAP) material to specified requirements without contamination from the subgrade material. The RAP material processing unit shall consist of a closed loop system with a crusher and a scalper screen, or other approved devices capable of reducing the RAP material to the specified gradation.

Provide the mixing unit with a continuous weighing system for the processed RAP material, and be coupled with meters to maintain the proper proportion of RAP material, liquid binder, set retarder (used only with fly ash) and water. Meter all water (including water added by the milling machine) introduced into the mix. If delivery of RAP material is stopped, automatically shut off the liquid binder, set retarder (used only with fly ash) and water pumps. Provide positive means for calibrating the weight measurement device and the additive metering devices.

Apply the additives in a mixing chamber that is capable of mixing the pulverized pavement material and additive to a homogeneous mixture. Equip the additive system to maintain the binder amount within plus or minus 0.2% of the specified application rate and to shut off automatically if delivery of RAP material is stopped. Place the mixture in a windrow or load it into trucks so segregation does not occur.

Place the recycled mixture without segregation using a self-propelled asphalt paver complying with **subsection 155.4**. If a pick-up machine is used to feed the windrow into the paver hopper, provide one capable of picking up the entire windrow down to the underlying materials.

Provide self-propelled vibratory steel and pneumatic rollers to establish the rolling procedure. The vibratory steel roller may also be used as a static steel roller.

b. Lime Slurry. Equip the milling chamber with spray bars to incorporate hydrated lime slurry and water into the RAP. The metering device for the spray bars is calibrated to, and controlled by the continuous weighing system for the RAP.

Provide slaking equipment specifically manufactured for this purpose. Equip transport, tank trucks or trailers with mechanical agitators.

c. Fly Ash. Provide equipment to introduce set retarder and water into the mix independent of one another.

155.10 HOT POUR CRACK SEALANT EQUIPMENT

Provide a machine used for pouring cracks, capable of mixing the asphalt and rubber or other specified material in the specified proportions into a homogeneous mixture at the specified temperatures. Use a double boiler melter with a permanently attached temperature gauge to continuously verify sealant temperature in the material tank. Do not use units with a solvent flush system for clean out, due to the risk of solvent contamination to the sealant. Use a melter with a heat chamber for hose storage and valve heating, or an air flush system to eliminate the need for a solvent flush clean-up system. Provide material tank mixing with a reversible paddle agitator in a vertical tank configuration. Use units similar to those purchased by KDOT Maintenance under Spec: MS 168, latest version.

155.11 MODIFIED SLURRY SEAL EQUIPMENT

a. Mixing Equipment. Use a self-propelled mixing machine capable of delivering and proportioning the aggregate, mineral filler, water, additives and emulsified asphalt to a revolving multi-blade dual mixer, and discharging the thoroughly mixed product. Provide storage capacity for all components to maintain a supply in the proportioning controls. Operate the machine continuously while loading, to eliminate unnecessary construction joints.

Provide individual volume or weight controls for proportioning each material to be added to the mix. Calibrate and properly mark each material control device. Provide controls accessible for ready calibration and placed so the Engineer may determine the amount of each material used at any time.

Equip the mixing machine with a water pressure system and nozzle spray bar to provide a water spray immediately ahead of and outside the spreader box as required.

Equip the machine with opposite side driving stations to optimize longitudinal alignment. Equip the machine to allow the mix operator to have full control of the forward and reverse speed during application of the material.

b. Spreading Equipment. Equip the machine with opposite side driving stations to optimize longitudinal alignment. Configure the machine to allow the mix operator to have full control of the forward and reverse speed during application of the material.

Spread the paving mixture uniformly by means of a mechanical laydown box attached to the mixer and equipped with paddles to agitate and spread the materials through the box. Design and operate the paddles so all the fresh mix shall be agitated to prevent the mixture from setting up in the box or causing side buildup and lumps. Flexible seals in the front and rear shall be in contact with the road to prevent loss of mixture from the box.

Equip the box with lateral movement controls. The rear flexible strike-off shall be adjustable. Rut filling equipment requires adjustable steel strike-off plates. Design and operate the spreader box and rear strike-off so a uniform consistency is achieved to produce a free flow of material to the rear strike-off without causing skips, lumps or tears in the finished surface. When directed by the Engineer, provide a secondary strike-off to improve surface texture. Use a secondary strike-off with the same adjustments as the rear flexible strike-off. Spread the mixture to fill cracks and minor surface irregularities and leave a uniform application of slurry on the surface. When directed by the Engineer, provide a secondary strike-off to improve surface texture. The secondary strike-off shall have the same adjustments as the rear flexible strike-off.

Operate the spreader to prevent the loss of the paving mixture when surfacing super-elevated curves. Keep the box clean and free of build up of asphalt and aggregate.

SECTION 156

ROADSIDE IMPROVEMENT EQUIPMENT

156.1 SEEDING EQUIPMENT

a. Seeding Drills. Use drills for roadside seeding and fertilizing in good working order so that the rate of seed and fertilizer is applied at the rates shown in the Contract Documents. Two or more separate seed compartments may be necessary for seeding certain projects. Provide seed compartments capable of the accuracy needed to obtain the seeding rates shown for the various grasses, wildflowers and legumes listed in the Contract Documents. Use a drill that can apply commercial grass seed and wildflower seed, or a drill with attachments that would allow the application of fertilizer, grass seeds and wildflower seeds at the rate and depth specified in the Contract Documents. The drill must be approved by the Engineer. The Engineer will approve the width of the drill on the basis of the area to be seeded. The space of seed-tubes, disks and boots shall be a maximum of 8 inches. Provide drills that accurately control the depth of seeding and fertilizer placement to a maximum depth of ½ inch. Construct the seed and fertilizer compartments with partitions to prevent the material sliding to one side of the drill while operating on steep slopes.

If a separate cultipacker is not used, use a seed drill with press wheels.

b. Hydraulic Slurry Seeding, Fertilization and Mulching. Provide machines used for hydraulic seeding operations with continuous agitation of the slurry mixture during seeding operations. Equip with pressure to force seed and mulch material to the right-of-way line of most typical highway sections. The minimum tank capacity is 750 gallons.

156.2 MULCHING EQUIPMENT

a. Mulch Puncher. Use mulch punchers so weight may be added or hydraulic force from the tractor to push the puncher into the ground. Use notched discs with a minimum diameter of 16 inches for punching purposes. Provide discs that are flat or uncupped like notched coulters commonly used on moldboard plows. Place discs a maximum of 8 inches apart along the axle or shaft. Use shaft or axle sections of disks with a maximum of 8 feet in length.

156.3 OTHER ROADSIDE IMPROVEMENT EQUIPMENT

a. Cultipacker. Use cultipackers constructed so that sections are a maximum of 6 feet in length. Pull a maximum of 3 sections behind a tractor or drill at any time

b. Root "Sprigger". Acceptable spriggers are constructed so the root planting mechanism is driven by the tractor's power take-off to maintain a constant planting of roots on steep slopes. The machine shall be capable of planting roots in a continuous unbroken pattern. The Engineer will check the machine on a slab or hard ground with the power take-off running to determine if enough roots are being fed through the machine.

SECTION 157

OTHER EQUIPMENT

157.1 REBAR INSERTION EQUIPMENT

a. Drilling Equipment. Use equipment that complies with the following requirements:

- Hydraulic driven
- Capable of operation in a clockwise direction;
- Truck or trailer mounted;
- Adjustment in transverse and longitudinal directions;
- Capable of operating at a pitch of 45º;
- A power system to raise and lower the bit; and
- Removal of loose material by drill shaft vacuum extraction during drilling.

b. Epoxy Pump. Use a pump system that the manufacturer has certified to deliver a proper mixture of specific material properties and a given resin to hardener ratio. The given ratio is supplied by the epoxy manufacturer.

The pump may be adaptable for variable mixture ratios. It shall maintain the ratio set for a temperature range of 40 to 120ºF and a pressure range of 20 to 100 pounds per square inch. The pump shall include the separate A and B supply hoses along with their respective back-flow prevention valves.

c. Epoxy Mixer. Provide epoxy mixer with adequate elements to thoroughly mix the resin and hardener components and be capable of operating within the same temperature and pressure ranges as the pump system. Use an easy to clean mixer constructed of semi-transparent materials in order to observe the mixing operation.

d. Injection Nozzle Assembly. Provide an injection nozzle capable of temporarily locking into the 1 inch diameter hole in the concrete and holding a minimum sustained pressure of 100 pounds per square inch without significant surface leakage. A design for a suitable assembly is available from the Bureau of Construction and Materials.

157.2 UNDERSEALING EQUIPMENT

a. Grout Plant. Provide a grout plant consisting of a positive displacement cement injection pump and a high speed colloidal mixing machine. Provide a mixing machine that operates between 800 and 2000 RPM, creating a high-shearing action with a subsequent pressure release to make a homogeneous mixture. Provide a pressure measuring gauge in the grout supply hose.

b. Drill. Provide an air compressor and rock drills or other devices capable of drilling the injection holes through the PCCP.

157.3 JOINT AND CRACK SEALING PCCP AND HMA EQUIPMENT

a. Air Compressor. Use an air compressor with a minimum capacity of 100 cubic feet per minute at 90 psi with a ⅝ inch hose (minimum). Use oil-free compressed air.

b. Applicator. For concrete pavement, use a sealant applicator head that completely fills the joints and cracks.

For asphalt pavement, use a sealant applicator head that completely fills the cracks.

c. Heating Pot. Prepare the material in a heating pot (400 gallon minimum capacity) equipped with an agitator that shall provide a proper mixing pattern to keep a consistent percent of fiber and maintain the heat distribution throughout the pot. Use equipment recommended by the sealant manufacturer.

d. Heat Lance. Use a heat lance manufactured by SEAL-ALL, L.A. HEAT LANCE, or another brand approved by the Engineer.

201 – CLEARING AND GRUBBING

SECTION 201

CLEARING AND GRUBBING

201.1 DESCRIPTION

Clear and grub the vegetation and debris as specified in the Contract Documents.

DO NOT clear and grub areas unless work will actively be performed in the exposed area (or portions of the exposed area) within 7 calendar days on exposed steep slope areas (40% or greater) or within 14 calendar days for all other exposed areas.

BID ITEM	UNITS
Clearing and Grubbing	Lump Sum

201.2 MATERIALS

Backfill stump holes using granular material or loose friable soil from the project. Use material that is free of excess moisture, frozen lumps, roots, sod, rocks greater than 4 inches in diameter or other deleterious material.

The Engineer will accept the backfill material based on visual inspection.

201.3 CONSTRUCTION REQUIREMENTS

Do not damage any vegetation designated to remain. The Engineer will identify any trees, shrubs and other vegetation designated to remain. Remove low hanging, unsound or unsightly branches on trees and shrubs designated to remain as specified in the Contract Documents. Trim the branches according to recognized industry practices.

Within the construction limits, clear and grub all vegetation not designated to remain. Undisturbed stumps and roots no more than 6 inches above the original ground line or low water level may remain, provided they are a minimum of 3 feet below the finished subgrade or embankment slope and approved by the Engineer.

Strip and stockpile the existing topsoil from within the construction limits. To the extent practical, use this material to cap the finished embankment and cut slopes. This work is subsidiary to grading items in the contract.

Where practical, do not store equipment or materials (including soil stockpiles) within 50 feet of rivers, streams or other surface waters. Where such storage is necessary, obtain the Engineer's written approval and include in the project SWPPP appropriate best management practices for the storage area.

Unless requested in writing from the Contractor, and approved in writing by the Engineer, or specified otherwise in the Contract Documents, do not exceed 750,000 square feet of surface area of erodible earth material per equipment spread at one time. The Engineer will limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow (within right-of-way) and embankment operations. Limit the exposed erodible earth material according to the capability and progress, and in keeping with the approved schedule.

Areas will not count toward the 750,000 square feet limit, when the following conditions are met:

For areas that will not be disturbed again due to project phasing:

- Finish grade the completed area;
- Stabilize and maintain stabilization according to **SECTION 902**; and
- Do not disturb the area again without a written request from the Contractor and written approval from the Engineer;

For areas that will be disturbed again due to project phasing:

- Rough grade; and
- Stabilize and maintain stabilization according to **SECTION 902**.

DO NOT clear and grub areas unless work will actively be performed in the exposed area (or portions of the exposed area) within 7 calendar days on exposed steep slope areas (40% or greater) or within 14 calendar days for all other exposed areas. If areas are cleared and grubbed and not finish graded, not part of project phasing and no meaningful work toward the completion of the bid item is performed within the exposed area (or portions of the exposed area) for 7 calendar days on exposed steep slope areas (40% or greater) or 14 calendar days for all other exposed areas, stabilize and maintain stabilization at these exposed areas according to **SECTION 902** at no cost to KDOT.

Remove and dispose of the cleared vegetation and debris. If authorized by the Engineer, dispose of the cleared vegetation and debris on the right-of-way.

Backfill and compact all stump holes, except in areas of excavation. Backfill the stump holes to the level of the surrounding ground. If the backfill area is within the limits of the new construction, compact the backfill to the type of compaction and within the moisture range designated in the Contract Documents.

Provide temporary erosion and pollution control according **DIVISION 900**.

201.4 MEASUREMENT AND PAYMENT

The Engineer will measure the clearing and grubbing as a lump sum.

Stabilization of finished areas will be measured and paid for under **DIVISION 900** bid items. Exempt areas specified in **subsection 201.3** will not be measured for payment.

Payment for "Clearing and Grubbing" at the contract unit price is full compensation for the specified work.

SECTION 202

REMOVAL OF EXISTING STRUCTURES

202.1 DESCRIPTION

Remove and dispose of the existing structures as specified in the Contract Documents. Existing structures include the structures identified in the Contract Documents for removal, and man-made structures not specifically identified in the Contract Documents that are in conflict with the new construction and would normally be encountered upon a careful examination of the work site. Excluded are utilities and structures for which other provisions are made for removal.

Protect any structures designated to remain.

Remove, clean and store any materials designated for salvage.

Remove, clean, store and reconstruct any existing structures as designated in the Contract Documents.

Inspect all building structures that are scheduled for removal, and determine if asbestos is present.

BID ITEMS	UNITS
Removal of Existing Structures	Lump Sum
Removal and Reconstruction of Existing Structures	Lump Sum

202.2 MATERIALS

a. Backfill Material. Backfill cavities created by removing existing structures, using granular material or loose friable soil from the project. Use material that is free of excess moisture, frozen lumps, roots, sod, rocks greater than 4 inches in diameter or other deleterious material. The Engineer will accept the backfill material based on visual inspection.

b. Materials to Reconstruct Existing Structures. Provide the specified materials that comply with the materials' divisions (**SECTIONS 1000 – 2500**).

If the existing structure is damaged during the removal operations, replace any damaged materials with new materials matching the originals.

202.3 CONSTRUCTION REQUIREMENTS

a. Removal of Existing Structures. Raze, remove and dispose of all existing man-made structures and debris not designated to remain.

If the substructure of an existing structure lies wholly or partly within the limits of a new structure, remove the existing substructure to accommodate the new structure. Remove the existing substructure to the natural stream bottom, or 12 inches below the natural ground surface or new finished lines, whichever is lower.

Unless the area is excavated during the new construction, backfill to the level of the surrounding ground and compact all cavities left by the structure removals. If the backfill area is within the limits of the new construction, compact the backfill to the type of compaction and within the moisture range designated in the Contract Documents.

Provide temporary erosion and pollution control according to **DIVISION 900**.

b. Removal and Reconstruction of Existing Structures. Before removing the existing structures designated for relocation, take sufficient measurements and color photographs of the existing structures so the reconstruction duplicates the original. Provide the Engineer with copies of the measurements and photographs.

Submit for the Engineer's approval, a written plan for the relocation and reconstruction of the existing structures, before beginning any relocation and reconstruction work. Reconstruct the structure according to the details in the Contract Document.

c. Existing Bridge Deck. Designate one Prime Contractor employee as the Removal Supervisor. The Removal Supervisor, or their designee, must be on location any time work is performed on removal of the existing structure.

Before performing any work to remove the deck, schedule a pre-work meeting with the Engineer. Include the Removal Supervisor and key personnel who will be working on the removal item. Discuss a detailed procedure of how removal will be accomplished and how damage to the structure will be avoided.

Remove the deck or any portion of the deck without damaging the girders.

Clearly mark the location of the existing girder top flanges on top of the existing deck concrete. Mark the entire length of all girders before sawing or removing any concrete. Limit concrete sawing to a maximum depth of 3 inches directly above any girder and within 3 inches of either edge of a girder top flange. Do not use drop-type pavement breakers. Do not use a hoe ram directly above any girder or within 1.0 foot of either edge of a girder top flange. Use a jackhammer no heavier than 15 pounds to remove concrete above and within 1.0 foot of either side of a girder top flange.

Also, see **SECTION 737 - CONTROLLED DEMOLITION**.

Damage includes, but is not limited to saw cuts, dents, cracks, distortion or any other damage found by the Engineer. This also includes spalling of prestressed concrete beams that would require repair.

If the girder is damaged:

- The Engineer, in coordination with the State Bridge Office (SBO), will determine if the damages require repair. The Engineer will determine what repairs are required for minor nicks, dents, cuts and spalls not affecting the structure capacity.
- If any damage requires additional engineering, hire an independent engineer, licensed in Kansas to develop repair plans, provide structural analysis and stress calculations (including fatigue calculations), and submit sealed calculations to the SBO for review and approval.
- The Contractor's independent engineer shall evaluate the capacity of any damaged members, and submit sealed calculations showing any capacity loss of damaged members.
- Submit a copy of the repair plan, per **SECTION 105**, sealed by a licensed Professional Engineer, to the SBO for approval.
- After repairs have been completed, the Contractor's independent engineer shall evaluate the capacity of any repaired members, and submit sealed calculations showing any capacity loss of repaired members.
- The ideal situation is to repair any damage so there is no structure capacity loss. Structure capacity loss would be a reduction of the controlling load rating capacity for the structure. If there is minor capacity loss, and KDOT deems this loss acceptable, KDOT will assess a Contract Deduct. See **subsection 203.4**. In this case, the Contractor has the option to either accept the deduction or repair to eliminate any capacity loss.

The Contractor is responsible for all repairs to the damaged girders as authorized by the Engineer, plus any materials, equipment, labor, delays and traffic from the damage or repair. If damage is severe, additional engineering and inspection fees incurred by KDOT may also be deducted.

d. Salvaged Materials. The salvaged material will remain the property of the State, County or City, as applicable. If not shown in the Contract Documents, the Engineer will designate the storage areas.

Remove the material in sections or pieces that can be transported and stored. Dismantle steel and wood bridges designated in the Contract Documents. Match mark the salvaged steel members, unless the Engineer waives this requirement.

Unless shown otherwise in the Contract Documents, salvage and clean all existing pipe determined usable by the Engineer.

If during the removal and transport to the storage area, the Contractor damages material designated as salvage, the Engineer will deduct 60% of the current quoted price for replacement material delivered to the project from payments due the Contractor.

e. Asbestos Removal. Inspect all building structures that are scheduled for removal, and determine if asbestos is present. Sample, test, remove and dispose of asbestos, while complying with all Federal and State regulations, laws, rules and ordinances pertaining to asbestos removal and waste disposal. File all appropriate notification forms and any required permits with Federal and State authorities, and pay all related fees. Provide the Engineer copies of all notification forms, correspondence, test results, recommendations and other information to document compliance with these requirements.

202.4 MEASUREMENT AND PAYMENT

The Engineer will measure the removal of existing structures and removal and reconstruction of existing structures by the lump sum. The initial inspection of building structures to determine if asbestos is present is subsidiary to these bid items.

If the Contract Documents identify asbestos in the removal of building structures, asbestos removal is subsidiary to "Removal of Existing Structures". If asbestos removal is not shown in the Contract Documents, but is required after the initial inspection indicates the presence of materials containing asbestos, the asbestos removal will be paid for as Extra Work, **SECTION 104**.

Payment for "Removal of Existing Structures" and "Removal and Reconstruction of Existing Structures" at the contract unit price is full compensation for the specified work.

When existing bridge deck damage is severe, KDOT inspection and engineering fees will be assessed under the bid item "Contract Deduct".

If after repairs are made, there is a reduced capacity for the structure, KDOT will assess an additional "Contract Deduct". The Contract Deduct will be calculated by multiplying the percent loss of capacity (calculated after repair) times the total contract price of all bridge bid items (reinforcing steel, structural steel, concrete, expansion joints, etc.) for the structure.

SECTION 203

RESETTING EXISTING CULVERTS

203.1 DESCRIPTION

Remove and reset the existing culverts and end sections as specified in the Contract Documents.

BID ITEMS	UNITS
Resetting End Section	Each
Resetting Pipe Culvert	Linear Foot

203.2 MATERIALS

Provide the required materials that comply with **SECTIONS 1000 – 2500**.

203.3 CONSTRUCTION REQUIREMENTS

Remove the designated structures without damaging. Store and protect the structure from damage, if the structure is not reset immediately. Replace, in kind, any structures or materials damaged or lost.

Clean all structures before resetting.

Reset the structures at the locations shown in the Contract Documents. Excavate for, place and backfill the structures according to **SECTION 204**.

203.4 MEASUREMENT AND PAYMENT

The Engineer will measure each removal and resetting of an existing end section.

The Engineer will measure the removal and resetting of an existing pipe culvert by the linear foot of culvert reset.

Payment for "Resetting End Section" and "Resetting Pipe Culvert" at the contract unit prices is full compensation for the specified work.

If, upon removal, the Engineer determines that the existing culvert or end section is damaged, and the damage is not a result of the Contractor’s actions, the Engineer will pay for the replacement of the culvert or end section as Extra Work, **SECTION 104**.

SECTION 204

EXCAVATION AND BACKFILL FOR STRUCTURES

204.1 DESCRIPTION

Excavate for the structures as shown in the Contract Documents. Unless specified otherwise, backfill the completed structures to the original ground line.

BID ITEMS	UNITS
Class * Excavation	Cubic Yard
Concrete for Seal Course (Set Price)	Cubic Yard
Foundation Stabilization	Cubic Yard
Foundation Stabilization (Set Price)	Cubic Yard
Granular Backfill	Cubic Yard
Granular Backfill (Wingwalls) (Set Price)	Cubic Yard
Granular Backfill (Wingwalls) (Set Price)	Cubic Yard
Water (Grading) (Set Price)	M Gallon

*Class of Excavation

204.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete .... **SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade .... **DIVISION 1102**
Aggregates for Backfill .... **DIVISION 1100**
Water .... **DIVISION 2400**

Provide sand, or other aggregate that contains sufficient binder to allow compaction and limit the flow of water through the material, as granular material for culvert bedding. Provide material with enough moisture to allow compaction. The Engineer will accept the granular bedding material based on visual inspection of the material placed on the project.

204.3 CONSTRUCTION REQUIREMENTS

a. Classification of Excavation.

(1) Class I Excavation and Class II Excavation. Excavation for bridges is normally classified as Class I and Class II Excavation. Class I and Class II Excavation is referenced to the Excavation Boundary Plane (a horizontal plane at a given elevation) shown in the Contract Documents.

(a) Class I Excavation is the entire volume of whatever nature, except water, found above the Excavation Boundary Plane, within the limits specified.

(b) Class II Excavation is the entire volume of whatever nature, including water, found below the Excavation Boundary Plane, within the limits specified.

(2) Class III Excavation. Bridge excavation not classified as Class I or Class II, is classified as Class III Excavation. Excavation for structures other than bridges is also classified as Class III Excavation.

Class III Excavation is the entire volume of whatever nature encountered, including water, within the limits specified. The water level for determining quantities is the water level during construction at which pumping or bailing is necessary to continue excavation.

b. Excavation Requirements.

(1) General. Allow the Engineer to define the limits of the excavation and cross-section the original ground before beginning the excavation for the structure.

Excavate all foundations to the elevations and dimensions shown in the Contract Documents. If rock of the quality that will not erode is encountered in the toe wall excavation, the Engineer may allow the toe wall to be keyed into the rock.

Follow OSHA safety regulations for sloping the sides of excavations, using shoring and bracing as required.

If material encountered below the foundation elevation will not support the structure, remove such material and replace with stable backfill material approved by the Engineer.

Save excavated material for structure backfill. Dispose of surplus excavated material and excavated material unsuitable as backfill material.

Provide temporary erosion and pollution control according to **DIVISION 900**.

When a bridge is constructed in conjunction with a new roadway alignment or elevation, construct the roadway embankment (a minimum of 300 feet) at the bridge to approximate grade first, then excavate for the abutments.

(2) Cofferdams. Use watertight cofferdams if excavating in water, or if the excavation is affected by groundwater. Construct and shore the cofferdams according to OSHA safety regulations. The minimum size of the cofferdams shall be greater than the limits for pay excavation. Extend the cofferdams below the bottom of the footing, or at least to an elevation as near the bottom of the excavation as foundation conditions will allow. If necessary, dewater the cofferdams.

(3) Foundations with Piling. Complete the foundation excavation before driving any piling. After driving all piling, remove the loose and displaced material in the foundation pit. If necessary, reshape and recompact the bottom of the excavation according to the Contract Documents.

(4) Spread Footing Bridge Foundations. From the elevation that rock or shale is encountered or from the top elevation of the footing, whichever is lower, excavate the footing as shown in the Contract Documents. No side forming is allowed below the top elevation of rock or shale, or below the top of the footing, whichever is lower. Cut spread footing bridge foundations in rock to within 6 inches of the bottom of footing elevation. Complete the excavation to the required elevation, using hand equipment. Do not use blasting excavation below the top of footing elevation.

If the bottom elevation of the spread footing excavation is in shale, minimize the time the shale is exposed to the elements before placing the concrete footing. Place the concrete footing within the time limits designated in the Contract Documents. Contact the Regional Geologist if the shale exposure exceeds the maximum time specified.

Mitigate the effects of the shale exposure by excavating a minimum of 4 inches below the over-exposed shale to expose sound material. The Contractor has the option (at own expense) to negate the time limits imposed for exposure of the shale by placing a 4-inch (minimum) concrete seal of Grade 4.0 concrete over the exposed shale before the specified time limits expire. If the Contractor chooses this option, excavate to 4 inches below the plan bottom of footing elevation so the bottom of footing elevation remains at the elevation designated by the Contract Documents.

After the excavation is completed, and all loose material is removed from the footing, drill exploratory borings 1½ to 2 inches in diameter and 5 feet deep to verify the quality and soundness of the material below the bottom of the footing. Notify the Engineer before starting the exploratory borings.

- For footings with an area of less than 12 square yards, drill the boring in the center of the footing.
- For footings with an area of 12 square yards or greater, drill a boring within 3 feet of each corner of the footing.

If an exploratory boring encounters unsound material, or if the material at the bottom of the footing does not match the material shown on the geology sheet in the Contract Documents, do not proceed with the construction of the spread footing until the site is reviewed by the Regional Geologist and a recommended course of action made.

c. Foundation Stabilization. When designated in the Contract Documents, the Contractor has the option to construct the foundation stabilization 6 inches thick, according to the details shown, or underrun the item when deemed unnecessary. When conditions require, the Engineer may approve a depth greater than 6 inches.

d. Foundation Stabilization (Set Price). If the Contract Documents do not designate foundation stabilization and a firm foundation is not encountered at the established grade for boxes or pipe culverts, the Engineer may approve the removal of unsound material and installation of suitable foundation stabilization material.

Before this work is done, the Engineer will determine the limits of excavation for the material removal.

e. Concrete Seal Course (Set Price). When designated in the Contract Documents, construct the concrete seal course according to the details shown.

When the Contract Documents do not show a concrete seal course, but the bottom of the excavation can not be pumped free of water, the Engineer may approve the placement of a concrete seal course. When approved by the Engineer, construct a 3-inch seal course of commercial grade concrete below the bottom of footing elevation. If the Contract Documents call for foundation stabilization, and the Engineer determines the conditions require a concrete seal course as specified above, underrun the foundation stabilization. The Engineer will consider alternate methods of sealing out the water. The burden of proof regarding an alternate method of sealing out the water will be on the Contractor.

If a concrete seal course is not shown in the Contract Documents, or the Engineer does not approve one, the Contractor may still place one at own expense.

When the Contract Documents show constructing foundation stabilization, the Contractor has the option to construct a concrete seal course in its place. However, the concrete seal course will be paid for as foundation stabilization at the contract quantity and unit price.

If a concrete seal course is constructed, uniformly consolidate the concrete without voids.

f. Backfill for Structures.

(1) General. Do not place backfill against any structure without the Engineer's approval.

Remove all shoring, bracing and cofferdams before backfilling a structure.

Use material from the structure excavation or material from the roadway excavation for the backfill of structures. If necessary, adjust the moisture content of the soil by adding water to or aerating the material.

Place granular backfill as detailed in the Contract Documents. If the area for granular backfill is excavated beyond the theoretical limits of the granular backfill, fill the over-excavation with granular backfill material suitable for the conditions, and that meets the Engineer's approval. Do not use hydraulic methods of backfill.

After the designated cure period for a concrete structure expires, wait at least 3 days before subjecting the structure to the pressures of backfilling or to live loads. If adverse curing conditions exist, the Engineer may extend this period.

Provide for drainage at all weep holes in concrete structures. Unless drainage is provided for otherwise in the Contract Documents, place approximately 2 cubic feet of crushed stone or sand gravel at each weep hole.

Place the backfill in horizontal layers evenly on all sides of the structure, a maximum of 8 inches thick (loose measurement). If the backfill is placed on only one side of a structure (such as abutments, piers, wingwalls), do not put excessive pressure against the structure. Prevent wedging action against the structure during the backfill. Bench the slopes bounding the excavation.

Extend each layer of the backfill to the limits of the excavation or to the original ground line. Continuously level and manipulate the material during the placing and compacting of each layer of the backfill. Use a motorgrader where possible. Compact each layer as specified before placing the next layer.

Drain all water from areas before backfilling. If backfill compaction is not required for piers, it is not necessary to drain the water from the pier excavations before backfilling.

If it is impossible to drain the water, deposit thin layers of backfill material into the water. When placing backfill material into water, the compaction requirements do not apply until the backfill progresses to the point that all water is absorbed by the backfill material.

Unless otherwise shown in the Contract Documents, backfill compaction is not required around piers, except piers adjacent to railroad tracks, roadways or in the toe slopes of embankments.

If the Contract Documents provide for "Compaction of Earthwork", compact the backfill according to **SECTION 205**. If the Contract Documents do not provide for compaction, compact the backfill according to Type B compaction in **SECTION 205**.

If the Contract Documents designate a moisture range for the embankment adjacent to the structure, use backfill material with uniform moisture content within the specified range according to **SECTION 205**. If the Contract Documents do not designate a moisture range, use backfill material with uniform moisture content adequate to produce the specified density.

(2) Backfill of Reinforced Concrete Box. If the top of a reinforced concrete box extends above the original ground line, continue the compacted backfill to the top of the reinforced concrete box. Place the backfill 10 feet wide on each side of the culvert for the full width of the roadway embankment.

(3) Granular Backfill (Wingwalls) (Set Price). When designated in the Contract Documents, construct the granular backfill for wingwalls according to the details shown.

(4) Granular Backfill (Wingwalls). When designated in the Contract Documents, construct the granular backfill for wingwalls according to the details shown.

204.4 MEASUREMENT AND PAYMENT

a. Contract Quantities. Provided the project is constructed essentially to the lines and grades shown in the Contract Documents, the quantities shown in the Contract Documents for the various balances will be the quantities for which payment is made.

If the Contract Documents have been altered, or if the Engineer or Contractor questions the accuracy of the contract quantities at any location, either party may request the quantities involved be measured.

b. Measured Quantities. The Engineer will measure quantities for the various classes of excavation by cross-sectioning the area. The Engineer will compute the quantities (volume) by the average end area method. Where it is impractical to measure material by the cross-section method, the Engineer will use 3-dimensional measurements. Measurement will not include additional excavation required to mitigate the effects of over-exposed shale in foundations.

(1) Bridge Excavation. The Engineer will measure the various classes of excavation by the cubic yard. If the Contract Documents show excavation dimensions, the measured quantity is limited to the volume bounded by vertical planes at the contract dimensions. When excavation dimensions are not shown in the Contract Documents, the quantity measured for payment is the quantity removed, limited to the volume bounded by vertical planes 2 feet outside the footings and tie beams.

(2) Excavation for Structures Other Than Bridges. If shown as a bid item in the Contract Documents, the Engineer will measure Class III excavation by the cubic yard. If not shown as a bid item in the Contract Documents, Class III excavation for structures other than bridges is subsidiary to other items of work.

If the Contract Documents show excavation dimensions, the measured quantity is limited to the volume bounded by vertical planes at the contract dimensions. When excavation dimensions are not shown in the Contract Documents, the quantity measured for payment is the quantity removed, limited to the volume bounded by vertical planes 2 feet outside the footings.

Excavation for reinforced concrete box culverts, pipe culverts or headwalls for culverts is not measured for payment. Excavation over the culvert necessitated by the imperfect trench method of backfill is not measured for payment. If rock is not shown in the Contract Documents and is encountered during the excavation for reinforced concrete box culverts, pipe culverts or headwalls for culverts, the rock excavation is paid for as Extra Work, **SECTION 104**.

(3) Concrete for Seal Course (Set Price). The Engineer will measure concrete placed for a seal course (either shown in the Contract Documents or approved by the Engineer) by the cubic yard. The quantity measured for payment is the quantity placed, limited to the volume bounded by vertical planes at the limits of the pay excavation for the structure. If the excavation for the structure is subsidiary, the quantity of concrete measured for payment is the quantity placed, limited to the volume bounded by vertical planes 2 feet outside the footings.

If the Contractor elects to use a concrete seal course in place of the foundation stabilization shown in the Contract Documents, the Engineer will measure and pay for the concrete seal course as the foundation stabilization at the contract quantity and at the contract unit price.

The excavation necessary to place the concrete seal course is not measured for payment.

(4) Foundation Stabilization. When designated in the Contract Documents and the Contractor opts to construct it, the Engineer will measure the foundation stabilization for box and pipe culverts by the cubic yard to the volume bounded by vertical planes at the contract dimensions to a depth of 6 inches, or greater depth approved by the Engineer.

If the Contractor deems the foundation stabilization unnecessary, the Engineer will underrun the item.

The Engineer will not measure excavation necessary to place the foundation stabilization.

(5) Foundation Stabilization (Set Price). The Engineer will measure the foundation stabilization (set price) by the cubic yard. The quantity measured for payment is the quantity placed, limited to the volume bounded by vertical planes at the limits of the pay excavation for the structure. If the excavation for the structure is subsidiary, the quantity of foundation stabilization measured for payment is the quantity placed, limited to the volume bounded by vertical planes 2 feet outside the footings.

The excavation necessary to place the foundation stabilization (Set Price) is not measured for payment.

(6) Granular Backfill, Granular Backfill (Wingwalls) and Granular Backfill (Wingwalls) (Set Price). The Engineer will measure granular backfill by the cubic yard. The Engineer will measure to the neat lines shown in the Contract Documents. The Engineer will not measure for payment the excavation required to place the granular backfill or any granular backfill material placed beyond the limits shown in the Contract Documents (over-excavated areas).

(7) Water (Grading) (Set Price). The Engineer will measure water used for earthwork compaction by the M gallon, by means of calibrated tanks or water meters. Water used for dust control, water wasted through the Contractor's negligence, water in excess of the quantity required to obtain the proper moisture content or water used for compaction of earthwork (backfill) around structures classified as bridges is not measured for payment.

c. Payment. Payment for the various classes of "Excavation", the various grades of "Concrete", "Foundation Stabilization", "Granular Backfill" and "Granular Backfill (Wingwalls)" at the contract unit prices is full compensation for the specified work.

Payment for "Concrete for Seal Course (Set Price)", "Foundation Stabilization (Set Price)", "Granular Backfill (Wingwalls) (Set Price)" and "Water (Grading) (Set Price)" at the contract set unit prices is full compensation for the specified work.

If the Engineer determines it is necessary to lower a footing below the elevation shown in the Contract Documents, the additional excavation is paid as follows:

- Additional excavation up to and including 2 feet below the contract elevation is paid at the contract unit price.
- Additional excavation from more than 2 feet up to and including 6 feet below the contract elevation is paid at 1½ times the contract unit price.
- Additional excavation more than 6 feet below the contract elevation is paid as Extra Work, **SECTION 104**.

SECTION 205

EXCAVATION AND EMBANKMENT FOR HIGHWAYS

205.1 DESCRIPTION

Excavate, haul, place, remove and dispose of the specified materials. Construct the embankments as specified in the Contract Documents. Compact the earthwork according to the requirements for the type of compaction and moisture range specified in the Contract Documents.

BID ITEMS	**UNITS**
Common Excavation	Cubic Yard
Common Excavation (Contractor-Furnished)	Cubic Yard
Rock Excavation	Cubic Yard
Rock Excavation (Non-Durable Shale)	Cubic Yard
Unclassified Excavation	Cubic Yard
Common Excavation (Unstable)	Cubic Yard
Common Excavation (Unsuitable)	Cubic Yard
Compaction of Earthwork (Type *) (MR-**)	Cubic Yard
Embankment	Cubic Yard
Embankment (Contractor-Furnished)	Cubic Yard
Eradication of Traveled Way	Station
Water (Grading) (Set Price)	M Gallon

*Type of Compaction
**Moisture Range

205.2 MATERIALS

Provide water for earthwork compaction that complies with **DIVISION 2400**.

If "Common Excavation (Contractor-Furnished)" is specified, provide soil or a mixture of soil and gravel, stone or other acceptable material. Provide material that is similar to the material shown in the Contract Documents or found in the Report of Soil Survey. Provide material with a quality satisfactory for the purpose intended. Do not use material that has sod, roots, stumps and other perishable and deleterious matter. Provide soil that complies with the requirements shown in the Contract Documents for the material used in the top 18 inches of the embankment.

The Engineer will accept the material based on compliance with these requirements and visual inspection of the material placed on the project.

Provide crushed stone for backfill that complies with **DIVISION 1100**.

205.3 CLASSIFICATION OF EXCAVATION

The geological information shown in the Contract Documents is based on studies made in the field, and represents the best information available to KDOT. The classification of embankment and drainage excavation as "Common Excavation", "Rock Excavation" or "Rock Excavation (Non-Durable Shale)", which classifications shall include all materials of whatever nature encountered, is shown in the Contract Documents. As the work is performed, the Engineer in conjunction with the Regional Geologist will determine if the classification of embankment and drainage excavation requires adjustment. The Engineer has the authority to identify and define the physical characteristics that determine the classification. The classification of materials for excavation is based on the materials in an unfrozen condition.

a. Common Excavation. Common excavation is all excavation not included as rock excavation or excavation otherwise classified. The following are included in common excavation: hot mix asphalt or concrete sidewalk, concrete ditch lining, concrete or stone wash checks and hot mix asphalt pavement 6 inches or less in thickness.

Depending on the makeup and characteristics of the common excavation, some material may or may not be used for embankment. The Engineer will identify which materials may not be used for embankment.

b. Common Excavation (Contractor-Furnished). Common excavation (Contractor-Furnished) is material provided by the Contractor that complies with the material requirements of this specification.

Non-durable shale provided as common excavation (Contractor-Furnished) shall be manipulated (sized) with equipment and water as required for non-durable shale excavation.

c. Rock Excavation. Rock excavation includes firm, rigid and unweathered sedimentary, igneous and metamorphic rock that is naturally in-place. Boulders or detached stones with a volume of 2 cubic yards or more are classified as rock excavation.

Portland cement concrete pavement, portland cement concrete base, cement treated base, hot mix asphalt pavement greater than 6 inches in thickness, concrete curb and gutter and any hot mix asphalt placed upon these structures is classified as rock excavation.

When common excavation is interlayered with the rock excavation, and the common excavation makes up 25% or less of the volume, the entire volume is classified as rock excavation.

d. Rock Excavation (Non-Durable Shale). Rock excavation (Non-Durable Shale) is non-durable rock shale that if used in embankments is required to be manipulated with construction equipment and water added until it is broken down to particle sizes shown in **subsection 205.4c**.

e. Unclassified Excavation. Unclassified excavation includes all excavation, regardless of type, nature or condition of materials encountered. When excavation is unclassified, the Contractor assumes full responsibility to estimate the kind and extent of the various materials to be encountered in order to accomplish the work. Unclassified excavation includes materials which, if classified, would be included in **subsections 205.3a.**, **b.**, **c.** and **d**.

f. Common Excavation (Unstable). Common excavation (Unstable) is considered to be material in the subgrade or embankment with any of the following characteristics:

- When the material encountered has a moisture content above the plastic limit of the soil.
- When the plastic limit of the soil is at or less than the optimum moisture content, the soil is not capable of being compacted at the optimum moisture content.

Suitable material with excess moisture caused by the Contractor's negligent operations is not classified as unstable excavation.

g. Common Excavation (Unsuitable). Common excavation (Unsuitable) is material encountered in the subgrade or embankment that contains a high organic content (such as peat or A-horizon soils).

205.4 CONSTRUCTION REQUIREMENTS

a. General Excavation Requirements. Before beginning the excavation, clear and grub all vegetation according to the Contract Documents. Remove existing structures as shown in the Contract Documents.

Strip and stockpile the existing topsoil from within the construction limits. To the extent practical use this material to cap the finished embankment and cut slopes. This work is subsidiary to grading items in the contract.

Where practical, do not store equipment or materials (including soil stockpiles) within 50 feet of rivers, streams or other surface waters. Where such storage is necessary, obtain the Engineer's written approval and include in the project SWPPP appropriate best management practices for the storage area.

Unless requested in writing from the Contractor, and approved in writing by the Engineer, or specified otherwise in the Contract Documents, do not exceed 750,000 square feet of surface area of erodible earth material per equipment spread at one time. The Engineer will limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow (within right-of-way) and embankment operations. Limit the exposed erodible earth material according to the capability and progress, and in keeping with the approved schedule.

Areas will not count toward the 750,000 square feet limit, when the following conditions are met:

For areas that will not be disturbed again due to project phasing:

- Finish grade the completed area;
- Stabilize and maintain stabilization according to **SECTION 902**; and

- Do not disturb the area again without a written request from the Contractor and written approval from the Engineer;

For areas that will be disturbed again due to project phasing:
- Rough grade; and
- Stabilize and maintain stabilization according to **SECTION 902**.

DO NOT clear and grub areas unless work will actively be performed in the exposed area (or portions of the exposed area) within 7 calendar days on exposed steep slope areas (40% or greater) or within 14 calendar days for all other exposed areas. If areas are cleared and grubbed and not finish graded, not part of project phasing and no meaningful work toward the completion of the bid item is performed within the exposed area (or portions of the exposed area) for 7 calendar days on exposed steep slope areas (40% or greater) or 14 calendar days for all other exposed areas, stabilize and maintain stabilization at these exposed areas according to **SECTION 902** at no cost to KDOT.

Before beginning excavation or depositing waste at the Contractor-Furnished site, obtain all permits and clearances required for compliance as shown in **SECTION 107**, (which most commonly includes wildlife and archaeological clearances). See **SECTION 106** for requirements for use of private property.

Before incorporating any material from these areas into the project, the Engineer shall require a copy of the KDWP clearance and the KSHS clearance. Before depositing any project waste onto these waste sites, the Engineer shall require a copy of the KDWP clearance, the KSHS clearance, and when required, the KDHE waste disposal permit.

If the Contractor's excavation operations expose potentially historical or archaeological significant sites, discontinue the excavation of such sites until the Engineer determines the disposition of the discovery. The Engineer will contact the ESS to determine the proper course of action, according to **SECTION 107**.

Obtain the Engineer's approval before wasting surplus excavation material. Use approved surplus excavated material to widen embankments, flatten slopes, or as directed by the Engineer. If surplus excavation material is wasted on the project, place the material to provide a neat appearance. Do not place waste materials in a manner that is detrimental to the abutting property.

If the Contract Documents designate certain materials to be excavated and stockpiled for future use, do not contaminate these materials in the process. Stockpile the materials neatly and compactly at locations approved by the Engineer.

Before beginning excavation, allow the Engineer to define the limits and cross-section the borrow areas shown in the Contract Documents. The Contractor shall define the limits and cross-section Contractor-Furnished sites before beginning excavation. Do not remove any material beyond the dimensions and elevations established. When borrow excavation is complete, grade the site uniformly to drain. Comply with any permit requirements.

The Engineer may allow the use of borrow pits or waste areas other than those shown in the Contract Documents, provided the change does not increase the cost for KDOT.

If rock, shale or unsuitable material is encountered in cuts, excavate this material to the cross-section or limits shown in the Contract Documents.

Do not overbreak rock excavation below the cross-section shown in the Contract Documents. If overbreakage occurs, backfill the overbreakage with material designated in the Contract Documents. If the designated backfill is material obtained through normal excavation, compact the backfill to the density requirements shown in the Contract Documents. If the designated backfill is crushed aggregate or other special aggregate, make sure that there are no layers of earth or shale between the backfill material and the surface of the rock. Before backfilling overbreakage areas with crushed stone for backfill or other specified material, shape the rock overbreakage area to drain.

Trim all slopes to the lines shown on the cross-sections. When warranted, the Engineer may approve a modified slope in rock or other material. Remove rock so that the resulting rock slope has a uniform face. Do not disturb any materials beyond the limits of the excavation.

Excavate all side ditches as shown in the Contract Documents.

Provide temporary erosion and pollution control according to **DIVISION 900**.

b. Presplit Rock Excavation. If designated in the Contract Documents, use a presplitting technique to split the face of the rock along the designated backslope. Presplit along the backslope before blasting the interior portion of the rock cut.

Devise a plan for the diameter, spacing and loading of the presplit holes. Drill the presplit holes the full depth of the rock ledge. Demonstrate to the Engineer with a 100-foot test section that the presplitting plan will produce an acceptable backslope. If the backslope of the test section is unacceptable, establish additional test sections until satisfactory results are obtained.

c. Shale Excavation. Shale will be classified as durable or non-durable in the Contract Documents. Durable and non-durable shale is prohibited in the top 18 inches of the embankment, unless specified in the Contract Documents.

- Durable Shale. Durable shale may be used as any other rock in a fill.
- Non-Durable Shale. Manipulate non-durable shale with equipment and water until 100% of the material is smaller than 6 inches in all dimensions, and until a minimum of 90% of the material is smaller than 3 inches in all dimensions. The Engineer will verify manipulation requirements with a visual inspection (e.g. have the Contractor scarify a known area to a known depth, calculate theoretical volume scarified, calculate an average volume for the stones between 3 and 6 inches and if the volume for the stones exceeds 10%, the test fails). Continue manipulation and retest until the above requirements are met. Compact and adjust the moisture content of this material as specified in the Contract Documents.

The Contractor will determine whether to manipulate and use the non-durable shale on the project, or waste the non-durable shale and replace it with other suitable material.

d. Common Excavation (Unstable). Excavate unstable material encountered during construction to the limits designated by the Engineer. Allow the Engineer to measure the area before the backfill is placed. Backfill the area where the unstable material was removed with suitable material from the project.

Aerate the unstable material until the moisture content is acceptable. Use this material in the construction of the project.

Remove and dry unstable material caused by the Contractor’s negligence to an acceptable moisture content and use in the project.

e. Common Excavation (Unsuitable). If excavation to the finished graded section results in subgrade or slopes of unsuitable material, excavate the unsuitable material to the limits designated by the Engineer. Remove the unsuitable material from the project. Allow the Engineer to measure the area before placing the backfill. Backfill with suitable material from the project.

f. Eradication of Traveled Way. Remove the surfacing, if any, excavate the embankment and fill the ditches. Grade the traveled way to approximately the original ground contour, or as shown in the Contract Documents. Stockpile any materials designated for salvage at the locations shown in the Contract Documents. Do not contaminate the salvaged material. Dispose of excess excavation, base materials and surfacing not designated for salvage.

g. Compaction Requirements. Requirements for the various types of compaction are shown in **TABLE 205-1**.

TABLE 205-1: SOIL COMPACTION REQUIREMENTS	
Type	**Minimum Compacted Soil Density**
Type AAA	100% of Standard Density
Type AA	95% of Standard Density
Type A	90% of Standard Density
Type B	Such that no further consolidation is gained by additional rolling. The Engineer will visually determine acceptable Type B compaction based on the following: • Acceptable Type B compaction is demonstrated if the tamping feet of a tamping (sheepsfoot) roller "walks out" of the soil and rides on top of the lift being compacted. • In soil with low plasticity or nonplastic fine-grained materials, the tamping feet may not "walk out" of the material being compacted. With these materials, acceptable Type B compaction is demonstrated if the tamping feet support the weight of the roller (without the drum of the roller contacting the lift being compacted). • In sand and gravel, where the use of a tamping roller produces unacceptable results, use other types of rollers (such as a pneumatic-tired) to compact this type of material. With these materials, acceptable Type B compaction is demonstrated if no further consolidation is evident after additional passes of the roller. • In small irregular areas where the use of conventional compaction equipment is impracticable, use other equipment and methods to obtain compaction. The Engineer will determine by visual inspection if Type B compaction is obtained. • If the Engineer is unable to visually determine that Type B compaction is obtained, the Engineer may conduct density tests on the compacted soil. If tested, the compacted soil density shall be at least 90% of the standard density.

h. Moisture Control Requirements. At the time of compaction, use soil with uniform moisture content within the moisture range designated in the Contract Documents.

Adjust the moisture content of the soil by adding water to or aerating the material to bring soil within the required moisture content.

If the soil is unstable within the designated moisture range, the DME will adjust the moisture range.

Water may be added to the soil in borrow and cut areas (before hauling) or on the embankment (after hauling). Use methods and equipment that will prevent undue loss of moisture. Add only the quantity of water necessary to provide a moisture content within the required moisture range plus a reasonable quantity to compensate for evaporation and other unavoidable losses.

Excavation areas may be pre-watered to provide uniform moisture content. Submit sketches of the areas with details of the proposed methods and equipment for the pre-watering for approval by the Engineer. Provide drilling equipment to obtain samples for moisture determination before, during and after the pre-watering. Using the results of the moisture samples, the Contractor and Engineer will jointly determine the quantities of water necessary to bring the soils to optimum moisture. The Engineer will allow sufficient water to bring the full depth and width of the excavation to optimum moisture plus up to 20% for evaporation.

In areas to be pre-watered, leave the vegetation in place until the watering is completed. If runoff is observed during the pre-watering, rip the area on the contour to a depth of approximately 2 feet at 4-foot intervals. To permit penetration to the full depth of the excavation (for uniform moisture content), allow a curing period after the pre-watering is completed. The Contractor and Engineer will use the moisture samples obtained by the Contractor (at locations and depth agreed to by the Contractor and Engineer) to determine moisture content and uniformity for the pre-watered areas. Strip the vegetation from the areas after the water has penetrated the soils.

Requirements for the various moisture ranges are shown in **TABLE 205-2**.

TABLE 205-2: SOIL MOISTURE CONTENT REQUIREMENTS	
Moisture Range	Moisture Content
0-5 (MR-0-5)	A maximum of 5 percentage points above optimum, nor less than optimum.
3-3 (MR-3-3)	A maximum of 3 percentage points above optimum, and a maximum of 3 percentage points below optimum.
5-5 (MR-5-5)	A maximum of 5 percentage points above optimum, and a maximum of 5 percentage points below optimum.
90 (MR-90)	Sufficient to allow the type of compaction specified in the Contract Documents. If Type B compaction is specified, the Engineer will determine by visual inspection if satisfactory moisture control and compaction are obtained.

i. Foundation Treatment. If an embankment is started less than 4 feet below the finished subgrade, remove all vegetation from the surface where the embankment will be placed. Plow, scarify or break up the cleared surface to a minimum depth of 6 inches (foundation area). Adjust the foundation area to a moisture content within the specified moisture range. Compact the foundation area as specified in the Contract Documents for the embankment.

If an embankment is placed over an existing surface (PCCP, HMA, gravel), plow, scarify or break up the full depth of the existing surface regardless of the height of the embankment.

j. Embankment Requirements. Construct the embankment from material classified as Soil, Rock/Soil or Rock, as defined in **TABLE 205-3**.

TABLE 205-3: EMBANKMENT GRADATION CLASSIFICATION	
Classification	Gradation Criteria
Soil	≤ 20% retained on the ¾ inch sieve
Rock/Soil	> 20%, but < 80% retained on the ¾ inch sieve
Rock*	≥80% retained on the ¾ inch sieve

*Could include concrete pavement.

If frozen soil is encountered in the surface of the original ground or in the surface of a partially constructed embankment, remove the frozen material or allow the frozen material to thaw before continuing construction of the embankment.

Unless shown otherwise in the Contract Documents, if shale (all shale classified as non-durable or common excavation) is used as embankment material, manipulate the shale with equipment and water until it complies with **subsection 205.4c**. Adjust the moisture content and compact the shale as specified in the Contract Documents.

Construct and backfill culverts and other structures below the embankment surface before the embankment is constructed.

When the embankment is placed against a hillside or an existing embankment with slopes steeper than 4:1, bench the existing slope with each lift of the embankment. Cut the benches wide enough to accommodate the hauling and compacting equipment. Begin cutting (horizontally) each new bench at the intersection of the original ground and the vertical side of the previous bench. Use the material excavated from the benches in the embankment.

Exercise care placing and compacting the embankment, when placed on only one side of a structure (such as abutments, piers and wingwalls). Do not put excessive pressure against the structure.

Place soil embankment material in horizontal lifts approximately 8 inches thick (loose measurement). Compact the earthen material as specified in the Contract Documents before placing the next lift. Compact manipulated (sized) non-durable shale to the compaction requirement in the Contract Documents and adjust the moisture content of the manipulated non-durable shale to MR-5-5. Use compaction equipment as specified in **DIVISION 150**. Provide sufficient motorgraders and tamping rollers to adequately blade and compact the material delivered to the embankment. Route the construction equipment uniformly over the entire surface of each lift. Continuously use a motorgrader to level and manipulate the material during the placing and compacting of each lift of the embankment. If the material delivered to the embankment is not properly placed and compacted, suspend delivery of materials to the embankment until the problem is corrected.

Where it is impracticable to use a roller, use a mechanical tamper. Place the embankment material in horizontal lifts not to exceed 8 inches (loose measurement) capable of being compacted by the mechanical tampers. Compact the earthen material as specified in the Contract Documents before placing the next lift.

If the Contract Documents do not specify a compaction requirement for the earthwork, place the embankment in uniform lifts not to exceed approximately 8 inches thick (loose measurement). Compact the earthen material to the requirements of Type B, MR-90.

Place rock/soil embankment material in horizontal lifts approximately 10 inches thick (loose measurement). Compact the embankment by making consecutive passes of a vibratory roller, with a minimum weight of 16 tons, until no further increase in density is achieved by successive passes. The Engineer shall verify the density by using the nuclear moisture/density gauge.

Place rock embankment material in horizontal lifts approximately the average size of the larger rocks, a maximum of 2 feet thick (loose measurement). Make no more than 10% of the rock embankment material larger than 7 feet in circumference measured in any direction and no more than 10% passing the 1-inch sieve as determined by visual inspection. The maximum size of rock placed will be limited by the thickness of rock to be placed, as shown on the plans.

An embankment made up largely of rock consists of rock in interparticle contact with itself, with no intervening layers of soil. Distribute the large stones uniformly and fill the voids with smaller stones, earth, sand or gravel. Level and manipulate each lift with a motorgrader, bulldozer or similar equipment capable of shifting and shaping the material. Compact each lift by routing construction traffic over the lift until no further consolidation under the traffic is visible. When shown in the Contract Documents to construct the top 12 inches with rock excavation, finish the grade with crushed stone for backfill compacted to Type B, MR-90, **SECTION 204**. No shale is allowed in the top 12 inches.

If the embankment is constructed of rock mixed with enough compactable material to make rolling feasible, and if the Contract Documents specify compaction, compact the embankment to meet Type B compaction requirements (regardless of the type of compaction specified).

If possible, use rock embankment material to form the base (full width) of the embankment. If rock and other embankment material are delivered to the embankment at the same time, place the rock in the outer portions of the embankment and the other material in the center of the embankment. Adjust the hauling and compacting operations (for both materials) as necessary to construct the embankment in level lifts.

Before rock embankment material is placed on compacted embankment constructed of other material, shape the top of the compacted embankment to slope from centerline to the outside. Do not build undrained pockets of rocks into the embankment.

Do not place rocks, broken concrete or other solid materials in embankment areas where piling will be driven or where culverts will be installed. Do not place rocks larger than 3 inches (in any dimension) in the top 12 inches of the embankment.

Where a grass median is constructed, do not place any rock excavation material or shale in the top 18 inches of the median area. Construct the top 18 inches of medians with earthen material suitable for growth of vegetation.

Dispose of all loose rocks within the right-of-way that will interfere with mechanical mowing.

Apply water as needed to control dust on the project.

k. Compaction in Cuts. Plow, scarify or break up the soil 6 inches below the grade line in cut sections. If necessary to obtain compaction, adjust the soil to a moisture content within the specified moisture range. Compact the soil as specified in the Contract Documents.

If the depth of compaction in cut sections is greater than 6 inches, excavate all material to within 6 inches of the lower limit of compaction. Plow, scarify or break up the material left in place. If necessary to obtain compaction, adjust the soil to a moisture content within the specified moisture range. Compact the soil as specified in the Contract Documents. Replace and compact (as embankment) the excavated material until the cut is compacted to the grade line shown in the Contract Documents.

205.5 MEASUREMENT AND PAYMENT

a. Contract Quantities. Provided the project is constructed essentially to the lines and grades shown in the Contract Documents, the quantities shown in the Contract Documents for the various balances will be the quantities for which payment is made.

If the Contract Documents are altered, or if the Engineer or Contractor questions the accuracy of the contract quantities in any balance, either party may request the quantities involved be measured by the cross-section method. Unless errors are noted or the original ground was disturbed before the work started, the cross-sections shown in the Contract Documents will be used as the original field cross-sections. Additional original cross-sections may be interpolated, or determined by other approved methods, at points necessary to accurately determine the quantities.

If the Contractor elects to waste the non-durable shale, or fraction thereof, and provide Common Excavation (Contractor-Furnished) in lieu of manipulating the non-durable shale, payment will be made for "Rock Excavation (Non-Durable Shale)," as though it was not wasted, not "Common Excavation (Contractor-Furnished)" actually used.

b. Measured Quantities. The Engineer will measure excavation and borrow (including rock, shale, unstable and unsuitable) by the cubic yard. The Engineer will measure quantities for the various types of excavation by cross-sectioning the area. The Engineer will compute the quantities (volume) by the average end area method. Where it is not possible to measure material by the cross-section method, the Engineer may use 3-dimensional measurements. If the depth of compaction through cut areas is greater than 6 inches, the material excavated to gain access to the lower 6-inch layer will be measured for payment. The excavation of unstable and unsuitable material necessary to obtain compaction in cut sections and in foundations for fill sections will be measured for payment. The Engineer will not measure rock overbreakage (below the depth shown in the Contract Documents) for payment. Excavation required for benching into an existing slope will not be measured for payment. The excavation required to remove unstable material caused by the Contractor's negligent operations will not be measured for payment.

If either the Contractor or Engineer questions the accuracy of the plan quantity for non-durable shale excavation, contact the Regional Geologist for guidance.

The Engineer will measure compaction of earthwork (in place after the rolling or tamping is complete) by the cubic yard. The Engineer will measure compaction of earthwork by cross-sectioning the area. The Engineer will compute the quantities (volume) by the average end area method. Where it is impractical to measure material by the cross-section method, the Engineer may use 3-dimensional measurements. The Engineer will not measure for payment the compaction of foundation area under a fill or the bottom 6-inch layer in a cut section.

The Engineer will measure water used for earthwork compaction and non-durable shale manipulation and compaction by the M Gallon by means of calibrated tanks or water meters.

If the Contractor uses non-durable shale for "Common Excavation (Contractor-Furnished)", the Engineer will not measure the manipulation water for payment. However, the Engineer will measure the water required to meet moisture requirements for compaction.

The Engineer will not measure water used for dust control, water wasted through the Contractor's negligence or water in excess of the quantity required to obtain the proper moisture content.

If the Contract Documents include the bid items "Embankment" or "Embankment (Contractor-Furnished)", the Engineer will not measure excavation, compaction and water separately for payment. The Engineer will measure the embankment in place by the cubic yard. The Engineer will measure quantities for the embankment by cross-sectioning the area. The Engineer will compute the quantities (volume) by the average end area method. Where it is impractical to measure material by the cross-section method, the Engineer may use 3-dimensional measurements. No payment will be made for quantities beyond the limits of the Contract Documents.

If the Contract Documents include the bid item "Eradication of Traveled Way", the Engineer will measure this item by the station along the centerline of the traveled way being eradicated. If the Contract Documents do not include the bid item "Eradication of Traveled Way", excavation required for this activity is measured for payment.

c. Payment.

(1) General. Payment for "Common Excavation", "Common Excavation (Contractor-Furnished)", "Rock Excavation", "Rock Excavation (Non-Durable Shale)", "Unclassified Excavation", "Compaction of Earthwork", "Embankment", "Embankment (Contractor-Furnished)" and "Eradication of Traveled Way" at the contract unit prices is full compensation for the specified work. Deduct any measured quantities placed beyond the limits of the Contract Documents, unless the placement was authorized by the Engineer.

Payment for "Water (Grading) (Set Price)" at the contract set unit price is full compensation for the specified work. Payment for water used for pre-watering excavation areas at 75% of the contract set unit price for

Water (Grading) (Set Price) is full compensation for the specified work. The contract set unit price will govern regardless of the accepted quantity provided.

(2) Common Excavation (Unstable). Payment for "Common Excavation (Unstable)", as provided below, is full compensation for the specified work to remove, manipulate and replace material, including any additional material needed to fill the created void.

Compaction for backfill of areas removed as Common Excavation (Unstable) will be paid for at the appropriate contract unit prices.

- Rural Projects (outside incorporated city limits): 1½ times the contract unit price for "Common Excavation", up to a maximum of $6.00 per cubic yard. If the contract unit price for "Common Excavation" is greater than $6.00 per cubic yard, the contract unit price is the maximum paid per cubic yard for this item.

  If the Contract Documents have the bid item of "Embankment" instead of "Common Excavation" the Engineer will pay for Common Excavation (Unstable) at 1½ times the contract unit price for "Embankment", up to a maximum of $6.00 per cubic yard.
- Urban Projects (inside incorporated city limits): 1½ times the contract unit price for "Common Excavation", up to a maximum of $10.00 per cubic yard. If the contract unit price for "Common Excavation" is greater than $10.00 per cubic yard, the contract unit price is the maximum paid per cubic yard for this item.

  If the Contract Documents have the bid item of "Embankment" instead of "Common Excavation," the Engineer will pay for Common Excavation (Unstable) at 1½ times the contract unit price for "Embankment", up to a maximum of $10.00 per cubic yard.

(3) Common Excavation (Unsuitable). Payment for the "Common Excavation (Unsuitable)", as provided below, is full compensation for the specified work.

Compaction for backfill of areas removed as Common Excavation (Unsuitable) will be paid for at the appropriate contract unit prices.

Excavation to replace unsuitable material removed from the project will be paid for at the appropriate contract unit price.

- Common Excavation (Unsuitable) not designated in the Contract Documents and encountered during construction is paid for at 3 times the contract unit price for "Common Excavation", up to a maximum of $12.00 per cubic yard, which price shall include the disposal of materials. If the contract unit price for "Common Excavation" is greater than $12.00 per cubic yard, the contract unit price will be the maximum paid per cubic yard for this item, which price shall include the disposal of materials.

  If the Contract Documents have the bid item of "Embankment" instead of "Common Excavation", the Engineer will pay for Common Excavation (Unsuitable) at $12.00 per cubic yard.

SECTION 206

SELECT SOIL

206.1 DESCRIPTION

Place select soil on the finished slopes at the locations shown in the Contract Documents.

BID ITEMS	UNITS
Select Soil	Cubic Yard
Select Soil (Contractor-Furnished)	Cubic Yard

206.2 MATERIALS

Use the topsoil designated in the Contract Documents for select soil. The topsoil may contain organic matter.

If "Select Soil (Contractor-Furnished)" is specified, provide topsoil with a quality suitable for the purpose intended. The topsoil may contain organic matter. The Contractor-Furnished site (for excavation of the topsoil) is subject to the environmental clearance provisions noted in **SECTION 107**. The Engineer will accept the select soil based on visual inspection of the material placed.

Do not use topsoil containing toxic matter.

206.3 CONSTRUCTION REQUIREMENTS

Before excavating the select soil from the locations shown in the Contract Documents, remove all weeds, tall grass and other objectionable material from the areas. Unless specified otherwise in the Contract Documents, excavate the select soil to a depth of 6 inches.

Stockpile or place the select soil at completed locations. Obtain the Engineer's approval of any stockpile site.

Before placing the select soil, finish all embankments as shown in the Contract Documents. Scarify the locations that will receive the select soil.

Cover the designated locations with the thickness of select soil as shown in the Contract Documents. After placing the select soil, use harrows or disks to break down clods and lumps. If placing heavy clay-bearing soil (Plastic Index greater than 25) on top of light sandy soil (Plastic Index less than 8), disk to a depth that will uniformly mix the two soils. Manipulate and roll the select soil with placing and spreading equipment to consolidate the material. If necessary, adjust the moisture content of the soil by adding water to or aerating the material.

Provide temporary erosion and pollution control according to **DIVISION 900**.

206.4 MEASUREMENT AND PAYMENT

a. Contract Quantities. Provided the project is constructed essentially to the lines and grades shown in the Contract Documents, the quantities shown in the Contract Documents for the various balances will be the quantities for which payment is made.

If the Contract Documents are altered, or if the Engineer or the Contractor questions the accuracy of the contract quantities for select soil in any balance, either party may request measurement of the quantities involved.

b. Measured Quantities. The Engineer will measure (by cross-sectioning) quantities of select soil by the cubic yard. The Engineer will compute the quantities (volume) by the average end area method. Where it is impractical to measure material by the cross-section method, the Engineer may use 3-dimensional measurements.

c. Payment. Payment for "Select Soil" and "Select Soil (Contractor-Furnished)" at the contract unit prices is full compensation for the specified work.

SECTION 207

OVERHAUL

207.1 DESCRIPTION

Overhaul is authorized hauling beyond the free-haul limit.

The free-haul limit is the specified distance the excavated material is hauled without additional compensation. Unless otherwise provided in the Contract Documents, the free-haul limit is 2,000 feet.

Excavated material that is hauled and deposited according to the Contract Documents, regardless of the length of the haul, is eliminated from consideration as overhaul.

BID ITEM	UNITS
Overhaul	Cubic Yard/Station

207.2 MATERIALS – None specified.

207.3 CONSTRUCTION REQUIREMENTS

Haul the excavated material beyond the free-haul limit to the location authorized by the Engineer.

207.4 MEASUREMENT AND PAYMENT

The Engineer will determine the limit of free-haul from a mass diagram by fixing 2 points on the volume curve, one on each side of the neutral grade point. One point is fixed in excavation and the other in embankment (the included quantity of excavation and embankment are in balance); the distance between them is the free-haul distance. All materials within the free-haul limit are eliminated from consideration as overhaul. The overhaul distance is determined by deducting the free-haul distance from the distance between the center of gravity of the remaining mass of excavation and the remaining mass of embankment.

The Engineer will compute the overhaul quantity by multiplying the overhaul distance in stations by the number of units of excavation in cubic yards hauled.

The Engineer may use an analytical method in lieu of the mass diagram method to determine the overhaul. The Engineer may use vehicle measurement to determine the quantity of material hauled.

If required, the Engineer will add the item of "Overhaul" to the contract.

The Engineer will pay for the completed and accepted "Overhaul" at the contract set unit price of $0.03 per cubic yard per station.

SECTION 208

LINEAR GRADING

208.1 DESCRIPTION

Construct the roadway to the approximate uniform section shown in the Contract Documents.

BID ITEMS	UNITS
Linear Grading (*) (**)	Station
Water (Grading) (Set Price)	M Gallon

*Type of Compaction, if specified
**Moisture Range, if specified

208.2 MATERIALS

Use the existing soil.

Provide water for earthwork compaction that complies with **DIVISION 2400**.

208.3 CONSTRUCTION REQUIREMENTS

Before placing an embankment of less than 4 feet on an existing surface, scarify or plow the existing surface to a depth of 6 inches. Thoroughly disk the non-surfaced area and remove the existing vegetation. Recompact the disked area before placing the embankment.

Before placing an embankment on a hillside or an existing embankment slope, scarify, plow or step the existing slope to a depth of 6 inches.

Use earthen materials that will produce a dense, well-compacted embankment. Obtain the embankment material from the locations provided in the Contract Documents.

If compaction of the earthwork is not specified, construct the embankment in horizontal layers a maximum of 8 inches thick (loose measurement). Place each layer the full-width of the embankment. Blade each layer until it is level and uniform, and compact to Type B, MR-90, **SECTION 205**.

If compaction of the earthwork is specified, construct the embankment in horizontal layers a maximum of 8 inches thick (loose measurement). Place each layer the full-width of the embankment. Blade each layer until it is level and uniform. Compact each layer as specified in the Contract Documents.

Construct the embankment to the grade lines, profiles and tolerances shown in the Contract Documents.

The Contractor may adjust the grade lines within the specified tolerances, except for bridges and other locations when the grade line shall match existing conditions. If required to adjust the grade line, maintain a minimum of 15 inches of earth cover (at the centerline of the project) on top of over-filled structures.

After the embankment is constructed, finish blade the surface until the embankment is consolidated, smooth and free of clods and other unsatisfactory materials. Finish the embankment within centerline grade and shoulder alignment tolerances. Do not construct abrupt changes in grade. Construct the roadway, slopes and ditches to the specified profiles, and construct all ditches to drain properly.

Remove and dispose of all surface rocks that would interfere with mechanical mowing.

Provide an adequate water supply for compaction, and apply water as needed to control dust on the project.

Provide temporary erosion and pollution control according to **DIVISION 900**.

208.4 MEASUREMENT AND PAYMENT

The Engineer will measure linear grading by the station, horizontally along the centerline of the roadway.

The Engineer will measure water used for earthwork compaction by M Gallons by means of calibrated tanks or water meters. The Engineer will not measure water used for dust control, water wasted through the Contractor's negligence or water in excess of the quantity required to obtain the proper moisture content.

Payment for "Linear Grading" at the contract unit price is full compensation for the specified work.

Payment for the quantity of "Water (Grading) (Set Price)" at the contract set unit price is full compensation for the specified work.

SECTION 209

SPECIAL FILL

209.1 DESCRIPTION

Provide and place special fill (foundation) for the foundation for the MSE system as shown in the Contract Documents.

Provide and place special fill (retained soil) behind the MSE wall as shown in the Contract Documents.

BID ITEMS	UNITS
Special Fill (*)	Cubic Yard

* Foundation or Retained Soil

209.2 MATERIALS

a. General. Provide soil meeting the requirements specified in the Contract Documents.

Material will be accepted under this specification with the receipt and approval by the KDOT Geotechnical Unit of laboratory test reports detailing the test results in accordance with the appropriate ASTM standards as performed by an AMRL certified and KDOT Geotechnical Unit approved laboratory.

Use soil for the special fill exhibiting a minimum drained friction angle and minimum undrained cohesion, as shown on the plans. Determine the strength properties of the soil in CIŪ single stage triaxial tests with pore pressure measurements (ASTM D 4767) if the soil is defined as fine grained by ASTM D 2487. If the soil is fine-grained, it must be of low plasticity as defined by ASTM D 2487. Use effective consolidation stresses as shown on the plans. Multi-stage tests will not be acceptable.

If the soil is a coarse-grained soil as defined by ASTM D 2487, it must be classed as low plasticity. Determine the strength properties of the soil in Consolidated - Drained Direct Shear (ASTM D 3080) testing. These soils similarly must exhibit a minimum drained friction angle as shown on the plans. Do not use these soils in areas prone to flooding. Use normal stresses as shown on the plans.

b. Shear Testing. Perform all shear testing on samples compacted to Type AA compaction standards (**SECTION 205**) for cohesive soils; or at 75% Relative Density for granular soils at optimum moisture content.

209.3 CONSTRUCTION REQUIREMENTS

Compact the fill to Type AA, MR-3-3 (**SECTION 205)** unless specified otherwise in the Contract Documents. Do not exceed 8-inch loose, lift thickness. Each lift will have a minimum of 2 density and moisture tests performed. Fill material different from that specifically approved for use will not be accepted until the testing requirements as set forth in **subsection 209.2** are met.

209.40 MEASUREMENT AND PAYMENT

The Engineer will measure the special fill by the cubic yard.

Payment for "Special Fill" at the contract unit price is full compensation for the specified work.

SECTION 210

SALVAGING, STOCKPILING AND PLACING TOPSOIL

210.1 DESCRIPTION

Within the construction limits, excavate existing topsoil from cut areas and areas to be covered by embankments. Haul and stockpile the salvaged topsoil to a location approved by the Engineer. Place the salvaged topsoil on backslopes, foreslopes and ditches or as directed by the Engineer. Do not place topsoil in areas of rock that are on a 3:1 slope or steeper in rock ditches or other areas listed in the plans. Leave stockpile areas in a neat condition.

BID ITEM	UNITS
Salvaged Topsoil	Square Yard

210.2 MATERIALS

Use the existing topsoil (available natural topsoil) from within the project construction limits. The topsoil may contain organic matter.

Do not use topsoil containing toxic matter.

210.3 CONSTRUCTION REQUIREMENTS

Before excavating the topsoil from the locations shown in the Contract Documents, remove all trees, shrubs, stumps, and other objectionable material as directed by the Engineer, from the areas. Unless specified otherwise in the Contract Documents, salvage the topsoil to a depth of 6 inches.

Stockpile topsoil or place topsoil at completed locations. Locate stockpiles within the right-of-way where topsoil will not run off into any waterway due to a rain event and where it will not impair drainage. Obtain the Engineer's approval of any stockpile site.

Finish all excavations and embankments before placing the topsoil. Place the topsoil to the finish elevation. Adjust the cut and fill sections to accommodate the placement of the salvaged topsoil such that after placement the cross section will be at the final grade as shown on the Plans. Note: If a cut section is rock, do not undercut.

After placing the topsoil, use harrows or disks to break down clods and lumps. If placing heavy clay-bearing soil (Plastic Index greater than 25) on top of light sandy soil (Plastic Index less than 8), disk to a depth that will uniformly mix the two soils in equal portions. Manipulate and roll the topsoil with placing and spreading equipment to consolidate the material. If necessary, adjust the moisture content of the soil by adding water to or aerating the material.

Provide temporary erosion and pollution control according to **DIVISION 900**.

210.4 MEASUREMENT AND PAYMENT

a. Contract Quantities. Provided the project is constructed essentially to the lines and grades shown in the Contract Documents, the quantities shown in the Contract Documents for the various balances will be the quantities for which payment is made.

If the Contract Documents are altered, or if the Engineer or the Contractor questions the accuracy of the contract quantities for topsoil in any balance, either party may request measurement of the quantities involved.

The quantity of roadway excavation to be measured for payment will not include excavation made below embankment areas to obtain topsoil or excavation made in undercutting slopes, ditches and shoulders in preparing such areas for topsoil placement. This excavation is subsidiary to salvaged topsoil.

Topsoil quantities shall not be deducted from the excavation quantities.

b. Measured Quantities. The Engineer will measure salvaged topsoil excavated by the square yard.

c. Payment. Payment for "Salvaged Topsoil" at the contract unit price is full compensation for the specified work.

SECTION 211

GEOFOAM LIGHTWEIGHT EMBANKMENT FILL

211.1 DESCRIPTION

Provide and install the geofoam lightweight expanded polystyrene (EPS) fill at the embankment locations shown in the Contract Documents.

BID ITEM	**UNITS**
Geofoam-Fill	Cubic Yard

211.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete .... **SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade .... **SECTIONS 1102**
Geofoam Lightweight Embankment Fill .... **DIVISION 1700**

211.3 CONSTRUCTION REQUIREMENTS

Fabricate the expanded polystyrene in standard sizes that are typically 4-foot wide by 2.5-foot thick by 8 to 16-foot long blocks. Trim the blocks prior to arriving at the job site with a uniformly even surface with a tolerance of ¼ inch in 10 feet.

Cut the blocks using a saw unless alternative cutting methods have been approved by the Engineer. Provide temporary weighting and guying down of the lightweight material as required until all blocks are built into a homogeneous mass.

Construct the geofoam-fill in successive layers of blocks with the block's long axis alternating by 90° and offsetting blocks by half their widths to prevent the continuation of joints within the polystyrene mass.

Connect the polystyrene blocks with gripper plates. Place gripper plates between horizontal layers of geofoam as required.

Do not damage the EPS during construction or storage. Protect the EPS from petroleum based solvents, flame, and other ignition sources. Do not expose the EPS to direct sunlight. Keep the expanded polystyrene covered with a light-colored opaque tarp.

211.4 MEASURMENT AND PAYMENT

The geofoam-fill will be measured by the cubic yard.

Payment for "Geofoam-Fill" at the contract unit price is full compensation for the specified work.

SECTION 212

GEOFOAM LIGHTWEIGHT EMBANKMENT FOR VOID FILL

212.1 DESCRIPTION

Construct the geofoam lightweight expanded polystyrene (EPS) fill at the locations designated in the Contract Documents. This work is to fill voids in the embankment behind the abutment.

BID ITEM	**UNITS**
Geofoam-Void Fill	Cubic Yard

Note: If this bid item is not included in the Contract Documents, this work is subsidiary to other items in the contract.

212.2 MATERIALS

Provide geofoam that complies with **DIVISION 1700**.

212.3 CONSTRUCTION REQUIREMENT

Construct the embankment if required in successive layers of geofoam with the block's long axis alternating by 90° and offsetting blocks by half their widths to prevent the continuation of joints within the polystyrene mass.

Trim the blocks so the surface is uniform and even with a tolerance of ¼ inch in 10 feet.

Cut the EPS blocks using a saw unless alternative cutting methods have been approved by the Engineer.

Provide temporary weighting and guying down of the geofoam material as required until all blocks are built into a homogeneous mass.

Connect the EPS blocks with gripper plates. Place gripper plates between horizontal layers of geofoam as required.

Do not damage the EPS during construction or storage. Protect the EPS from petroleum based solvents, flame, and other ignition sources. Do not expose the EPS to direct sunlight. Keep the EPS covered with a light-colored opaque tarp.

212.4 MEASUREMENT AND PAYMENT

The Engineer will measure the geofoam-void fill by the cubic yard.

Payment for "Geofoam-Void Fill" at the contract unit price is full compensation for the specified work.

When the bid item is not included in the Contract Documents, geofoam-void fill will not be measured for payment, but will be subsidiary to other bid items in the contract.

SECTION 213

PREFABRICATED VERTICAL DRAIN

213.1 DESCRIPTION

Excavate for and place geosynthetics to provide a drainage pathway for consolidating embankments and foundation soils as shown in the Contract Documents.

BID ITEM	UNITS
Prefabricated Vertical Drain	Linear Foot

213.2 MATERIALS

Provide prefabricated vertical drain that complies with **DIVISION 1700**.

213.3 CONSTRUCTION REQUIREMENTS

a. Qualification of the Prefabricated Vertical Drain Contractor. At least 1 month before the construction of the prefabricated vertical drains, provide KDOT's Bureau of Structures and Geotechnical Services, Geotechnical Unit with evidence of successful installation of prefabricated vertical drains on 3 or more projects under similar conditions using the same installation technique. For the completed projects, include the location, description, size, the owner's name, address and telephone number, and the project engineer's name.

KDOT's Bureau of Structures and Geotechnical Services, Geotechnical Unit will approve (or deny) the Contractor's qualifications. No adjustment in contract price will be allowed if the submittal is rejected.

Before installing drains, satisfactorily install 3 test prefabricated vertical drains to the maximum anticipated depth shown in the Contract Documents at locations designated by the Engineer.

b. Construction of Prefabricated Vertical Drain. Survey, number and stake the drains within 6 inches of the locations indicated in the Contract Documents, or as directed by the Engineer.

Install drains from the working surface to the depth shown in the Contract Documents, or as specified by the Engineer.

Do not vary the installed drains from the vertical by more than 1 inch per 4 feet.

Provide a suitable means of determining the quantity of prefabricated vertical drain material used, and the depth of the drain.

Splice or connect the drain material in a workmanlike manner for continuity of drain material. Leave a 4 to 8-inch length of drain material protruding above the natural ground surface at each drain location. Cut the drain material neatly at its upper end.

If obstructions are encountered below the working surface that cannot be penetrated using normal and accepted procedures, complete the drain from the elevation of the obstruction to the working surface and notify the Engineer. At the direction of the Engineer, install a new drain within 2 feet from the obstructed drain. The injection of limited amounts of water will be allowed to facilitate the anchoring of drains. Make a maximum of 2 attempts to install the replacement prefabricated vertical drain as directed by the Engineer. If the drain still cannot be installed to the design tip elevation, abandon the drain location.

213.4 MEASUREMENT AND PAYMENT

The Engineer will measure prefabricated vertical drains by the linear foot.

The Engineer will pay for "Prefabricated Vertical Drain" at the contract unit price which is full compensation for the specified work.

Satisfactory test drain installations will be paid for at the contract unit price per foot for "Prefabricated Vertical Drain". The Contractor will be paid for all obstructed drains properly completed at the contract unit price.

SECTION 214

MECHANICALLY STABILIZED EARTH FILL

214.1 DESCRIPTION

Provide and install the complete mechanically stabilized earth (MSE) fill system as specified in the Contract Documents. This includes at a minimum: excavation, grading, and compaction of the MSE Fill foundation, general and local dewatering as required for proper execution of the work, erection of welded wire facing elements, placement of soil reinforcing, and placement and compaction of select backfill material within the reinforced soil volume.

BID ITEM	**UNITS**
MSE Fill	Cubic Yard

214.2 MATERIALS

a. General. Provide the complete MSE fill system (engineering design, geogrid, welded wire facing, and all necessary accessories) from an approved manufacturer in accordance with the acceptable alternates for each particular MSE fill as listed in the Contract Documents.

The Bureau of Construction and Materials will maintain a list of approved systems in the Retaining Wall Systems prequalified list. Products will remain on the prequalified list as long as field performance is satisfactory.

b. Welded Wire Fabric. Use welded wire fabric complying with **SECTION 1603** and the approved shop drawings. Galvanize the welded wire fabric in conformance with the requirements of ASTM A123.

c. Backfill. Provide aggregates for backfill that meet the requirements of MSE wall backfill, **SECTION 1107**.

d. Soil Reinforcing.

(1) Soil Reinforcing Geogrid. Use soil reinforcing geogrid of oriented, drawn, long chain high density polyethylene or polypropylene containing stabilizers and inhibitors added to the base plastic for resistance to ultraviolet and heat degradation. Use the geogrid material as designated in the approved wall system. The designated soil reinforcing geogrid will be accepted on the basis of a Type A Certification.

(2) Soil Reinforcing Geosynthetic. Use soil reinforcing of woven, high tenacity polyester yarns coated with polyvinyl chloride to maintain the integrity of the geosynthetic during handling and placement and to protect it during construction. Use the geosynthetic material as designated in the approved wall system. The designated soil reinforcing geosynthetic will be accepted on the basis of a Type A Certification.

e. Attachment Devices.

(1) Connectors. Use clevis connectors and connector rods fabricated of cold drawn steel wire complying with ASTM A82 and welded in accordance with ASTM A185 and galvanized in accordance with ASTM A153, or approved equal.

(2) Tie Bar. Use tie bars fabricated of cold drawn steel wire complying with ASTM A82 and galvanized in accordance with ASTM A153.

(3) Connection Pins. Use connection pins fabricated of cold drawn steel wire complying with ASTM A82 and galvanized in accordance with ASTM A153.

(4) Devices will be accepted on the basis of receipt and approval of a Type A Certification and visual inspection.

f. Facing Geotextile. Use a minimum Class 2 nonwoven geotextile that complies with **DIVISION 1700**.

214.3 CONSTRUCTION REQUIREMENTS

a. MSE Fill Excavation. Remove all materials encountered without regard to classification. Coordinate excavation for the wall with the underdrain construction so that drainage pipes will be constructed as specified. Maintain stable sides at all excavations by providing reasonable cut back slopes or shoring, where necessary.

b. Foundation Preparation. Grade the foundation for the retained earth volume, for a width equal to or exceeding the length of the geogrid plus 6 inches, or to the limits shown in the Contract Documents. Prior to MSE fill construction, compact the foundations to Type AA, MR 3-3 according to **SECTION 205**. Remove and replace any foundation soils found to be unstable or unsatisfactory.

c. MSE Fill Erection. Check the plumbness and tolerances of each facing row prior to erection of the next facing row. Should any row be out of tolerance, remove the fill and reset the section to the proper tolerance.

Vertical and horizontal alignment of the MSE fill face shall not vary by more than 2 inches when measured along a 10-foot straightedge, or as shown in the plans and specifications. The overall vertical tolerance (plumbness) of the MSE Fill shall not exceed 1 inch per 10 feet of wall height. Negative (outward leaning) batter is not acceptable. The offset limit between consecutive rows of facing shall not exceed 1 inch from planned offset.

Place connectors within 1/2 inch from the dimensions shown on the Contract Documents or approved shop drawings.

d. Backfill Placement. Closely follow the erection of each lift of facing with backfill. At each reinforcing level, roughly level backfill before placing and or attaching the reinforcement. Place reinforcing as shown in the Contract Documents normal to the face of the MSE fill. For geosynthetic reinforcing, the end of the geogrid sheet will terminate with a transverse element at the retained soil limit to prevent curling of the sheet and aid in construction. Tightly draw the reinforcing against the connections at the connectors and stake the end of the geogrid sheet at the retained soil limit before backfilling is allowed, and maintain tautness during backfilling operations. Place backfill in maximum loose lift thickness of 10 inches or less as may be necessary to obtain the specified density.

Compact the entire retained earth volume to 95% of maximum laboratory dry density at a moisture requirement of MR 3-3, **SECTION 205**. For backfills containing more than 30% retained on the ¾-inch sieve, use a method of compaction consisting of at least 4 passes of a roller. Accomplish compaction without disturbance or displacement of reinforcing and facing. Begin compaction from the area nearest the MSE fill face to the back of the reinforcing, except for a strip 3 feet wide adjacent to the backside of the facing. Compact this 3-foot strip with light mechanical tampers after compaction of the remainder of the layer. Soil density tests will not be required within this 3-foot area.

At the end of each day's operations, shape the last level of backfill to permit runoff of rainwater away from the wall face.

Remove and replace any wall materials that become damaged during backfill placement at the Contractor's expense.

214.4 MEASUREMENT AND PAYMENT

The Engineer will measure MSE Fill by the cubic yard. The Engineer will use the neat lines shown in the Contract Documents to compute the quantities.

Payment for "MSE Fill" at the contract unit price is full compensation for the specified work.

SECTION 215

GRANULAR DRAINAGE BLANKET

215.1 DESCRIPTION

Excavate for, and place aggregate to provide a drainage pathway for consolidating embankments and foundation soil as detailed in the Contract Documents.

BID ITEM	UNITS
Granular Drainage Blanket (*)	Square Yard
*Thickness	

215.2 MATERIALS

Provide aggregate for granular drainage blanket that complies with **SECTION 1114**.

215.3 CONSTRUCTION REQUIREMENTS

After clearing and grubbing, and any required foundation treatment of the embankment, bring the embankment to grade at the bottom of the granular drainage blanket. Place the granular material to prevent excessive debris from being introduced into the drainage blanket. Place the drainage blanket in 24-inch (maximum) lifts. Extend the drainage blanket under the embankment footprint behind the abutment to the end slope face and across the width of the embankment or as shown in the Contract Documents for drainage. Compact the drainage blanket by routing construction equipment across the drainage blanket until no further consolidation is evident. The nominal thickness of the drainage blanket at each location is specified in the Contract Documents.

215.4 MEASUREMENT AND PAYMENT

The Engineer will measure granular drainage blanket by the square yard.

Payment for the various thicknesses of "Granular Drainage Blanket" at the contract unit price is full compensation for the specified work.

SECTION 301

SUBGRADE MODIFICATION

301.1 DESCRIPTION

Modify the subgrade using the materials and methods shown in the Contract Documents.
When the Contract Documents specify, realign the shoulders and clean and reshape the ditches.

BID ITEMS	UNITS
Manipulation for Aggregate Subgrade Modification (*)(**)	Square Yard
Manipulation for In-Place Material Subgrade Modification (**)	Square Yard
Aggregate for Subgrade Modification (*)	Cubic Yard
Calcium Chloride	Ton
Cement	Ton
Fly Ash	Ton
Water (Subgrade Modification) (Set Price)	M Gallon

* Type, typically Rock, Silt or Millings
**Calcium Chloride, Cement or Fly Ash

301.2 MATERIALS

Provide materials that comply with the applicable requirements.

Aggregate for Subgrade Modification…	**DIVISION 1100**
Emulsified Asphalt (SS-1H or CSS-1H)	**DIVISION 1200**
Medium Cure Cutback Asphalt (MC-250)	**DIVISION 1200**
Calcium Chloride	**DIVISION 1700**
Portland Cement / Blended Hydraulic Cement	**DIVISION 2000**
Fly Ash	**DIVISION 2000**
Water for Subgrade Modification	**DIVISION 2400**
Admixtures / Retarders	**DIVISION 1400**

Provide silt for subgrade modification that complies with **TABLE 301-1**.

TABLE 301-1: SILT FOR SUBGRADE MODIFICATION

% Retained - Square Mesh Sieve		P.I. (maximum)
No. 4	No. 200	
0-5	0-50	12

In-place material may be existing rock surfacing or milled pavement. When pavement millings are provided, the maximum size shall be 1½ inches.

301.3 CONSTRUCTION REQUIREMENTS

a. Aggregate Subgrade Modification.

(1) General. Perform subgrade modification to the depth shown in the Contract Documents. Spread, mix and compact the materials as specified in the Contract Documents. Do not perform subgrade modification on frozen subgrade. Do not incorporate calcium chloride, cement or fly ash if air temperatures are expected below 32ºF during the first 24 hours after compaction.

(2) Subgrade preparation. Scarify the existing roadbed to the depth and width shown in the Contract Documents to provide the binder material. When the Contract Documents specify, provide binder material from the shoulder slopes, ditches and back slopes.

(3) Aggregate. Pulverize and mix the specified binder material and aggregate for subgrade modification until no more than 5% of the material is retained on a 2-inch sieve.

If silt is the specified aggregate, a maximum of 20% by weight, minus No. 200 sieve material, is allowed in the combined mixture.

(4) Calcium Chloride, Cement or Fly Ash (additive) Modified Subgrade. Before incorporating the additive in the subgrade, blade the roadway to allow uniform distribution of the additive. On projects having more than 20,000 square yards of manipulation, use equipment with a recycling or mixing drum and with an automatic water proportioning system to incorporate the additive and water into the subgrade to the specified depth. This system may be pressurized or mechanical in nature, utilizing vane or augers feeding cement or fly ash through a funnel or hood at a controlled rate.

On projects having less than 20,000 square yards of manipulation, and in irregular areas, submit a plan to the Engineer for approval that includes equipment and procedures that address subgrade preparation and application process to spread the cement or fly ash at the specified rate.

On projects having more than 20,000 square yards of manipulation, and consisting of multi-phased construction, contact the District Office for approval to waive the use of the controlled application system. Consideration will be based on the Contractor's proposed alternate method of applying the cement or fly ash, the square yards of manipulation in each phase, and the size of individual areas within each phase.

The Engineer will conduct laboratory tests on site materials and the specified additive content to establish the optimum moisture content.

Distribute the additive in a manner that minimizes loss of the material. Do not apply the additive if conditions are such that the material is lost due to the wind or rain. Do not use an additive that was not properly handled and stored in weatherproof containers. When specified, apply a uniform coverage of a retarder to the additive, immediately following the spreading of the additive. If the moisture content of the pulverized subgrade will accommodate additional moisture, the retarder may be diluted with water to obtain a uniform application.

Mix the subgrade, additive and water. Continue mixing until a homogeneous, friable mixture that complies with **TABLE 301-2** is obtained.

TABLE 301-2: CALCIUM CHLORIDE, CEMENT OR FLY ASH MODIFIED SUBGRADE	
% Retained - Square Mesh Sieves	
1 ½-inch	**½-inch**
0	50, maximum

Complete the mixing within 30 minutes of adding the water to the additive and the subgrade.

The uniform moisture content of the mixture immediately before being compacted shall be within ±3% of the optimum moisture content. If the moisture content of the mixture exceeds the optimum moisture content, add additional cement or fly ash to lower the moisture content. Distribute the mixture as needed to maintain the optimum moisture content during the compaction operations.

(5) Compaction. Use a vibratory roller having a minimum operating weight of 12 tons, with a minimum centrifugal force of 24 tons for the initial compaction of the mixture. Use a rubber-tired or smooth-wheeled roller to complete the compaction of the surface. Compact the modified subgrade to a minimum of 95% of the combined materials dry density, as determined in Part V. The compacted subgrade shall have uniform density and remain stable under construction traffic. Complete the compaction operations within 2 hours of incorporating the additive into the subgrade. If any of these requirements are not satisfied, reprocess, recompact and refinish the deficient areas.

(6) Trimming. After compacting the modified subgrade, trim the surface to the specified lines and grades. On projects having more than 20,000 square yards of manipulation, use automatic grade controlled equipment to trim the compacted modified subgrade. In irregular areas, trim the subgrade by wetting, blading and rolling. Compact the trimmed surface of the modified subgrade with a smooth-wheel or a pneumatic-tire roller. If necessary during the final rolling, lightly scarify and blade the surface to eliminate equipment imprints.

(a) Option 1 for Cement or Fly Ash Treated Subgrade. After compaction is complete, trim and recompact the subgrade within 2 ½ hours of the time the water and cementing agent is added to the subgrade. Compact the trimmed surface of the treated subgrade with a smooth-wheel or a pneumatic-tire roller. Lightly scarify and blade the surface to eliminate equipment imprints while performing final rolling.

(b) Option 2 for Cement or Fly Ash Treated Subgrade. After compaction is complete, trim the treated subgrade after 2 ½ hours of the time the water and cementing agent is added to the subgrade. Compact the trimmed surface of the treated subgrade with a smooth-wheel or a pneumatic-tire roller. Remove loose trimmed material from any low spots and fill with the next course of material at the Contractor's expense.

Clean and dress the shoulders and shoulder slopes. Remove all excess material and debris.

(7) Curing and Protection. Protect the finished subgrade against drying for 7 days after completion, or until the subgrade is covered with base or surfacing if covered before 7 days. Protect the finished subgrade from drying by spraying with water to maintain a continuous moist condition. The Contractor may apply an asphalt prime coat instead of keeping the finished surface moist with water during the curing period. If this option is chosen, apply SS-1H, CSS-1H or MC-250 at the rate of 0.22 gallons per square yard to achieve a minimum of 0.13 gallons per square yard residue. Multiple light applications may be necessary to obtain the specified rate of application without runoff.

b. In-Place Material Subgrade Modification. Pulverize or process the in-place material as specified in the Contract Documents.

Construct the subgrade modified with in-place materials according to **subsection 301.3a.**, using the specified in-place material for the aggregate.

c. Construction Traffic. Avoid placing construction loads or operating equipment until the treated subgrade has cured and can withstand the loads without damaging the subgrade. If the subgrade deforms under the construction loads and cannot return back to its original condition, or if it deflects more than 1 inch, allow the subgrade additional curing time before operating equipment on the subgrade. Repair any damaged subgrade.

d. Succeeding Course. Cover the finished treated subgrade with the specified lift of HMA or aggregate base before it is subjected to freezing. If the finished treated subgrade is not covered with a lift of HMA or aggregate base and is subjected to freezing, the Engineer will determine when the subgrade needs to be reworked. KDOT will not pay for the replacement and refinishing of the treated subgrade if the material loses the required stability, density or finish before the next course is placed.

301.4 MEASUREMENT AND PAYMENT

The Engineer will measure aggregate for subgrade modification and silt for subgrade modification by the cubic yard by vehicle measurement at the place of unloading. If weight is converted to cubic yards for payment, the moisture in the aggregate is not measured for payment.

The Engineer will measure water used for modified subgrade by the M Gallon using calibrated tanks or water meters. The Engineer will measure water used for subgrade preparation and mixing, compacting and curing the modified subgrade. The Engineer will not measure water used for dust control, water wasted through the Contractor's negligence or water in excess of the quantity required for mixing and compacting the modified subgrade.

If the Contractor opts to use asphalt material to cure the modified subgrade, the Engineer will not measure the asphalt material for payment.

The Engineer will measure calcium chloride, cement and fly ash by the ton. The Engineer will not measure additional cement or fly ash added to the mixture to reduce moisture content.

The Engineer will measure the various types of subgrade manipulation by the square yard.

Payment for "Manipulation for Aggregate Subgrade Modification", "Manipulation for In-Place Material Subgrade Modification", "Aggregate for Subgrade Modification", "Calcium Chloride", "Cement" and "Fly Ash" at the contract unit prices and "Water (Subgrade Modification) (Set Price)" at the contract set unit price is full compensation for the specified work.

SECTION 302

LIME TREATED SUBGRADE

302.1 DESCRIPTION

Mix soil, lime and water either in-place or off-site in a borrow area. Use the mixed materials to construct a uniform lime treated subgrade as shown in the Contract Documents.

BID ITEMS	UNITS
Lime	Ton
Manipulation (Lime Treated Subgrade)	Square Yard
Water (Lime Treated Subgrade) (Set Price)	M Gallon

302.2 MATERIALS

Provide materials that comply with the applicable requirements.

Emulsified Asphalt (SS-1 or CSS-1)	**DIVISION 1200**
Medium Cure Cutback Asphalt (MC-250)	**DIVISION 1200**
Liquid Membrane Forming Compounds	**DIVISION 1400**
Lime	**DIVISION 2000**
Water for Lime Treated Subgrade	**DIVISION 2400**

302.3 CONSTRUCTION REQUIREMENTS

a. Preparation and Maintenance of the Subgrade or Off-Site Borrow Area. Before the application of the lime treatment, use automatic grade controlled equipment to trim the surface of the subgrade or borrow area to the specified lines and grades. In irregular areas, trim the subgrade or borrow area by wetting, blading and rolling. Trim borrow areas to the profile established by the Contractor. Uniformly compact the trimmed subgrade or borrow area.

Maintain the subgrade or borrow area as prepared. Provide proper drainage at all times. Correct defects that develop in the subgrade or borrow area.

b. Application of Lime. When the lime is not applied through a mixing chamber to the prepared in-place subgrade or off-site borrow area, scarify the prepared area to a minimum depth of 4 inches and a maximum depth of approximately 1 inch less than the specified depth of lime treatment. The specified depth of lime treatment for in-place areas is designated in the Contract Documents. The Contractor shall determine the depth of lime treatment for off-site areas.

The application rate of lime is based on the weight of soil being treated and is shown in the Contract Documents. If the application rate is not shown in the Contract Documents, assume a rate of 5% of the weight of soil.

Perform the scarification with positive depth control equipment. Do not use a plow or disc for the scarification. The Engineer may approve the use of a positive depth controlled motor grader scarifier on a performance basis.

When pebble quicklime is used, slake it at the jobsite to manufacture hydrated lime slurry, according to **DIVISION 2000** and the following.

Determine the amount of water needed to make slurry from dry quick lime using the following:

$$W_W = ((A+B)/P_S)-W_{QL}$$

Where:

A = (Quicklime Delivered) * (% purity in decimal form) * 1.32 = $W_{QL} * P_{CaO} * 1.32$

B = (Quicklime Delivered) * (% inert material) * 1.0 = $W_{QL} * P_I$

$A + B$ = Total Hydrated Lime Produced (Pay Quantity)

W_W = Weight of Water Required for Slurry of Given Percent Solids, tons

W_{QL} = Quicklime Weight, tons

P_{CaO} = Percent of CaO in the Quicklime, purity (as a decimal)

P_I = Percent of Inert Material in the Quicklime (as a decimal)

P_S = Percent Solids in the Lime Slurry (as a decimal)
Gallons of Water = W_W * 2000/8.34

Use a percent solids between 20 and 40%. Determine the concentration strength of the hydrated lime slurry and rate of application to obtain the percent of lime specified in the Contract Documents and advise the Engineer accordingly. See **TABLE 302-1**.

Apply hydrated lime to the scarified areas as slurry. Use equipment that can apply lime slurry through a system of spray bars and nozzles. Regulate the amount of lime slurry from each nozzle and the speed of the delivery vehicle so that the specified amount of lime is placed on the soil. The concentration of the hydrated lime slurry shall allow the application of the correct quantity of lime without adding an undue quantity of excess moisture to the mixture. The application and mixing of the hydrated lime slurry shall result in a uniform lime concentration.

Test the concentration of the lime suspension at the minimum rate of 1 per day or 1 per mixed batch, whichever is greater; use **TABLE 302-1** and a volume measuring device and scale. Use KT-62, Percent Solids of Lime to determine water requirements for slaking for a percent solids. During slaking, check the density of the solution periodically to determine the time required for complete slaking. The minimum amount of time for slaking is 20 minutes.

Apply the hydrated lime slurry the same day it is produced. Continuously agitate the hydrated lime after the batch is made. If the liming operation is interrupted, continue agitating the hydrated lime in storage. If the interruption will be lengthy, the Contractor has the option to cease mixing. In either case, prior to resuming liming operations, the Contractor shall re-test the concentration and adjust the rate of application accordingly. The Engineer will verify the results.

Check the lime application, such as pH testing. Other methods, may be used if approved by the Engineer.

c. Adding Water. Add water, as necessary, to facilitate mixing of the hydrated lime slurry and soil. During the initial mixing operation, add water to obtain a minimum moisture content of 8% above the optimum moisture content of the raw soil being treated.

The Engineer will measure the moisture content (KT-11) immediately after the mixing is completed, and before sealing or compacting.

d. Preliminary Mixing. Mix the lime, soil and water to the dimensions specified in the Contract Documents. For off-site borrow areas, the Contractor shall determine the depth and width. For projects containing more than 20,000 square yards of manipulation, positively control the depth of mixing to maintain the specified depth ± ½ inch. Use equipment with positive depth control that can maintain cutting or mixing heads in a fixed position relative to the wheels or tracks of the machine carrying the head.

Perform a minimum of 2 passes with the mixer traveling in the primary direction. Continue mixing until 95% of the mixture passes the 2-inch sieve as determined by the Engineer (KT-42).

While mixing, do not disturb the roadway or borrow area beyond the specified limits of the lime treatment.

e. Aging. Seal the mixture to prevent moisture loss by lightly rolling with a pneumatic-tired roller. Blade the surface to shed water.

(1) Material Mixed In-Place. Maintain the mixture in the sealed condition for a minimum of 24 hours prior to commencing final mixing.

(2) Material Mixed in a Borrow Area. Maintain the mixture in the sealed condition a minimum of 24 hours or until the mixture is ready to be used.

In both (1) and (2) above keep the surface moist by spraying with water. If the final mixing is not performed within 14 days of the preliminary mixing, add 1% lime by weight of raw soil, in the final mixing operation. If the Contractor knows the final mixing will not be performed within 14 days, the Contractor may reduce the rate of lime applied in the initial application by 1%, and add the 1% in the final mixing.

f. Final Mixing. After the initial mixing and aging (24 hours) is completed, re-mix the mixture to the specified depth (± ½ inch) and width, until 95% of the mixture passes the 1½-inch sieve and 40% passes the No. 4 sieve as determined by the Engineer (KT-42). Periodic mixing over an interval of time is allowed to facilitate the breakdown in particle size. Bring the mixture to the moisture content required for compaction with a minimum of 3% above optimum of the proctor density of the lime treated soil.

While mixing, do not disturb the roadway or borrow area beyond the specified limits of the lime treatment.

g. Compaction of the Mixture. When the material is mixed in-place, compact the material after completing the required final mixing.

When the material is mixed off-site, excavate and haul the material to the project site. Place the material on the prepared and trimmed surface, and compact the material.

Compact the mixture to Type B compaction, MR-3-3 moisture control, **SECTION 205**. Blade the mixture to eliminate surface irregularities during the compaction operations. Maintain the moisture content to a minimum of 3% above optimum of the proctor density of the lime treated soil.

h. Finishing and Curing the Lime Treated Subgrade. After the mixture is compacted, use automatic grade controlled equipment to trim the lime treated subgrade to the specified lines and grades. In irregular areas, trim the lime treated subgrade by wetting, blading and rolling. Compact the trimmed surface with a smooth-wheel or a pneumatic-tire roller.

After the compacted mixture is finished, cure the lime treated subgrade for 7 days, by keeping the finished surface moist with water. Do not allow vehicles or equipment (other than watering equipment) on the finished lime treated subgrade during the curing period.

At the Contractor's option, apply an asphalt prime coat instead of keeping the finished surface moist with water. If asphalt prime coat is used, apply SS-1, CSS-1 or MC-250 at the rate of 0.22 gallons per square yard to achieve a minimum of 0.13 gallons per square yard residue. The use of a liquid membrane forming compound is also an acceptable curing medium. Multiple light applications may be necessary to obtain the specified rate of application without run-off.

When a base course or subbase is to be constructed upon the lime treated subgrade, the Engineer may reduce the curing period to when the lime treated subgrade gains sufficient strength to support the construction and hauling equipment. Repair any damage to the lime treated subgrade due to construction of the base course or subbase.

i. Seasonal Limitations. Do not perform lime treatment operations if the ambient air temperature is below 40°F, or the soil is frozen.

(1) Projects with Rigid Pavement. Cover the finished lime treated subgrade with base or pavement before it is subjected to freezing. If the lime treated subgrade is not covered by base or pavement and is subjected to freezing, re-compact the lime treated subgrade before placing any pavement. The Engineer will determine the extent of the re-compaction.

(2) Projects with Flexible Pavement. Cover the finished lime treated subgrade with the specified lift of HMA or aggregate base before it is subjected to freezing. If lime treated subgrade is not covered with a lift of HMA or aggregate base and is subjected to freezing, add additional lime and re-compact the lime treated subgrade before placing any pavement. The Engineer will determine (by laboratory or field tests) the additional quantity of lime to add, if any, and the extent of the re-compaction.

302.4 MEASUREMENT AND PAYMENT

The Engineer will measure lime by the ton. If bagged lime is used, the Engineer will use the net weight marked on the bag by the manufacturer for the measurement. If certified railroad car or certified truck quantities are used, the Engineer will use the net weight of the lime for the measurement.

Using the relationship for Pure Quicklime (CaO) x 1.32 = Hydrated Lime ($Ca(OH)_2$), determine the basis of pay for jobsite slaked hydrated lime (A+B) according to **subsection 302.3b.** using the certified lime purity for each load.

Calculate the pay quantity for carbide lime as follows:

Pay Quantity = (Weight of material delivered) (% solids)

The percent moisture will not be credited toward water for pay.

The Engineer will measure the manipulation of the lime treated subgrade by the square yard. Material placed beyond the neat lines indicated in the Contract Documents is not measured for payment without approval by the Engineer.

The Engineer will measure water used for lime treated subgrade by the M Gallon using calibrated tanks or water meters. The Engineer will measure water used for subgrade preparation, mixing subgrade and lime, compacting and curing the lime treated subgrade. The Engineer will not measure water used for slaking the lime, dust control, water wasted through the Contractor's negligence or water in excess of the quantity required for mixing and compacting the lime treated subgrade.

If the Contractor opts to use asphalt prime coat or liquid membrane forming compound to cure the lime treated subgrade, the Engineer will not measure the asphalt prime coat for payment or liquid membrane forming compound.

The Engineer will not measure for payment, the lime, manipulation or water used for adding additional lime or re-compaction if:

- The off-site borrow area mixture is not used with 14 days of the preliminary mixing.
- The lime treated subgrade is not covered with pavement before it is exposed to freezing temperatures.

Payment for "Lime" and "Manipulation (Lime Treated Subgrade)" at the contract unit prices and "Water (Lime Treated Subgrade) (Set Price)" at the contract set unit price is full compensation for the specified work.

TABLE 302-1: STRENGTH OF HYDRATED LIME SLURRY	
Lb. per gal. of suspension	**Lb. Ca $(OH)_2$ per gallon, suspension**
8.41	.135
8.50	.272
8.58	.412
8.66	.546
8.75	.691
8.83	.830
8.91	.962
8.99	1.106
9.08	1.244
9.16	1.392
9.25	1.517
9.33	1.679
9.41	1.816
9.50	1.948
9.58	2.09
9.66	2.23
9.75	2.38
9.85	2.52
9.91	2.68
10.00	2.80
10.08	2.94
10.16	3.09
10.24	3.24
10.33	3.39
10.41	3.52
10.49	3.71
10.58	3.86
10.66	4.00
10.74	4.15
10.83	4.29
10.91	4.45
11.00	4.60
11.08	4.73
11.16	4.90
11.25	5.04
11.33	5.18
11.41	5.32
11.50	5.49
11.58	5.62
11.66	5.78
11.75	5.95
11.83	6.09
11.91	6.22
12.00	6.37
12.08	6.51

SECTION 303

CEMENT OR FLY ASH TREATED SUBGRADE

303.1 DESCRIPTION

Mix subgrade soil, cement or fly ash and water to construct a uniform treated subgrade as shown in the Contract Documents.

BID ITEMS	UNITS
Cement	Ton
Fly Ash	Ton
Manipulation for Treated Subgrade (*)	Square Yard
Water (Treated Subgrade) (Set Price)	M Gallon

*Cement or Fly Ash

303.2 MATERIALS

Provide materials that comply with the applicable requirements.

Emulsified Asphalt (SS-1 or CSS-1)	**DIVISION 1200**
Medium Cure Cutback Asphalt (MC-250)	**DIVISION 1200**
Concrete Admixtures & Curing Materials	**DIVISION 1400**
Portland Cement & Blended Hydraulic Cement	**DIVISION 2000**
Fly Ash	**DIVISION 2000**
Water for Treated Subgrade	**DIVISION 2400**

303.3 CONSTRUCTION REQUIREMENTS

a. Subgrade Preparation. Prepare the subgrade to the lines and grades shown in the Contract Documents.

Scarify the prepared subgrade to the depth of treatment designated in the Contract Document prior to applying the cement or fly-ash. Perform the scarification with positive depth control equipment. Do not use a plow or disc for the scarification. Based on performance, the Engineer may approve the use of an automatic grade control motor grader scarifier. Bring the scarified subgrade to within the specified moisture content of the previous moisture range before adding cement or fly ash.

b. Application. On projects having more than 20,000 square yards of manipulation, apply cement or fly ash using a controlled application system. This system may be pressurized or mechanical in nature, utilizing vane or augers feeding cement or fly ash through a funnel or hood at a controlled rate.

On projects having less than 20,000 square yards of manipulation, and in irregular areas, submit a plan to the Engineer for approval that includes equipment and procedures that address subgrade preparation and application process to spread the cement or fly ash at the specified rate.

On projects having more than 20,000 square yards of manipulation, and consisting of multi-phased construction, contact the District Office for approval to waive the use of the controlled application system. Consideration will be based on the Contractors proposed alternate method of applying the cement or fly ash, the square yards of manipulation in each phase, and the size of individual areas within each phase.

Do not apply the cement or fly ash when conditions are such that the material is lost due to the wind. Do not use cement or fly ash that was not properly handled and not stored in weatherproof containers.

The Engineer will check the application rate of cement or fly ash by having the Contractor blade a flat area in the path of the cement or fly ash application, place a planar surface with a minimum surface area of 1 square foot (e.g. a straight-sided pan) and of sufficient height to contain the admixture on the prepared area and allow the train to pass over the surface. Weigh the test surface before and after the cement or fly ash application and calculate the application rate. Other methods to check the application rate may be used.

c. Mixing. Mix the scarified subgrade and cement or fly ash. Continue mixing and adding water until a homogeneous, friable mixture that complies with **TABLE 303-1** is obtained. Use equipment with a recycling or mixing drum, and with an automatic water proportioning system to pulverize the subgrade to the specified depth.

Do not perform treated subgrade operations when the ambient air temperature is below 40°F, or the soil is frozen.

TABLE 303-1: PERCENT RETAINED - SQUARE MESH SIEVES*	
1½-inch	**½-inch**
0	50 maximum

*The Engineer will determine the percent retained on the specified sieves according to KT-42.

Complete the mixing within 30 minutes of adding the cement or fly ash to the pulverized subgrade.

The uniform moisture content of the mixture immediately before being compacted shall be ±3 percentage points of the optimum moisture content. If the moisture content of the mixture exceeds the specified moisture content, add additional cement or fly ash to lower the moisture content. Spray the mixture with water, as necessary, to maintain the specified moisture content during the compaction operations.

d. Compaction. For the initial compaction of the mixture, use a vibratory roller having a minimum operating weight of 12 tons, with a minimum centrifugal force of 24 tons. Use a rubber-tired or smooth-wheeled roller to complete the compaction of the surface. When the thickness is greater than 6 inches, compact multiple lifts of equal thickness with a maximum lift thickness of 6 inches. Compact the treated subgrade to a minimum of 95% of the combined materials dry density. Complete the compaction operations within 2 hours of incorporating the cement or fly ash into the subgrade. If any of these requirements are not satisfied, reprocess, recompact and refinish the deficient areas.

e. Trimming. After compaction of the treated subgrade, trim and recompact the treated subgrade to the specified lines and grades. On projects having more than 20,000 square yards of manipulation, use automatic grade controlled equipment to trim the subgrade. In irregular areas, trim the subgrade by wetting, blading and rolling.

(1) Option 1. After compaction is complete, trim and recompact the subgrade within 2 ½ hours of the time the water and cementing agent is added to the subgrade. Recompact the trimmed surface of the treated subgrade with a smooth-wheel or a pneumatic-tire roller. Lightly scarify and blade the surface to eliminate equipment imprints while performing final rolling.

(2) Option 2. After compaction is complete, trim the treated subgrade after 2 ½ hours of the time the water and cementing agent is added to the subgrade. After curing according to **subsection 303.3f.**, recompact the trimmed surface of the treated subgrade with a smooth-wheel or a pneumatic-tire roller. Remove loose trimmed material from any low spots and fill with the next course of material at the Contractor's expense.

f. Curing. Protect the finished subgrade against drying for 7 days after completion (Option 1-after compaction, Option 2-after trimming), or until the subgrade is covered with a base or surfacing if covered before 7 days. Protect the finished subgrade from drying by spraying with water to maintain a continuous moist condition. The Contractor may apply an asphalt prime coat instead of keeping the finished surface moist with water during the curing period. If this option is chosen, apply SS-1, CSS-1 or MC-250 at the rate of 0.22 gallons per square yard to achieve a minimum of 0.13 gallons per square yard residue. Multiple light applications may be necessary to obtain the specified rate of application without runoff.

g. Construction Traffic. Avoid placing construction loads or operating equipment until the treated subgrade has cured and can withstand the loads without damaging the subgrade. If the subgrade deforms under the construction loads and cannot return back to its original condition, or if it deflects more than 1 inch, allow the subgrade additional curing time before operating equipment on the subgrade. Repair any damaged subgrade.

h. Succeeding Course. Cover the finished treated subgrade with the specified lift of HMA or aggregate base before it is subjected to freezing. If the finished treated subgrade is not covered with a lift of HMA or aggregate base and is subjected to freezing, the Engineer will determine when the subgrade needs to be reworked. KDOT will not pay for the replacement and refinishing of the treated subgrade if the material loses the required stability, density or finish before the next course is placed.

303.4 MEASUREMENT AND PAYMENT

The Engineer will measure cement or fly ash used in the mixture by the ton. The Engineer will not measure additional cement or fly ash added to the mixture to reduce the moisture content.

The Engineer will measure the manipulation for treated subgrade by the square yard.

The Engineer will measure water used for cement treated subgrade by the M Gallon using calibrated tanks or water meters. The Engineer will measure water used for preparation of the subgrade, mixing subgrade and cement or fly ash, and the 7-day protection from drying period. The Engineer will not measure water used for dust control, water wasted through the Contractor’s negligence or water in excess of the quantity required for mixing and compacting the cement subgrade.

If the Contractor opts to use asphalt material to cure the treated subgrade, the Engineer will not measure the asphalt material for payment.

Payment for "Cement", "Fly Ash" and "Manipulation for Treated Subgrade" at the contract unit prices and "Water (Treated Subgrade) (Set Price)" at the contract set unit price is full compensation for the specified work.

SECTION 304

CRUSHED STONE SUBGRADE

304.1 DESCRIPTION

Construct a uniform crushed stone subgrade as backfill in cut sections or as topping of fill sections as shown in the Contract Documents.

BID ITEMS	UNITS
Crushed Stone Subgrade (*)	Square Yard
Water (Crushed Stone Subgrade) (Set Price)	M Gallon
*Thickness	

304.2 MATERIALS

Provide materials that comply with the applicable requirements.

Aggregates for Backfill .... **DIVISION 1100**
Water for Crushed Stone Subgrade .... **DIVISION 2400**

304.3 CONSTRUCTION REQUIREMENTS

Prepare the cut or fill section for the crushed stone subgrade by scarifying, watering, blading and compacting to the specified lines and grades. Do not place crushed stone subgrade on frozen subgrade.

The Engineer will obtain a sample of the crushed stone for backfill from materials stockpiled at the project site, and submit to MRC where the relative density will be determined using KT-69. Allow 48 hours for testing by the MRC.

Uniformly mix the crushed stone with a sufficient quantity of water to provide satisfactory compaction. The mixing methods are:

- Central Plant Method. Use a stationary mechanical mixing plant to mix the water and aggregate.
- Road Mix Method. After the aggregate is placed in a uniform windrow, use a motor grader, or other equipment approved by the Engineer, to mix the water and the aggregate.

Spread and compact the crushed stone subgrade as specified in the Contract Documents. If the thickness is greater than 6 inches, spread and compact the crushed stone subgrade in multiple lifts of equal thickness with a maximum lift thickness of 6 inches. Compact the crushed stone subgrade to a uniform density, a minimum of 70% of the relative density. The Engineer will verify the relative density using a nuclear gauge (KT-41).

If during production, the gradation changes ±10% from the single point designation on any single sieve, cease spreading and compaction operations. The Engineer will obtain a new sample for relative density, submit sample to the MRC and a new relative density value will be established.

304.4 MEASUREMENT AND PAYMENT

The Engineer will measure crushed stone subgrade by the square yard.

The Engineer will measure water used for crushed stone subgrade by the M Gallon using calibrated tanks or water meters. The Engineer will measure water used for subgrade preparation, mixing and compacting the crushed stone subgrade. The Engineer will not measure water used for dust control, water wasted through the Contractor's negligence or water in excess of the quantity required for mixing and compacting the crushed stone subgrade.

Payment for "Crushed Stone Subgrade" at the contract unit price and "Water (Crushed Stone Subgrade) (Set Price)" at the contract set unit price is full compensation for the specified work.

SECTION 305

AGGREGATE BASE AND AGGREGATE SHOULDERS

305.1 DESCRIPTION

Construct aggregate base and aggregate shoulders on prepared subgrade as shown in the Contract Documents.

BID ITEMS	**UNITS**
Aggregate Base (*)(**)	Square Yard
Aggregate Shoulder (*)(**)	Square Yard
Calcium Chloride	Ton
Water (Aggregate Base) (Set Price)	M Gallon
Water (Aggregate Shoulders) (Set Price)	M Gallon

*Type of Aggregate
**Thickness

305.2 MATERIALS

Provide materials that comply with the applicable requirements.

Aggregate for Aggregate Base	**DIVISION 1100**
Aggregate for Shoulder	**DIVISION 1100**
Calcium Chloride	**DIVISION 1700**
Water for Aggregate Base and Aggregate Shoulder	**DIVISION 2400**

305.3 CONSTRUCTION REQUIREMENTS

a. Subgrade Preparation. Unless other subgrade preparation is included in the Contract Documents, water, scarify, blade and compact the roadway and shoulder subgrade to obtain the lines and grades shown in the Contract Documents. Remove all vegetation before shaping and rolling. Remove and dispose of any excess material. If additional embankment material is needed, obtain the material from locations shown in the Contract Documents or as directed by the Engineer.

Excavate the subgrade as shown in the Contract Documents. If existing pavements or bridges are encountered, excavate the subgrade at all control points to a depth that will allow placement of the required thickness, flush with the existing surface. Use a transition (from normal to special section) of sufficient length to prevent an abrupt or noticeable change in grade. Remove and dispose of the excavated subgrade. Compact the excavated areas to a depth of 6 inches, according to the Contract Documents. When subgrade compaction is not specified in the Contract Documents, compact the excavated areas to a depth of 6 inches, according to Type B, MR-90, **SECTION 205**.

b. Mixing. The mixing methods are:

- Central Plant Method. Use a stationary mechanical mixing plant to uniformly mix the water and aggregate.
- Road Mix Method. After the aggregate is placed in a uniform windrow, use a motor grader, or other equipment approved by the Engineer, to uniformly mix the water and the aggregate.

Mix the aggregate with sufficient water to allow compaction of the mixture to the specified density. If the aggregate is predominantly limestone, use the central plant. Use a central plant or road mix method to mix types of granular aggregate other than limestone, or to mix any type of aggregate if the original contract quantity is less than 15,000 square yards.

When shown in the Contract Documents, mix calcium chloride with the aggregate at the specified rate. Add the calcium chloride (in solution, flakes, pellets or granular) at the same time the water is mixed with the aggregate.

c. Placing, Compacting and Finishing. Immediately after mixing the aggregate and water, use an aggregate spreader to place the mixture full-lane or full-shoulder width. Do not place the mixed material on the prepared subgrade when conditions are such that the hauling and placing will damage the prepared subgrade. Do not dump or mix the aggregate on any paved surface.

The maximum compacted thickness of any layer of aggregate base or shoulder is 6 inches. If the thickness is greater than 6 inches, spread and compact the aggregate base in multiple lifts of equal thickness with a maximum lift thickness of 6 inches. The maximum compacted thickness of any layer may be increased to 8 inches when vibrating compaction equipment or other compaction equipment is approved by the Engineer. On aggregate course projects without shoulders, construct all lifts, regardless of thickness, with an edge slope of 1:1 or flatter. If the aggregate base or shoulder is constructed in more than 1 layer, allow sufficient time for the initial layer to cure to prevent any rutting or surface distortion from equipment being used to place the succeeding layers.

Spread and compact the aggregate base or shoulders as specified in the Contract Documents. Compact the aggregate base to a minimum uniform density of 95% of the standard density. Compact the aggregate shoulders until no further consolidation is gained by additional blading and rolling. The Engineer will visually verify compaction of the aggregate shoulders.

After compacting the aggregate base, trim the surface to the specified lines and grades. On projects having more than 20,000 square yards of aggregate base, use automatic grade controlled equipment to trim the compacted aggregate base. In irregular areas, trim the aggregate base by wetting, blading and rolling. Compact the trimmed surface of the aggregate base with a smooth-wheel or a pneumatic-tire roller. When necessary, lightly scarify and blade the surface to eliminate equipment imprints while performing final rolling.

d. Curing and Maintenance of Aggregate Base. Cure the compacted layer to develop sufficient stability to resist wheel truck rutting before vehicular hauling or heavy equipment is permitted on the base. When Contract Documents call for a PGAB or cutback asphalt prime coat on the aggregate base, cure the compacted layer to maximum moisture content of 60% of optimum moisture content for AB-1, AB-2, & AB-4 and 70% for AB-3, prior to the construction of the Asphalt Prime Coat. The Engineer will perform testing to determine when the cure of the aggregate base is complete. The Engineer may require that the surface of the aggregate base be kept moist during the curing period to prevent loss of surface material.

Do not apply surfacing until the aggregate base is cured. Maintain the base until the surfacing is applied.

e. Shoulders, Entrances and Side Roads. When shoulder construction is not included in the Contract Documents, re-construct, compact and shape the existing shoulder from the top of the completed aggregate base to the shoulder line. Shape the shoulders to provide a uniform shoulder line.

Raise the grade of entrances and side roads to meet the edge of the completed aggregate base. Construct, compact and shape the entrances and side roads full width with shoulders and shoulder radii adjacent to the shoulders of the roadway.

Obtain additional embankment material for shoulders, entrances and side roads from adjacent slopes and ditches. Dispose of excess material from shoulders, entrances and side roads on adjacent backslopes.

305.4 MEASUREMENT AND PAYMENT

The Engineer will measure aggregate base and aggregate shoulder by the square yard.

The Engineer will measure the water used in the mixture and used on the finished surface during the curing period by the M Gallon using calibrated tanks or distributors. The Engineer will not measure water in the mixture in excess of 5% above the optimum moisture. The Engineer will not measure water used for subgrade preparation or construction of earthen shoulders, entrances and side roads. The Engineer will not measure water used for dust control or water wasted through the Contractor’s negligence.

The Engineer will measure Grade 2 calcium chloride (concentrated calcium chloride or equivalent) used in the mixture by the ton. If Grade 1 calcium chloride (regular) is used, 1.2 tons of Grade 1 is the equivalent of 1 ton of Grade 2. The Engineer will not measure the wedges at the pavement edge.

Payment for "Aggregate Base", "Aggregate Shoulders" and "Calcium Chloride" at the contract unit prices and "Water (Aggregate Base) (Set Price)" and "Water (Aggregate Shoulders) (Set Price)" at the contract set unit prices is full compensation for the specified work.

SECTION 306

CEMENT TREATED BASE

Exception: If the PCCP in the contract is <u>not</u> specified as QC/QA, (Bid item Quality Control Testing (CTB) is not included as a bid item) subsections 306.2 (entire subsection), 306.4d. and 306.4g. of this SECTION are <u>not</u> applicable to the contract.

306.1 DESCRIPTION

Design a cement treated base (CTB) mixture meeting the requirements of the Contract Documents. Construct 1 or more courses of the CTB on a prepared roadway as shown in the Contract Documents.

BID ITEMS	UNITS
Cement Treated Base	Square Yard
Quality Control Testing (CTB)	Square Yard

306.2 CONTRACTOR QUALITY CONTROL REQUIREMENTS

a. General. Provide qualified personnel and sufficient equipment complying with the requirements listed in Part V to conduct quality control testing that complies with Appendix B, Sampling and Testing Frequency Chart for Concrete Construction Items for Quality Control/Quality Assurance Projects.

Allow the Engineer access to the Contractor's laboratory to observe testing procedures, calculations, test documentation and plotting of test results.

Calibrate and correlate the testing equipment with prescribed procedures, and conduct tests in compliance with specified testing procedures as listed in Part V.

Maintain a Quality Manual in the field laboratory showing the calibrations performed on all test equipment and when the next calibration is due for that equipment. As a minimum, follow the calibration/verification interval established in Table 1: Concrete Materials Test Equipment in Section 5.2.7.8-Cement Treated Base: Contractor's Quality Control Plan (CTB), Part V. See also, Part V Section 5.2.7.8.1-Example of a Laboratory Quality Manual for CTB.

Provide personnel and equipment to conduct quality control testing that complies with the Contract Documents. Provide certified technicians to perform process control testing. Use equipment that complies with, and is calibrated according to the specified test methods.

b. Quality Control Plan (QCP). At the pre-construction conference, submit to the Engineer for approval by the DME, a QCP as outlined in Section 5.2.7-Contractor's Quality Control Plan, Part V. Follow 5.2.7.8-Cement Treated Base: Contractor's Quality Control Plan in Part V as a general guideline. Keep a printed copy of the approved QCP in the Contractor's laboratory and make available to the Engineer when requested.

The Contractor's laboratory and equipment will be inspected and approved as outlined in Part V, Section 5.2.7-Contractor's Quality Control Plan.

Include a listing of the names and phone numbers of individuals and alternates responsible for quality control administration and inspection. On the Contractor's organizational chart, show the specified lines of authority relating both to mix design and quality control operations during production. Post the organizational chart in the Contractor's test facility.

Provide a quality control organization or private testing firm having personnel certified according to the Policy and Procedures Manual for The Certified Inspection and Testing (CIT) Training Program. The testing for this type of construction will require personnel certified in ACI Concrete Field Testing Technician (CF), Aggregate Field Tester (AGF), Soils Field Tester (SOF) and Nuclear Moisture Density Gauge Tester (NUC) classifications. Only persons certified in the appropriate classifications covering the specific tests required shall perform such testing. Provide a minimum of 1 employee on the project certified in the QC/QA Concrete/Cement Treated Base Specs (QCS) classification.

Only persons certified in the appropriate classifications covering the specific tests required shall perform such testing. At the beginning of the project, provide the Engineer with the list of certified technicians and alternates, phone numbers and tests/inspection they will be performing. As personnel changes and certifications may expire, continue to provide the Engineer with an accurate list.

Provide an organizational chart showing the specified lines of authority relating to both mix design and quality control operations during production. Identify the company official acting as liaison with KDOT, and the Certified Technician who will direct inspection and testing. Post the chart in the test facility.

Submit the mix design for the CTB. If an existing mix design is used, provide the mix design number. Include all the elements of the mix design specified in the Contract Documents.

Submit the proposed methods and procedures to control the elements identified as necessary for the quality of the CTB. These elements include, but are not limited to: producing the aggregate, managing the aggregate stockpiles, proportioning the individual materials for the mixture, mixing and transporting the mixture, placing and consolidating the mixture, and finishing and curing the mixture.

c. Required Duties of Certified Technicians. Be available on the project site whenever cement treated base is being produced and being placed on the project site. Perform and utilize quality control tests and other quality control practices to assure that delivered materials and proportioning meet the requirements of the mix designs, including temperature, slump, air content and strength.

Periodically inspect all equipment utilized in transporting, proportioning, mixing, placing, consolidating, finishing and curing to assure it is operating properly and that placement, consolidation, finishing and curing comply with the mix design and other contract requirements.

d. Contractor's Testing Facilities. Describe the testing facility and its accreditation in the QCP.

Locate the testing facility either at the plant site or at the project. Obtain approval of the testing facilities and location from the DME before the commencement of mixture production.

Provide suitable space for the required testing equipment. Also, equip the testing facility with these items for the exclusive use of the testing facility's quality control personnel and the Engineer:

- A telephone with a private line;
- A copying machine; and
- Broadband internet connection (for 1 computer). If the Engineer determines that broadband internet service is not available, provide a fax machine, at no additional cost.

e. Documentation. Include in the QCP procedures, charts and forms to be used to provide the required documentation.

Record and document all test results and calculations. Record all original documentation in a bound field book or other KDOT approved bound record and turn over to KDOT at the end of the project.

At all times, have complete records of all inspections and tests readily available on site for the Engineer. All records documenting the Contractor's quality control inspections and tests become the property of KDOT upon completion of the work.

Indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and the corrective action taken in the records. Examples of quality control forms and charts are available in Part V, or Contractors may design their own. Documentation procedures are subject to approval by the Engineer before the start of the work and to compliance checks during the progress of the work.

Maintain control charts on an ongoing basis. Plot data according to **SECTION 106**.

Record all test results and calculations on electronic data sheets. Record specific test results on a Daily Quality Summary Sheet to facilitate the computation of moving test averages. Base the moving averages on 4 consecutive test results. Include a description of quality control actions taken (adjustment of aggregate or additive proportions in the mix, moisture adjustments, etc.) in the Daily Quality Summary Sheet.

Provide forms on a computer-acceptable medium, where required. Document batch tickets and gradation data according to KDOT requirements.

Complete testing and charting within 1 working day after sampling.

Keep all quality control charts current. Email or fax the data to the Field Engineer and DME, weekly. Show both individual test results and moving average values. As a minimum, plot the single test values and the 4-test moving average values for gradation of combined aggregates, in-place CTB moisture and dry density, and compressive strength (requires a separate graph for PWL, but no moving average plot).

Complete the charting within 1 working day after the sampling or testing, respective to each type of test.

Make all test results and control charts available to the Engineer at the project site. The Engineer will periodically make compliance checks on the documentation during the progress of the work.

Submit (email or fax) copies of all failing test results (based on a moving average of 4 tests, if appropriate) and a summary sheet to the Field Engineer on a daily basis.

File all reports, records, charts and diaries developed during the progress of construction activities. Upon completion of the contract, all documentation becomes the property of KDOT.

f. Testing Requirements. In the QCP, identify test methods, procedures and equipment proposed for use. Use standard KDOT test methods and properly calibrated measuring and testing equipment as outlined in Part V. Detail any alternative sampling method, procedure or inspection equipment proposed to be used. Such alternatives are subject to review and approval by the DME.

Take all samples for tests and perform in-place tests at random locations selected according to the Contractor's QC Plan and at the rates specified in the Sampling and Testing Frequency Chart for Cement Treated Base for Quality Control/Quality Assurance Projects in Appendix B, Part V. Retain the latest 10 gradation samples for use by the Engineer.

Retain the second half of the latest 10 gradation samples for use by the Engineer.

g. Mix Design. Design a mixture of aggregate and portland cement or fly ash, or both. If fly ash is used in the mixture, address the set time and strength gain as a function of the ambient temperature. Design the mixture according to the following requirements:

(1) The compressive strength shall be between 650 and 1600 psi. Any test correlating to the maximum value or higher requires scoring or sawing joints in the base that fall within the failing test section (from previous to next passing test sections). Determine compressive strength at 7 days, according to Part V.

(2) Submit a single point gradation for the combined aggregates along with a plus/minus tolerance for each sieve to the Engineer. The plus/minus tolerances shall be used by the Contractor to perform quality control checks and by the Engineer to perform aggregate gradation verification testing. Perform tests on the combined materials.

(3) Submit the mix batch weights in an acceptable manner to the DME. Address the initial set times (specified in AASHTO T 154) and placement times (with regards to the set times) in the proposed mix design.

(4) Submit laboratory compressive strength test results on a minimum of 1 set of 3 plugs, produced from the proposed mix design and utilizing the actual materials proposed for use on the contract.

(5) Submit the test results 2 weeks prior to the anticipated date for using the design on the contract. The Engineer will review the design within 5 working days of receipt. The Engineer may perform any testing necessary to verify the adequacy of the Contractor's design. If the Engineer calls for verification tests, supply the Engineer with the necessary materials to enable the Engineer to test the mix properties within 5 working days of notification.

(6) Submit any proposed changes to the approved mix design to the DME for approval before implementing the proposed changes.

h. Corrective Action. In the QCP, identify procedures for notifying the Engineer when corrective measures must be implemented, and for halting production.

Notify the Engineer when the moving average test result trend line for any property approaches the specification limits. Cease operations when 2 consecutive moving average points fall outside the specification limits, or 2 consecutive single compressive strength tests exceed the specification limits. Ceasing operations is the Contractor's responsibility. Quality control tests for this determination include aggregate gradation, compliance with the mix design band and in-place density of CTB.

Failure to cease operations for the conditions cited above will subject all subsequent material to rejection, or acceptance at a reduced price, as determined by the Engineer.

The Engineer may examine materials represented by individual test results, which lie beyond the Contractor's normal quality control testing variation. The investigation may be based on either Contractor or KDOT test results. The information from additional testing (including testing of in-place pavement) may be used to define unacceptable work according to **SECTION 105**. The Engineer will apply appropriate price reductions or initiate corrective action.

If a dispute exists between the Engineer and Contractor about the validity of any test results other than compressive strengths or thickness determination, the KDOT District Materials Laboratory or MRC will perform referee testing. If one of the disputed KDOT test results was generated at the MRC, then an independent laboratory agreeable to both parties will be selected. The AASHTO Accreditation Program shall have approved the selected laboratory for the appropriate test procedure. If referee testing indicates that KDOT test results are correct, the Contractor is responsible for the cost of additional testing, including referee testing performed at the MRC. If the referee testing indicates that the Contractor test results are correct, KDOT is responsible for the cost of additional testing.

i. Non-Conforming Materials. In the QCP, specifically address how non-conforming materials will be controlled and identified.

Establish and maintain an effective and positive system for controlling non-conforming material, including procedures for its identification, isolation and disposition. Reclaim or rework non-conforming materials according to procedures acceptable to the Engineer.

Identify all non-conforming materials and products to prevent use, shipment and intermingling with conforming materials and products. Provide holding areas, mutually agreeable to the Engineer and Contractor.

The Engineer will determine if reclaiming or reworking of non-conforming materials is allowed.

306.3 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete Admixtures & Curing Material	**DIVISION 1400**
Portland Cement and Fly Ash	**DIVISION 2000**
Water for CTB	**DIVISION 2400**
Aggregates for CTB	**DIVISION 1100**

306.4 CONSTRUCTION REQUIREMENTS

a. Preparation and Maintenance of the Subgrade. Before placing any CTB material on any section, complete the ditches and drains along that section to effectively drain the highway. Use automatic grade control equipment to trim the surface of the subgrade to the line, grade and cross-section as shown in the Contract Documents. Maintain the subgrade to the as-constructed condition under other contract bid items, repairing any encountered defects to the specifications of the previous bid items. Maintain the subgrade surface to readily drain at all times. Protect the subgrade from damage when handling materials, tools and equipment. Do not store or stockpile materials on the subgrade. Do not place material or lay CTB on a frozen or muddy subgrade.

Lightly spray the subgrade with water to obtain a thoroughly moistened condition before the CTB is placed. Do not puddle water on the grade.

Do not place CTB on frozen subgrade. Do not deposit any material until the subgrade or base has been checked and approved by the Engineer.

b. Mixing the Materials. Do not place CTB on the project until the Engineer has reviewed and approved the submitted mix design.

Plant mix the aggregate, cementing agent and water according to the approved mix design.

Control the charge in a batch mixer, or the rate of feed to a continuous mixer (pugmill), to allow complete mixing of all the materials. Mix the materials to produce a homogeneous mixture. Do not use frozen aggregate.

Take all compressive strength samples at the plant site. Compact the samples prior to the CTB reaching its initial set.

c. Spreading and Compacting the CTB. The maximum compacted thickness of a single lift is 6 inches. If the thickness is greater than 6 inches, spread and compact the subgrade in multiple lifts of equal thickness with a maximum lift thickness of 6 inches. If the base is spread in multiple lifts, offset the longitudinal joints by at least 6 inches.

If multiple lifts are placed, keep the surface of each lift moist until the succeeding lift is spread. Cover the exposed lower lift with the final lift the same day the lower lift is placed.

Compact each lift of CTB to a minimum of 95% of the standard density.

Compact the CTB within 2 hours from the time the water and cementing agent is added to the aggregate, or before the mixture reaches the initial set, whichever is the shorter timeframe.

d. Compaction Determination. Determine dry density and moisture content according to Part V.

If the mix is stiff (can be slip-formed), determine the standard density by averaging the 3 most recent field molded densities using plant mixed base material. Compact one standard mold (using plant mixed material with the proper moisture content) for each day's operation as specified in KT-37.

If the mix is fluid (requires forming), determine the Standard Dry Density by averaging the 3 most recent consolidated unit weight test results (KT-20). It will be necessary to convert the unit weight (wet density) into a standard dry density which also requires the percent of moisture (KT-11 (4)) to be known. Use Equation 1 to determine the standard dry density.

Equation 1: $$\text{Standard Dry Density} = \frac{\text{Wet Density}}{(1+[\%\text{Moisture}/100])}$$

Determine the density of the CTB within 1 day of the compaction operations. The Engineer may verify the Contractor's density test results by conducting density tests at random. If the comparison is not favorable, the DME will investigate to determine the cause and may suspend production until corrective action is taken.

e. Trimming and Finishing the CTB. Trim and recompact the CTB within 2½ hours of the time the water and cementing agent is added to the aggregate.

Trim and compact the CTB to the grades, lines and typical cross sections shown in the Contract Documents. Dress the edge slopes and joints between sections.

Use automatic grade control equipment to trim the surface of the CTB to line grade and cross section.

Keep the surface of the CTB moist during all finishing operations.

Perform the finishing and compacting operations to produce a smooth, dense surface, free of surface compaction planes, cracks, ridges or loose material.

If required, lightly scarify the surface of the CTB to loosen any imprints left by the trimming and compacting equipment. Recompact the surface of the CTB.

At the end of each day's operations, construct a straight transverse construction joint by cutting back into the completed work to form a vertical face. Place a protective covering of earth on the newly constructed CTB a distance back of the joint for turning of equipment used on the following day's work.

Upon satisfactory performance, the Engineer may approve the use of equipment that combines the placing, compacting and finishing operations.

f. Protection and Curing. Keep the surface of the CTB moist until the curing material is applied. Apply the curing material immediately after completing the trimming and finishing. Protect the CTB against the loss of moisture for a curing period of 7 days (unless the Contractor's mix design test results justify a different curing period). Protect the CTB against freezing during the curing period.

Apply a wax-based liquid membrane-forming compound for the curing material. The minimum application rate for wax-based liquid membrane-forming compound is 0.12 gallons per square yard. Use an enclosed spray system that minimizes wind influence and obtains the proper application rate. Keep all traffic and construction equipment off the CTB. The only exception is the equipment used to apply the curing material. Cover the surface and edges of the CTB with a complete, uniform coverage. Use a hand sprayer in inaccessible areas.

If the wax-based liquid membrane-forming compound will be in place for more than 30 days, reapply a single coat at the single application rate within 7 days of placing the pavement.

At locations where it is necessary to carry traffic across the CTB, place a layer (8 inches or greater, compacted depth) of stable earth (sand-clay) over the CTB.

The Contractor may place portland cement concrete pavement (PCCP) on the CTB after a minimum of 24 hours, provided all traffic and construction equipment is kept off the CTB.

The Contractor assumes the risk of 7-day compressive strength requirements when PCCP is placed early.

To promote cracking through the full depth of the base, score or cut the finished CTB surface to coincide with the pavement joint locations, in a parallel manner and within 1 foot:

- if the 7-day compressive strength exceeds 1600 psi. (Note: This does not apply if the CTB has developed cracks at regular intervals prior to placing the PCCP.)
- if the Contractor opts to place the PCCP over the CTB before the 7-day compressive strength is determined. The Engineer may waive this requirement when the Contractor's control charts for CTB shows a history that the 7-day compressive strength is below 1600 psi.

g. Compressive Strength Determination. Using random numbers, select and obtain sampled material at the plant. Make and cure compression test specimens to represent each sublot. Make and cure compression test specimens, and determine the 7-day compressive strength of the CTB according to Part V. Sulfur cap compression test specimens in accordance with AASHTO T 231. When additional test specimens are taken for early determination of the compressive strength, the specimens are for information only. Perform the 7-day compressive strength testing. Maintain records of all sampling and testing. The Engineer will witness all compressive strength tests and initial the Contractor's documentation.

A percent within limits (***PWL***) analysis shall be made on a lot-by-lot basis and shall be based on Contractor quality control test results on all quality control samples representing the lot of the completed CTB. The ***PWL*** result shall be determined as specified under Computation of Pay Factor. Compute the pay adjustment as shown in Equation 2. It shall be based on the compressive strength values within each lot and the lower specification limits (***LSL***).

KDOT will use a spreadsheet program to calculate pay adjustments for compressive strength and to compare the Contractor's QC and KDOT's verification test results. If the comparison fails, KDOT's value will be used to calculate the pay adjustment for that lot. The lot comparison is based on KDOT's verification result falling within the Contractor's mean, plus or minus 2 times the Contractor's sample standard deviation. When the Contractor's sample standard deviation is less than 260 psi, then 260 psi shall be used for the sample standard deviation during lot comparison with KDOT's value. When there are 3 or more tests in a lot and when the lot comparison between Contractor and KDOT tests pass, the Contractor's actual standard deviation will be used to calculate the compressive strength pay factor. When requested, KDOT will provide a copy of this program to the Contractor. It is the Contractor's responsibility to obtain the software required to run this program.

Values computed using equations referenced in this specification may vary slightly from the spreadsheet values due to the rounding of numbers. In such cases, the numbers computed by the spreadsheet shall take precedence.

A typical lot is defined as a normal day's placement. At the beginning of the project, estimate the quantity to be placed during a normal day and submit to the Engineer for approval. Once approved, break the quantity into 4 equal parts (each part represents a sublot). Determine a random location for sampling within each sublot. When the total quantity for the day deviates from expectations, adjust the number of sublots based on **TABLE 306-1**.

TABLE 306-1: SUBLOT BREAKDOWN OF A NORMAL DAY'S PRODUCTION	
Number of Sublots	**% of Daily Quantity**
4	75-115
3	50-74
2	25-49
1	1-24

Adjust the quantity of the last sublot to accommodate any minor changes in production, and adjust the random location for sampling based on the size of the sublot. When there is only 1 test in a lot, the pay factor will be automatically calculated by the KDOT spreadsheet using a sample standard deviation of 260 psi and n of 3. When there are 2 tests in a lot, the pay factor will be calculated by the KDOT spreadsheet using a spreadsheet calculated standard deviation and n of 3. When there are 3 or 4 tests, the lot stands on its own. Regardless of the number of Contractor tests in a lot, the lot comparison between Contractor and KDOT tests will apply. When the quantity exceeds 115% of the normal daily quantity, increase the number of sublots and restrict the 4th sublot to a maximum of 100% of the established normal daily quantity. Each sublot added may have a maximum of 25% of the normal daily quantity.

Compute the sample standard deviation as shown in Section 5.2.1-Statistics, Part V.

Calculate the Compressive Strength Quality Indices ($\boldsymbol{Q_L}$) for each lot as shown in Section 5.2.1-Statistics, Part V. Use the following definitions, and round to the nearest hundredth.

Where: $\overline{X}$ is the average measured compressive strength of all QC samples representing a lot, rounded to 1.0 psi.
LSL is the lower specification limit for compressive strength, defined as 650 psi.
S is the sample standard deviation of the compressive strength of all QC samples representing a lot, rounded to 0.1 psi.

Determination of the percent within limits (***PWL***) values. Use the computed ***Q*** value to determine the compressive strength percent within limits value (PWL_C) by locating the Q_L values in the left column of the ***PWL*** Table in Section 5.2.1-Statistics, Part V. Select the appropriate PWL_C by moving across the selected Q_L to the column representing the number of samples in the lot.

When the computed Q_L is a negative value ($\overline{X}$ lies below the ***LSL***), the Engineer will determine if the material in the lot may remain in place. If the material is left in place, and there were no individual plugs found to be less than 600 psi, then 50.00 is assigned as the ***PWL*** value. For results exceeding these limits and permitted to remain in place, use the calculated ***PWL*** value.

When the computed Q_L is greater than the largest Q_L value shown in the table, a value of 100.00 is assigned as the ***PWL*** value for the designated PWL_C.

Computation of Cement Treated Base Compressive Strength Pay Adjustment. Compute the pay factor for compressive strength using Equation 2 and round to nearest thousandth (0.001). Multiply the pay factor times the square yards, times $5.00 per square yard to determine the pay adjustment.

Equation 2: $$P = \frac{(PWL_C \text{ x } 0.15)}{100} - 0.135$$

Cement Treated Base Compressive Strength Pay Factor (Failing Comparison Test). When the comparison between Contractor and KDOT tests fails, use KDOT test results to calculate the compressive strength pay factor for the lot. Follow the procedures as stated above to determine the pay factor or disposition of the lot. Use the following values to determine Q_L: $\overline{X}$ of KDOT's test result for the lot, ***S*** of 260 psi, ***LSL*** of 650 psi. When selecting the PWL_C value from the ***PWL*** in TABLE 2, use ***n*** of 4.

h. Weather Limitations. Do not place material if the CTB will be exposed to ambient air temperatures below 32ºF during the first 7 days of cure. (See **subsections 306.4b., c.** and **f.**). Remove and replace all CTB that is permitted to freeze within the first 24 hours, whether frozen on the surface or full depth. When materials are exposed to freezing ambient air temperatures after the first 24 hours but before the 7 day cure period is complete, demonstrate that the 7 day design strength has been achieved. Failure to demonstrate the 7 day design strength has been achieved shall require removal and replacement at Contractor's expense.

As directed by the Engineer and at the Contractor's expense, repair or replace cured materials exposed to ambient air temperatures below freezing or repeated freeze/thaw cycles that result in loosening or fluffing of the surface.

A lift of pavement placed prior to exposure to freezing ambient air temperatures constitutes curing of the CTB.

Do not place material on frozen subgrade. Mixing and placing may proceed when the ambient air temperature is 40ºF and rising, and discontinue when the ambient air temperatures reaches 45ºF and falling.

306.5 MEASUREMENT AND PAYMENT

The Engineer will measure the CTB and quality control testing of CTB by the square yard. Material placed beyond the neat lines indicated in the Contract Documents is not measured for payment unless authorized by the Engineer.

Payment for "Cement Treated Base" and "Quality Control Testing (CTB)" at the contract unit prices is full compensation for the specified work.

No adjustment of the contract unit price for "Quality Control Testing (CTB)" is made for overruns or underruns in the contract quantity.

If the PCCP in the contract is specified as QC/QA, (Quality Control Testing (CTB) is included as a bid item), compressive strength pay adjustments will apply under the bid item "Cement Treated Base Compressive Strength Pay Adjustment", and will be shown as an added item to the contract.

SECTION 307

GRANULAR BASE

307.1 DESCRIPTION

Construct a granular base on a prepared subgrade as shown in the Contract Documents.

BID ITEMS	**UNITS**
Granular Base (*)	Square Yard
Water (Granular Base) (Set Price)	M Gallon
*Thickness	

307.2 MATERIALS

Provide materials that comply with the applicable requirements.

Aggregate for Granular Base .... **DIVISION 1100**
Water for Granular Base .... **DIVISION 2400**

307.3 CONSTRUCTION REQUIREMENTS

Recompact soft and yielding subgrade material. Do not place granular base on frozen subgrade. If the project has more than 20,000 square yards of manipulation, use automatic grade controlled equipment to trim the subgrade. In irregular areas, trim the subgrade by wetting, blading and rolling.

Use a stationary mechanical mixing plant to uniformly mix the water and aggregate. A motor grader with water truck, or rotary cross-shaft mixer with water delivery system may be used to mix aggregate and water when the original contract quantity is less than 15,000 square yards.

Mix the granular aggregate with sufficient water to allow compaction of the mixture to the specified density at ± 3 % of the optimum moisture content.

Immediately after mixing the aggregate and water, haul the mixture to the prepared subgrade, place the mixture full-lane width using an aggregate spreader, and compact the mixture. The Engineer will not allow placing of the base material on the prepared subgrade when conditions are such that the hauling and placing will damage the prepared subgrade. The maximum compacted thickness of any layer of granular base or shoulder is 6 inches. When the thickness is greater than 6 inches, spread and compact the aggregate in multiple lifts of equal thickness with a maximum lift thickness of 6 inches. Spread and compact the granular base as specified in the Contract Documents. Compact the granular base to a minimum of 95% of the standard density. Compact granular base placed more than 2 feet outside the edge of pavement to a minimum of 90% of the standard density.

Trim the compacted granular base to the lines and grades in the Contract Documents. Compact the surface of the granular base with a smooth-wheel or a pneumatic-tire roller. While performing final rolling, lightly scarify and blade the surface to eliminate equipment imprints.

Maintain density until paved. When paving is delayed and the granular base dries out, re-establish the specified dry density just prior to paving.

307.4 MEASUREMENT AND PAYMENT

The Engineer will measure granular base by the square yard.

The Engineer will measure water used for granular base by the M Gallon using calibrated tanks or water meters. The Engineer will measure water used for granular base preparation, mixing and compacting the granular base. The Engineer will not measure water used for dust control, water wasted through the Contractor’s negligence, or water in excess of the quantity required for mixing and compacting the granular base.

Payment for "Granular Base" at the contract unit price and "Water (Granular Base) (Set Price)" at the contract set unit price is full compensation for the specified work.

SECTION 308

GEOSYNTHETIC REINFORCED BASE

308.1 DESCRIPTION

Place geosynthetic reinforcement for the base at the locations designated in the Contract Documents.

BID ITEM	**UNITS**
Geosynthetic Reinforcement (for Base)	Square Yard

308.2 MATERIALS

Provide geosynthetic for base course reinforcement that complies with **DIVISION 1700**.

308.3 CONSTRUCTION REQUIREMENTS

Store and handle the geosynthetic according to the manufacturer's recommendations. Do not expose the geosynthetic to direct sunlight, ultraviolet rays, and temperatures greater than 140°F, mud, dirt, dust, and debris.

Place the geosynthetic on the prepared surface to the limits shown in the Contract Documents. Overlap parallel strips or roll ends a minimum of 12 to 36 inches as designated on the Contract Documents.

Limit placement of geosynthetic to that which can be covered with base material within 72 hours.

When placing the base lift over the geosynthetic, do not allow construction traffic directly on the geosynthetic.

308.4 MEASUREMENT AND PAYMENT

The Engineer will measure the geosynthetic reinforcement by the square yard to the neat lines shown in the Contract Documents.

Payment for "Geosynthetic Reinforcement (for Base)" at the contract unit price is full compensation for the specified work.

SECTION 401

GENERAL CONCRETE

401.1 DESCRIPTION

Provide the grades of concrete specified in the Contract Documents.
See **SECTION 402** for specific requirements for Structural Concrete.
See **SECTION 403** for specific requirements for On Grade Concrete.
See **SECTION 404** for specific requirements for Prestressed Concrete.

401.2 MATERIALS

Provide materials that comply with the applicable requirements.

Aggregate	**DIVISION 1100**
Admixtures and Plasticizers	**DIVISION 1400**
Grade 2 Calcium Chloride	**DIVISION 1700**
Cement, Fly Ash, Silica Fume, Slag Cement and Blended Supplemental Cementitious	**DIVISION 2000**
Water	**DIVISION 2400**

401.3 CONCRETE MIX DESIGN

a. General. Design the concrete mixes specified in the Contract Documents.

Do not place any concrete on the project until the Engineer approves the concrete mix designs. Once the Engineer approves the concrete mix design, do not make changes without the Engineer's approval.

Take full responsibility for the actual proportions of the concrete mix, even if the Engineer assists in the design of the concrete mix.

Provide aggregate gradations that comply with **DIVISION 1100** and Contract Documents.

If desired, contact the DME for available information to help determine approximate proportions to produce concrete having the required characteristics on the project.

Submit all concrete mix designs to the Engineer for review and approval. Submit completed volumetric mix designs on KDOT Form No. 694 and all required attachments at least 60 days prior to placement of concrete on the project. The Engineer will provide an initial review of the design within 5 business days following submittal.

Include the following with the mix design data:

(1) Test data.

(a) Test data from KT-73 tested at 28 days, KT-79 tested at 28 days **or** AASHTO T-277 tested at 56 days for all bridge overlays, Moderate Permeability Concrete, and any project with over 250 cubic yards of concrete (this includes structural concrete, on grade concrete etc.). Provide the test data for each mix, tested at the highest paste content (cementitious and water) that meets **subsection 401.3h**. Submit accelerated cure procedures for the Engineer's approval. The field verification test procedure must be the same test procedure as the mix design approval test.

(b) Test data from ASTM C 1567 for field blended cements meeting **subsection 401.3d.(6)** for all concrete utilizing all actual materials proposed for use on the project at designated percentages.

(2) Single point grading for the combined aggregates along with a plus/minus tolerance for each sieve. Use plus/minus tolerances to perform quality control checks and by the Engineer to perform aggregate grading verification testing. The tests may be performed on the combined materials or on individual aggregates, and then theoretically combined to determine compliance.

(3) Laboratory 28 day compressive strength test results on a minimum of 1 set of 3 cylinders produced from the mix design with the highest water to cementitious ratio for the project, utilizing all actual materials proposed for use on the project at designated percentages.

(4) Historical mix production data for the plant producing concrete for the project to substantiate the standard deviation selected for use in **subsection 401.3b**.

(5) Necessary materials to enable the Engineer to test the mix properties and Surface Resistivity, if applicable.

After initial review, the Engineer will perform any testing necessary to verify the design. This may include a 3 cubic yard test batch at the producing plant.

Mix designs will remain approved when verification testing for strength and permeability conducted within the last 12 months indicate continued compliance with the specifications and percentages of constituents including aggregate and cementitious materials and product, type and supplier of admixtures remain the same. Test results on the same mix from other sources are acceptable. Provide ASTM C 1567 results on an annual basis if the mix includes supplemental cementitious materials (SCM).

Improvements in concrete strength, workability, durability and permeability are possible if the combined aggregate grading is optimized. Procedures found in ACI 302.1 or other mix design techniques, approved by the Engineer, are acceptable in optimizing the mix design.

A water-reducing admixture for improving workability may be required. Adjust the designated slump accordingly.

With the exception of concrete for pavement as shown in **SECTION 403**, use the middle of the specified air content range of 6½ ± 1.5% for the design of air entrained concrete.

Maximum air content is 10%. Take immediate steps to reduce the air content whenever the air content exceeds 8%.

Determine air content by KT-19 (Volumetric Method). A regularly calibrated KT-18 (Pressure Method) meter may be used for production with random verification by the Volumetric Method. See KT-19 for special requirements when using the Volumetric Method with high cementitious concretes or mixtures with midrange water reducers or plasticizers.

Delay the commencement of tests from 4 to 4½ minutes after the sample has been taken from a continuous mixer. If a batch type mixer is used, take the tests at the point of placement and begin testing immediately.

b. Concrete Mix Design Based On Previous Data. Provide concrete mix designs based on previous 28-day compressive strength test data from similar concrete mixtures. Similar mixtures are within 1000 psi of the specified 28-day compressive strength, and are produced with the same type and sources of cementitious materials, admixtures and aggregates.

Consider sand sources the same, provided they are not more than 25 miles apart on the same river and no tributaries enter the river between the 2 points. Consider crushed locations similar if they are mined in one continuous operation, and there is no significant change in geology. Mixes that have changes of more than 10% in proportions of cementitious materials, aggregates or water content are not considered similar.

Air entrained mixes are not considered similar to non-air entrained mixes.

Mixes tested with admixtures are not the same as mixes tested without those admixtures.

Test data should represent at least 30 separate batches of the mix. One set of data is the average of at least 2 cylinders from the batch. The data shall represent a minimum of 45 days of production within the past 12 months.

Do not include data over 1 year old. When fewer than 30 data sets are available, the standard deviation of the data must be corrected to compensate for the fewer data points.

Provide a concrete mix design that will permit no more than 5% of the 28-day compressive strength tests to fall below the specified 28-day compressive strength (*f'c*) based on equation A, and no more than 1% of the 28-day compressive strength tests to fall below the specified 28-day compressive strength (*f'c*) by more than 500 psi based on equation B.

Equation A: $f'cr = f'c + 1.62 * k * s$

Equation B: $f'cr = (f'c - 500) + 2.24 * k * s$

Where:
$f'cr$ = average 28-day compressive strength required to meet the above criteria.
$f'c$ = specified 28-day compressive strength
s = standard deviation of test data
k = constant based on number of data points
n = number of data points
$k = 1.3 - n / 100$, where $15 < n < 30$
$k = 1$, where $n > 30$

Provide a concrete mix design that has an average compressive strength that is equal to the larger of Equation A or Equation B. Submit all supporting test data with the mix design.

All other concrete mix designs.

For concrete mixes that have fewer than 15 data points, or if no statistical data is available, use Equations A and B to calculate *f'cr* using the following values.

s = 20% of the specified 28-day compressive strength (*f'c*)
k = 1

c. Portland Cement and Blended Hydraulic Cement. Unless specified otherwise in the Contract Documents, select the type of portland cement or blended hydraulic cement according to **TABLE 401-1**.

Design concrete with a maximum water to cementitious ratio of 0.50 and minimum cementitious content of 480 lbs per cubic yard except for concrete for pavement and shoulders.

TABLE 401-1: PORTLAND CEMENT & BLENDED HYDRAULIC CEMENT	
Concrete for:	**Type of Cement Allowed**
On Grade Concrete	Type IP(x) Portland-Pozzolan Cement Type IS(x) Portland- Slag Cement Type IT(Ax)(By) Ternary Blended Cement Type II Portland Cement
All Concrete other than On Grade Concrete.	Type I Portland Cement Type IP(x) Portland-Pozzolan Cement Type IS(x) Portland- Slag Cement Type IT(Ax)(By) Ternary Blended Cement Type II Portland Cement
High Early Strength Concrete	Type III Portland Cement Type I, IP(x), IS(x), IT(Ax)(By), or II Cement may be used if strength and time requirements are met.

d. Blended Cement Concrete. When approved by the Engineer, the concrete mix design may include SCMs such as fly ash, slag cement, silica fume or blended SCM from an approved source as a partial replacement for portland cement or blended hydraulic cement. Obtain the Engineer's approval before substituting SCMs for Type III cement. Changes in SCM or cement will require a new mix design approval.

(1) Cements meeting **SECTION 2001** are not field blended cements.

(2) Cements with SCMs added at the concrete mixing plant are field blended cements.

(3) Supplementary materials can be combined with cement to create field blended cements. Do not exceed allowable substitution rates noted in **TABLE 401-2**. Substitute 1 pound of SCM for 1 pound of cement.

(4) SCMs in prequalified cements are to be included in the total combined substitution rate.

TABLE 401-2: ALLOWABLE SUBSTITUTION RATE FOR SUPPLEMENTARY CEMENTITIOUS MATERIAL.	
Material	**Substitution Rate***
Slag Cement	40% Maximum
Fly Ash	25% Maximum
Blended SCM	25% Maximum
Silica Fume	5% Max
Total Combined	50%

* Total Substitution Rate includes material in preblended cements and blended SCMs.

(5) Design field blended cement concrete meeting the applicable requirements for Volume of Permeable Voids, Surface Resistivity, or Rapid Chloride Permeability using the parameters described in **subsection 401.3a**.

(6) For field blended cementitious material provide mortar expansion test results from ASTM C 1567 using the project's mix design concrete materials at their designated percentages. Provide a mix with a maximum expansion of 0.10 % at 16 days after casting.

ASTM C 1567 is not necessary for concrete modified with **only** silica fume.

When used, add silica fume with other cementitious materials during batching procedures. If the silica fume cannot be added to the cementitious materials, add the loose silica fume to the bottom of the stationary drum that is wet, but has no standing water, before adding the dry materials. The Engineer may approve shreddable bags on a performance basis, only when a central batch mixing process is used. If so, add the bags to half of the mixing water and mix before adding cementitious materials, aggregate and remainder of water.

Mix silica fume modified concrete for a minimum of 100 mixing revolutions.

(7) Submit complete mix design data including proportions and sources of all mix ingredients, and the results of strength tests representing the mixes proposed for use. The strength data may come from previous KDOT project records or from a laboratory regularly inspected by Cement and Concrete Reference Laboratory (CCRL), and shall equal or exceed the strength requirements for the Grade specified in the Contract Documents as determined by **subsection 401.3b**. Perform compressive strength tests according to KT-76.

e. Strength. Design concrete to meet **TABLE 401-3**.

TABLE 401-3: CONCRETE STRENGTH REQUIREMENTS	
Specified 28 Day Compressive Strengths, minimum, psi *f'c*	
Grade of Concrete:	**Non Air Entrained/Air Entrained Concrete**
Grade 7.0	7,000
Grade 6.0	6,000
Grade 5.0	5,000
Grade 4.5	4,500
Grade 4.0	4,000
Grade 3.5	3,500
Grade 3.0	3,000
Grade 2.5	2,500

f. High Early Strength Concrete. Design the high early strength concrete mix to comply with strength and time requirements specified in the Contract Documents.

Unless otherwise specified, design high early strength concrete for pavement at a minimum of 1 of the Contractor's standard deviations above 2400 psi (cylinders) at 24 hours.

Submit complete mix design data including proportions and sources of all mix ingredients, and the results of time and strength tests representing the mixes proposed for use. The strength and time data may come from previous KDOT project records or from an independent laboratory, and shall equal or exceed the strength and time requirements listed in the Contract Documents.

g. Slump. Designate a slump for each concrete mix design that is required for satisfactory placement of the concrete application not to exceed 5 inches except where controlled by maximum allowable slumps stated in **SECTIONS 402, 403** and **404**. Reject concrete with a slump that limits the workability or placement of the concrete.

h. Permeability. Except for Structural Concrete as shown in **SECTION 402**, supply a concrete with either a maximum 28 day Volume of Permeable Voids of 12.0% as per KT-73, a minimum 28 day surface resistivity of 9.0 kΩ-cm as per KT-79, or a maximum 56 day Rapid Chloride Permeability of 3,000 Coulombs as per AASHTO T-277. The field verification test procedure must be the same test procedure as the mix design approval test.

i. Admixtures for Acceleration, Air-Entraining, Plasticizing, Set Retardation and Water Reduction. Verify that the admixtures used are compatible and will work as intended without detrimental effects. Use the dosages recommended by the admixture manufacturers. Incorporate and mix the admixtures into the concrete mixtures according to the manufacturer's recommendations. Determine the quantity of each admixture for the concrete mix design. The Engineer will allow minor adjustments to the dose rate of admixtures to compensate for environmental changes during placement without a new concrete mix design or trial batch.

Redosing is permitted to control slump or air content in the field, when approved by the Engineer, time and temperature limits are not exceeded, and at least 30 mixing revolutions remain before redosing. Redose according to manufacturer's recommendations.

If another admixture is added to an air-entrained concrete mixture, determine if it is necessary to adjust the air-entraining admixture dosage to maintain the specified air content.

(1) Accelerating Admixture. When specified in the Contract Documents, or in situations that involve contact with reinforcing steel and require early strength development to expedite opening to traffic, a non-chloride accelerator may be approved. The Engineer may approve the use of a Type C or E accelerating admixture. A Grade 2 calcium chloride accelerator may be used when patching an existing pavement more than 10 years old.

Add the calcium chloride by solution (the solution is considered part of the mixing water).

- For a minimum cure of 4 hours at 60°F or above, use 2% (by dry weight of cement) calcium chloride.
- For a minimum cure of 6 hours at 60°F or above, use 1% (by dry weight of cement) calcium chloride.

(2) Air-Entraining Admixture. When specified, use an air-entraining admixture in the concrete mixture.

(3) Water-Reducers and Set-Retarders. If unfavorable weather or other conditions adversely affect the placing and finishing properties of the concrete mix, the Engineer may allow the use of water-reducers and set-retarders. Verify that the admixtures will work as intended without detrimental effects. If the Engineer approves the use of water-reducers and set-retarders, their continued use depends on their performance. If at any point, a water-reducer is used to produce a slump equal to or greater than 7 ½ inches, comply with **subsection 401.3g**.

(4) Plasticizer Admixture. A plasticizer is defined as an admixture that produces flowing concrete, without further addition of water, and/or retards the setting of concrete. Flowing concrete is defined as having a slump equal to or greater than 7 ½ inches while maintaining a cohesive nature.

Include a batching sequence in the concrete mix design. Consider the location of the concrete plant in relation to the job site, and identify when and at what location the water reducer or plasticizer is added to the concrete mixture.

Manufacturers of plasticizers may recommend mixing revolutions beyond the limits specified in **subsection 401.8**. If necessary, address the additional mixing revolutions in the concrete mix design. The Engineer may allow up to 60 additional revolutions when plasticizers are designated in the mix design.

Before the concrete mixture with a slump equal to or greater than 7 ½ inches is used on the project, conduct tests on at least 1 full trial batch of the concrete mix design in the presence of the Engineer to determine the adequacy of the dosage and the batching sequence of the plasticizer to obtain the desired properties. Determine the air content of the trial batch both before and after the addition of the plasticizer. Monitor the slump, air content, temperature and workability at regular intervals of the time period from when the plasticizer is added until the estimated time of completed placement. At the discretion of the Engineer, if all the properties of the trial batch remain within the specified limits, the trial batch may be used in the project.

Do not add water after plasticizer is added to the concrete mixture.

401.4 REQUIREMENTS FOR COMBINED MATERIALS

a. Measurements for Proportioning Materials.

(1) Cement. Measure cement as packed by the manufacturer. A sack of cement is considered as 0.04 cubic yards weighing 94 pounds net. Measure bulk cement by weight. In either case, the measurement must be accurate to within 0.5% throughout the range of use.

(2) Supplemental Cementitious Materials. Supplemental cementitious materials proportioning and batching equipment is subject to the same controls as required for cement. Provide positive cut off with no leakage from the cut off valve. Cementitious materials may be weighed accumulatively with the cement or separately. If weighed accumulatively, weigh the cement first.

(3) Water. Measure the mixing water by weight or by volume accurate to within 1% throughout the range of use.

(4) Aggregates. Measure the aggregates by weight, accurate to within 0.5% throughout the range of use.

(5) Admixtures. Measure liquid admixtures by weight or volume, accurate to within 3% of the quantity required. If liquid admixtures are used in small quantities in proportion to the cement as in the case of air-entraining agents, use readily adjustable mechanical dispensing equipment capable of being set to deliver the required quantity and to cut off the flow automatically when this quantity is discharged.

b. Testing of Aggregates.

(1) Production of On Grade Concrete Aggregate (OGCA). If OGCA is required, notify the Engineer in writing at least 2 weeks in advance of producing the aggregate. Include the source of the aggregate and the date production will begin. Failure to notify the Engineer, as required, may result in rejection of the aggregate for use as OGCA. Maintain separate stockpiles for OGCA at the quarry and at the batch site and identify them accordingly.

(2) Testing Aggregates at the Batch Site. Provide the Engineer with reasonable facilities at the batch site for obtaining samples of the aggregates. Provide adequate and safe laboratory facilities at the batch site allowing the Engineer to test the aggregates for compliance with the specified requirements.

KDOT will sample and test aggregates from each source to determine their compliance with specifications. Do not batch the concrete mixture until the Engineer has determined that the aggregates comply with the specifications. KDOT will conduct sampling at the batching site, and test samples according to the Sampling and Testing Frequency Chart in Part V. For QC/QA contracts, establish testing intervals within the specified minimum frequency.

After initial testing is complete, and the Engineer has determined that the aggregate process control is satisfactory, use the aggregates concurrently with sampling and testing as long as tests verify compliance with specifications. When batching, sample the aggregates as near the point of batching as feasible. Sample from the stream as the storage bins or weigh hoppers are loaded. If samples cannot be taken from the stream, take them from approved stockpiles, or use a template and sample from the conveyor belt. If test results indicate an aggregate does not comply with specifications, cease concrete production using that aggregate. Unless a tested and approved stockpile for that aggregate is available at the batch plant, do not use any additional aggregate from that source and specified grading until subsequent testing of that aggregate indicate compliance with specifications. When tests are completed and the Engineer is satisfied that process control is satisfactory, production of concrete using aggregates tested concurrently with production may resume.

c. Handling of Materials.

(1) Approved stockpiles are permitted only at the batch plant and only for small concrete placements or for maintaining concrete production. Mark the approved stockpile with an "Approved Materials" sign. Provide a suitable stockpile area at the batch plant so that aggregates are stored without detrimental segregation or contamination. At the plant, limit stockpiles of tested and approved coarse, fine and intermediate aggregate to 250 tons each, unless approved for more by the Engineer. If mixed aggregate is used, limit the approved stockpile to 500 tons, the size of each being proportional to the amount of each aggregate to be used in the mix.

Load aggregates into the mixer such that no material foreign to the concrete or material capable of changing the desired proportions is included.

(2) Segregation. Do not use segregated aggregates. Previously segregated materials may be thoroughly re-mixed and used when representative samples taken anywhere in the stockpile indicated a uniform gradation exists.

(3) Cement and Supplemental Cementitious. Protect cement and supplemental cementitious materials in storage or stockpiled on the site from any damage by climatic conditions which would change the characteristics or usability of the material.

(4) Moisture. Provide aggregate with a moisture content of ± 0.5% from the average of that day. If the moisture content in the aggregate varies by more than the above tolerance, take whatever corrective measures are necessary to bring the moisture to a constant and uniform consistency before placing concrete. This may be accomplished by handling or manipulating the stockpiles to reduce the moisture content, or by adding moisture to the stockpiles in a manner producing uniform moisture content through all portions of the stockpile.

For plants equipped with an approved accurate moisture-determining device capable of determining the free moisture in the aggregates, and provisions made for batch to batch correction of the amount of water and the weight of aggregates added, the requirements relative to manipulating the stockpiles for moisture control will be waived. Any procedure used will not relieve the producer of the responsibility for delivering concrete of uniform slump within the limits specified.

(5) Separation of Materials in Tested and Approved Stockpiles. Only use KDOT Approved Materials. Provide separate means for storing materials approved by KDOT. If the producer elects to use KDOT Approved Materials for non-KDOT work, during the progress of a project requiring KDOT Approved Materials, inform the Engineer and agree to pay all costs for additional material testing.

Clean all conveyors, bins and hoppers of any unapproved materials before beginning the manufacture of concrete for KDOT work.

401.5 MORTAR AND GROUT

a. General. Follow the proportioning requirements in **subsection 401.5b.** and **c.** for mortar and grout unless otherwise specified in the Contract Documents, including altering the proportions when a minimum strength is specified.

b. Mortar. Mortar is defined as a mixture of cementitious materials, FA-M aggregate and water, which may contain admixtures, and is typically used to minimize erosion between large stones or to bond masonry units.

Proportion mortar for laying stone for stone rip-rap, slope protection, stone ditch lining or pavement patching at 1 part of portland cement and 3 parts of FA-M aggregate by volume with sufficient water to make a workable and plastic mix.

Proportion mortar for laying brick, concrete blocks or stone masonry at ½ part masonry cement, ½ part portland cement and 3 parts FA-M aggregate, either commercially produced masonry sand or FA-M, by volume with sufficient water to make a workable and plastic mix.

Do not use air-entraining agents in mortar for masonry work.

The Engineer may visually accept the sand used for mortar. The Engineer may visually accept any recognized brand of portland cement or masonry cement that is free of lumps.

c. Grout. Grout is defined as a mixture of cementitious materials with or without aggregate or admixtures to which sufficient water is added to produce a pouring or pumping consistency without segregation of the constituent materials and meeting the applicable specifications.

401.6 COMMERCIAL GRADE CONCRETE

If the Contract Documents allow the use of commercial grade concrete for designated items, then use a commercial grade mixture from a ready mix plant approved by the Engineer.

The Engineer must approve the commercial grade concrete mixture. Approval of the commercial grade mixture is based on these conditions:

- All materials are those normally used for the production and sale of concrete in the vicinity of the project.
- The mixture produced is that normally used for the production and sale of concrete in the vicinity of the project.
- The mixture produced contains a minimum cementitious content of 6 sacks (564 lbs) of cementitious material per cubic yard of concrete.
- The water-cementitious ratio is as designated by the Engineer. The maximum water-cementitious ratio permitted may not exceed 0.50 pounds of water per pound of cementitious material including free water in the aggregate.
- Type I, II, III, IP, IS or IT cement may be used unless otherwise designated. Fly ash, slag cement and blended supplemental materials may be substituted for the required minimum cement content as specified in **subsection 401.3**. No additives other than air entraining agent will be allowed. The Contractor will not be required to furnish the results of strength tests when submitting mix design data to the Engineer.
- In lieu of the above, approved mix designs (including optimized) for all other grades of concrete, Grade 3.0 or above, are allowable for use as commercial grade concrete, at no additional cost to KDOT.

Exercise good engineering judgment in determining what equipment is used in proportioning, mixing, transporting, placing, consolidating and finishing the concrete.

Construct the items with the best current industry practices and techniques.

Before unloading at the site, provide a delivery ticket for each load of concrete containing the following information:

- Name and location of the plant.
- Time of batching concrete.
- Mix proportions of concrete (or a mix designation approved by the Engineer).
- Number of cubic yards of concrete batched.

Cure the various items placed, as shown in **DIVISION 700**.

The Engineer may test commercial grade concrete by molding sets of 3 cylinders. This is for informational purposes only. No slump or unit weight tests are required.

401.7 CERTIFIED CONCRETE

If KDOT inspection forces are not available on a temporary basis, the Engineer may authorize the use of concrete from approved concrete plants. Approval for this operation is based on certification of the plant and plant personnel, according to KDOT standards. KDOT's approval may be withdrawn any time that certification procedures are not followed. Contact the DME for additional information.

The Engineer will not authorize the use of certified concrete for major structures such as bridges, RCB box bridges, RCB culverts, permanent main line and ramp pavement or other structurally, critical items.

Each load of certified concrete must be accompanied by a ticket listing mix proportions, time of batching and setting on revolution counter, total mixing revolutions and must be signed by certified plant personnel.

401.8 MIXING, DELIVERY AND PLACEMENT LIMITATIONS

a. Concrete Batching, Mixing and Delivery. Batch and mix the concrete in a central mix plant, in a truck mixer or in a drum mixer at the work site. Provide plant capacity and delivery capacity sufficient to maintain continuous delivery at the rate required. The delivery rate of concrete during concreting operations must provide for the proper handling, placing and finishing of the concrete.

Seek the Engineer's approval of the concrete plant/batch site before any concrete is produced for the project. The Engineer will inspect the equipment, the method of storing and handling of materials, the production procedures and the transportation and rate of delivery of concrete from the plant to the point of use. The Engineer will grant approval of the concrete plant/batch site based on compliance with the specified requirements. The Engineer may, at any time, rescind permission to use concrete from a previously approved concrete plant/batch site upon failure to comply with the specified requirements.

Clean the mixing drum before it is charged with the concrete mixture. Charge the batch into the mixing drum such that a portion of the water is in the drum before the aggregates and cementitious material. Uniformly flow materials into the drum throughout the batching operation. All mixing water must be in the drum by the end of the first 15 seconds of the mixing cycle. Keep the throat of the drum free of accumulations restricting the flow of materials into the drum.

Do not exceed the rated capacity (cubic yards shown on the manufacturer's plate on the mixer) of the mixer when batching the concrete. The Engineer may allow an overload of up to 10% above the rated capacity for central mix plants and drum mixers at the work site, provided the concrete test data for strength, segregation and uniform consistency are satisfactory, and no concrete is spilled during the mixing cycle.

Operate the mixing drum at the speed specified by the mixer's manufacturer (shown on the manufacturer's plate on the mixer).

Mixing time is measured from the time all materials, except water, are in the drum. If it is necessary to increase the mixing time to obtain the specified percent of air in air-entrained concrete, the Engineer will determine the mixing time.

If the concrete is mixed in a central mix plant or a drum mixer at the work site, mix the batch between 1 to 5 minutes at mixing speed. Do not exceed the maximum total 60 mixing revolutions. Mixing time begins after all materials, except water, are in the drum, and ends when the discharge chute opens. Transfer time in multiple drum mixers is included in mixing time. Mix time may be reduced for plants utilizing high performance mixing drums provided thoroughly mixed and uniform concrete is being produced with the proposed mix time. Performance of the plant must conform to Table A1.1 of ASTM C 94, Standard Specification for Ready Mixed Concrete. Five of the 6 tests listed in Table A1.1 must be within the limits of the specification to indicate that uniform concrete is being produced.

If the concrete is mixed in a truck mixer, mix the batch between 70 and 100 revolutions of the drum or blades at mixing speed. After the mixing is completed, set the truck mixer drum at agitating speed. Unless the mixing unit is equipped with an accurate device indicating and controlling the number of revolutions at mixing speed, perform the mixing at the batch plant and operate the mixing unit at agitating speed while travelling from the plant to the work site. Do not exceed 300 total revolutions (mixing and agitating). An additional 60 mixing revolutions may be allowed by the Engineer when plasticizers are designated in the mix design.

If a truck mixer or truck agitator is used to transport concrete that was completely mixed in a stationary central mixer, agitate the concrete while transporting at the agitating speed specified by the manufacturer of the equipment (shown on the manufacturer's plate on the equipment). Do not exceed 200 total revolutions (additional re-mixing and agitating).

Provide a batch slip including batch weights of every constituent of the concrete and time for each batch of concrete delivered at the work site, issued at the batching plant that bears the time of charging of the mixer drum with cementitious materials and aggregates. Include quantities, type, product name and manufacturer of all admixtures on the batch ticket.

On paving projects and other high volume work, the Engineer will evaluate the haul time, and whether tickets will be collected for every load. Thereafter, random checks of the loads will be made. Maintain all batch tickets when not collected.

When non-agitating equipment is used for transportation of concrete, place within 30 minutes of adding the cement to the water. Provide approved covers for protection against the weather when required by the Engineer.

When agitating equipment is used for transportation of the concrete, place concrete within the time and temperature conditions shown in **TABLE 401-5**.

TABLE 401-5: AMBIENT AIR TEMPERATURE AND AGITATED CONCRETE PLACEMENT TIME

T = Ambient Air Temperature at Time of Batching (°F)	Time limit agitated concrete must be placed within, after the addition of cement to water (hours)	Admixtures
T < 75	1 ½	None
75 ≤ T	1	None
75 ≤ T < 90	1 ½	Set Retarder

In all cases, if the concrete temperature at time of placement is 90°F or above, or under conditions contributing to quick stiffening of the concrete, place the concrete within 45 minutes of adding the cement to the water. Do not use concrete that has developed its initial set. Regardless of the speed of delivery and placement, the Engineer will suspend the concreting operations until corrective measures are taken, if there is evidence that the concrete cannot be adequately consolidated.

Weather conditions and the use of admixtures can affect the set times for the concrete. Do not use the time limits and total revolutions as the sole criterion for rejection of concrete. Exceed the time limits and total revolutions only after demonstrating that the properties of the concrete can be improved. Evaluation of the consistency and workability should be taken into consideration. Reject concrete that cannot be adequately consolidated.

Adding water to concrete after the initial mixing is prohibited, with this exception:

If the concrete is delivered to the work site in a truck mixer, the Engineer will allow water (up to 2 gallons per cubic yard) be withheld from the mixture at the batch site, and if needed, added at the work site to adjust the slump to the specified requirements. Determine the need for additional water as soon as the load arrives at the construction site. Use a calibrated water-measuring device to add the water, and add the water to the entire load. Do not add more water than was withheld at the batch site. After the additional water is added, turn the drum or blades an additional 20 to 30 revolutions at mixing speed. The Engineer will supervise the adding of water to the load, and will allow this procedure only once per load. Conduct all testing for acceptance and produce any required cylinders after all water or admixtures have been added.

Do not add water at the work site if the slump is within the designated slump tolerance, even if water was withheld.

Do not add water at the work site if the percent air is above 8%, regardless of the slump, even if water was withheld.

Do not withhold and add water if plasticizer is added to the concrete mixture at the batch site.

If at any time during the placement of concrete it is determined that redosing with water is adversely affecting the properties of the concrete, the concrete will be rejected and the Engineer will suspend the practice.

b. Placement Limitations.

(1) Placing Concrete at Night. Do not mix, place or finish concrete without sufficient natural light, unless an adequate, artificial lighting system approved by the Engineer is provided.

(2) Placing Concrete in Cold Weather. Unless authorized by the Engineer, discontinue mixing and concreting operations when the descending ambient air temperature reaches 40°F. Do not begin concreting operations until an ascending ambient air temperature reaches 35°F and is expected to exceed 40ºF.

If the Engineer permits placing concrete during cold weather, aggregates may be heated by either steam or dry heat system before placing them in the mixer. Use an apparatus that heats the mass uniformly and is so arranged as to preclude the possible occurrence of overheated areas which might injure the materials. Do not heat aggregates directly by gas or oil flame or on sheet metal over fire. Aggregates that are heated in bins, by steam-coil or water-coil heating, or by other methods not detrimental to the aggregates may be used. The use of live steam on or through binned aggregates is prohibited. Unless otherwise authorized, maintain the temperature of the mixed concrete between 50 to 90°F at the time of placing. Do not, under any circumstances, continue concrete operations if the ambient air temperature is less than 20°F.

If the ambient air temperature is 35°F or less at the time the concrete is placed, the Engineer may require that the water and the aggregates be heated to between 70 and 150°F.

Do not place concrete on frozen subgrade or use frozen aggregates in the concrete.

Make adjustments for potential longer set time and slower strength gain for concrete with SCMs. Adjust minimum time requirements as stated in **SECTION 710** for concrete used in structures. For concrete paving, be aware of the effect that the use of SCMs (except silica fume) may have on the statistics and moving averages.

401.9 INSPECTION AND TESTING

Unless otherwise designated in the Contract Documents or by the Engineer, obtain samples of fresh concrete for the determination of slump, weight per cubic yard and percent of air from the final point of placement.

The Engineer will cast, store and test strength test specimens in sets of 3.

KDOT will conduct the sampling and test the samples according to **DIVISION 2500** and the Sampling and Testing Frequency Chart in Part V. For QC/QA contracts, establish testing intervals within the specified minimum frequency.

The Engineer will reject concrete that does not comply with specified requirements.

The Engineer will permit occasional deviations below the specified cementitious content, if it is due to the air content of the concrete exceeding the designated air content, but only up to the maximum tolerance in the air content.

Continuous operation below the specified cementitious content for any reason is prohibited.

As the work progresses, the Engineer reserves the right to require the Contractor to change the proportions if conditions warrant such changes to produce a satisfactory mix. Any such changes may be made within the limits of the specifications at no additional compensation to the Contractor.

APPENDIX A – NON-MANDATORY INFORMATION

GENERAL CONCRETE

Design general concrete according to **TABLE 401-A1** meeting the applicable requirements for Volume of Permeable Voids, Surface Resistivity, or Rapid Chloride Permeability as required in **subsection 401.3h**.

TABLE 401-A1: GENERAL CONCRETE

Grade of Concrete	lb. of Cementitious per yd of Concrete, minimum	lb. of Water per lb. of Cementitious, maximum
Grade 7.0(**): MA Gradation	700	0.35
Grade 6.0(**): MA Gradation	650	0.35
Grade 5.0(**): MA Gradation	602	0.35
Grade 4.5(**): MA Gradation	602	0.40
Grade 4.0(**): MA Gradation	602	0.44
Grade 3.5 and 3.0(**): MA Gradation	564	0.46
Grade 2.5(**): MA Gradation	526	0.50

General Concrete (*) (**)
*Grade as specified in the Contract Documents
Air Entrained meeting **subsection 401.3a.

Air entrained concrete with a target air of 6.5 ± 1.5 percent.

Maximum water to cementitious ratio of 0.50 and a minimum cementitious content of 480 lbs per cubic yard. Maximum limit of lb. of water per lb. of cementitious material includes free water in aggregates, but excludes water of absorption of the aggregates.

APPENDIX B – NON-MANDATORY INFORMATION

SUGGESTED GUIDELINES FOR MEETING KDOT'S PERMEABILITY SPECIFICATIONS

General:

Water and chlorides permeate through the mortar and paste of the concrete mixes. They do not readily permeate through the larger aggregates. Permeability can be improved by decreasing the mortar and paste of the concrete mix and increasing the coarse aggregate portions.

The use of optimized mix designs, blended cements, and/or supplementary cementitious materials (SCMs) can reduce the permeability of concrete. **SECTIONS 1102 and 1116**, Aggregates for Concrete describes optimized aggregate gradations for concrete mixes. Additional testing for alkali silica reaction (ASR) is required when SCMs are used in concrete as per **SECTION 401**. The amount of SCMs required to pass the ASR testing may be different than the amount required to comply with the permeability specifications. SCMs may also lower the necessary water cement (w/c) ratio and may slow set times and strength gain.

Optimizing the coarse aggregate gradations can decrease permeability. This includes mixes with more than 60% retained on the # 8 sieve and gradations with fineness modulus above 4.75. A fineness modulus of over 5.0 can yield even better results. Use the largest practical nominal maximum size aggregate allowed.

In general, keeping the w/c ratio below 0.43 may help meet the permeability specifications, as may lower cementitious content mixes when using Type I/II cements. These two properties control the paste in the mix. Concrete mixes with less than 25% paste (as displayed on KDOT Form 694) are more likely to pass the permeability specifications. Acceptable concrete can be mixed with paste contents of 23% or lower. Water cement ratios below 0.39 often do not provide enough water for all constituents to properly react, especially when admixtures are used, and may be counterproductive. High early strength concrete mixes using Type III cement and higher cementitious contents have also been able to pass the Standard Permeability requirements because of their low w/c ratios.

In general, the use of water reducers is helpful in reducing the paste content. Material compatibilities, following the admixture suppliers' recommendations for dosage rates, and the order of introduction of the chemicals into the mix are paramount to meeting KDOT specifications. Contractors should work with their admixture suppliers to find an admixture that works well with their combination of materials.

Changes made to an approved mix design will change the permeability, especially additional water, or redosing water that was withheld from the mix at a concrete plant. It is also recommended that concrete producers verify their mixes with a minimum of 3 cubic yards after doing their laboratory mix designs.

Standard Permeability Concrete (SPC) Requirements:

Volume of Permeable Voids 12.0% max, or
Surface Resistivity 9.0 kΩ-cm min, or
RCPT 3000 Coulombs max.

The SPC requirements may be met without the use of optimized mix designs, blended cements or SCMs. With certain aggregates, 25% slag cement will be required to pass the ASR testing. With other aggregates, a minimum of 30% slag cement by weight of total cementitious materials is usually needed. Some fly ashes require a minimum of 18% to 20% of the total cementitious material to pass the ASR test. Class C fly ash will react differently than Class F fly ash.

Some people believe that lower absorption aggregates have a better chance of meeting the permeability specification, but higher absorption aggregates have been used in concrete mixes utilizing these guidelines and have met the SPC specifications. KDOT has found that the properties of the concrete are often more important than the absorption of the aggregate when meeting this specification.

Moderate Permeability Concrete (MPC) Requirements:

Volume of Permeable Voids 11.0% max, or
Surface Resistivity 13.0 kΩ-cm min, or
RCPT 2000 Coulombs max.

Concrete mixes for MPC will require aggregates with a minimum Soundness of 0.95, a maximum LA Wear of 40, and a minimum Acid Insoluble Residue of 85%. These aggregates, by nature, are harder aggregates with very low absorption. MPC may rely more heavily on optimized gradations, blended cements or SCMs in order to meet the specification. Consideration could be given to ternary blends of cementitious materials, using more than one

SCM, or combining a blended cement with an additional SCM. Combinations of 25% to 30% slag cement with as little as 10% to 25% Class C fly ash have been very effective in keeping permeabilities below the level required for MPC. Incorporation of 20% Class F Fly Ash will often satisfy the requirements of the MPC specification.

Low Permeability Concrete (LPC) Requirements:

Volume of Permeable Voids 9.5% max, or
Surface Resistivity 27.0 kΩ-cm min, or
RCPT 1000 Coulombs max.

LPC will also use harder aggregates with very low absorption. These mixes must be optimized with the MA-6 gradation. Mix designs with 5% silica fume and 95% Type I/II cement often meet the LPC requirements. These mixes have traditionally been known as silica fume concrete. Ternary mix designs are useful in meeting these requirements. Consider using 3% to 5% silica fume with 25% to 30% slag cement, or 25% to 30% slag cements with 10% to 25% Class C fly ash. Class F fly ash alone may also be effective in reducing the permeability to these levels.

Contact KDOT's Bureau of Research or the District Office for additional guidance in meeting the Permeability Specifications.

SECTION 402

STRUCTURAL CONCRETE

402.1 DESCRIPTION

Provide the grades of concrete specified in the Contract Documents.

This specification is specific to Structural Concrete. See **SECTION 401** for general concrete requirements.

402.2 MATERIALS

Provide materials that comply with the applicable requirements.

General Concrete	**SECTION 401**
Aggregate	**DIVISION 1100**
Admixtures, and Plasticizers	**DIVISION 1400**
Cement, Fly Ash, Silica Fume, Slag Cement and Blended Supplemental Cementitious	**DIVISION 2000**
Water	**DIVISION 2400**

402.3 CONCRETE MIX DESIGN

a. General. Design structural concrete mixes as specified in the Contract Documents.

b. Concrete Mix Design. Two options are available for mix design procedures. Use the procedures outlined in **SECTION 401** or Appendix A to design structural concrete mixes. Mixes developed using Appendix A must meet permeability requirements of **TABLE 402-1**.

c. Concrete Strength Requirements. Design concrete to meet the strength requirements of **SECTION 401**.

d. Portland Cement, Blended Hydraulic Cement, and Individual and Blended Supplemental Cementitious Materials. Unless specified otherwise in the Contract Documents, select the type of portland cement, blended hydraulic cement and individual and blended supplemental cementitious materials according to **SECTION 401**.

e. Structural Concrete Specific Requirements. Design concrete to meet the following requirements:

(1) Maximum water to cementitious ratio of 0.50 and a minimum cementitious content of 480 lbs per cubic yard.

(2) Air entrain concrete with a target air content of 6.5 ± 1.5 percent.

(3) Determine the air loss due to pumping operations once in the AM and once in the PM. Determine the difference between the air content from concrete sampled before the pump, and concrete sampled after pumping. Make adjustment to the mix to compensate for the pumping of the concrete.

(4) Maximum air content is 10%. Take immediate steps to reduce the air content whenever the air content exceeds 8%.

(5) Determine air content by KT-19 (Volumetric Method). A regularly calibrated KT-18 (Pressure Method) meter may be used for production with random verification by the Volumetric Method. See KT-19 for special requirements when using the Volumetric Method with high cementitious concretes or mixtures with midrange water reducers or plasticizers.

(6) Concrete permeability requirements according to **TABLE 402-1**.

(7) Use Quality Requirements for Structural Aggregates as listed in **SECTION 1102**, Aggregates For Concrete Not Placed on Grade.

(8) Use gradation requirements for aggregates as listed in **SECTION 1102**, Aggregates For Concrete Not Placed on Grade.

(9) Use MA-6 optimized gradation for Low Permeability Concrete for Bridge Overlays.

(10) Perform 28-day Volume of Permeable Voids as per KT-73, 28-day Surface Resistivity as per KT-79, **or** 56-day Rapid Chloride Permeability as per AASHTO T-277 when required. Submit accelerated cure procedures for the Engineer's approval. The field verification test procedure must be the same test procedure as the mix design approval test.

(11) To meet permeability requirements, the use of supplemental cementitious materials may be necessary. See **SECTION 401**.

(12) When used, add silica fume with other cementitious materials during batching procedures. If the silica fume cannot be added to the cementitious materials, add the loose silica fume to the bottom of the stationary drum that is wet, but has no standing water, before adding the dry materials. The Engineer may approve shreddable bags on a performance basis, only when a central batch mixing process is used. If so, add the bags to half of the mixing water and mix before adding cementitious materials, aggregate and remainder of water.

Mix silica fume modified concrete for a minimum of 100 mixing revolutions.

(13) ASTM C-1567 is required if supplementary cementitious materials (SCMs) are utilized. See **subsection 401.3d.(6)** for requirements. ASTM C 1567 is not necessary for concrete modified with only Silica Fume.

TABLE 402-1: REQUIREMENTS FOR STRUCTURAL CONCRETE

	Volume of Permeable Voids, maximum	Surface Resistivity, minimum	Rapid Chloride Permeability, maximum	ASTM C-1567 Accelerated Mortar Bar Expansion
Use Low Permeability Concrete (LPC) for Bridge Overlays	9.5%	27.0 kΩ-cm	1000 Coulombs	0.10% @ 16 days
Use Moderate Permeability Concrete (MPC) for specified Full Depth Bridge Decks.	11.0%	13.0 kΩ-cm	2000 Coulombs	0.10% @ 16 days
Use Standard Permeability Concrete (SPC) for all other structural concrete not specified as Low or Moderate Permeability.	12.0%	9.0 kΩ-cm	3000 Coulombs	0.10% @ 16 days

f. Slump.

(1) Designate a slump for each concrete mix design that is required for satisfactory placement of the concrete application. Reject concrete with a slump that limits the workability or placement of the concrete.

(2) If the designated slump is 3 inches or less, the tolerance is ±3/4 inch, or limited by the maximum allowable slump for the individual type of construction.

(3) If the designated slump is greater than 3 inches the tolerance is ±25% of the designated slump.

(4) For drilled shafts the target slump just prior to being pumped into the drilled shaft is 9 inches. If the slump is less than 8 inches, redose the concrete with admixtures as permitted in **subsection 401.3i**.

(5) Do not designate a slump in excess of 5 inches for all other structural concrete.

APPENDIX A – NON-MANDATORY INFORMATION

GENERAL CONCRETE FOR STRUCTURES AND SILICA FUME MODIFIED CONCRETE

CONCRETE FOR STRUCTURES

Design concrete for structures according to **TABLE 402-A1** meeting the applicable requirements for Volume of Permeable Voids, Surface Resistivity or Rapid Chloride Permeability as required in **TABLE 402-1**.

TABLE 402-A1: CONCRETE FOR STRUCTURES

Grade of Concrete	lb. of Cementitious per yd of Concrete, minimum	lb. of Water per lb. of Cementitious, maximum
Grade 6.0(**)(***)(****): MA Gradation	700	0.35
Grade 5.0(**)(***)(****): MA Gradation	602	0.35
Grade 4.5(**)(***)(****): MA Gradation	602	0.40
Grade 4.0(**)(***)(****): MA Gradation	602	0.44
Grade 3.5 and 3.0(**): MA Gradation	564	0.46
Grade 2.5(**): MA Gradation	526	0.50

Structural Concrete (*) (**) (***)(****)
*Grade as specified in the Contract Documents
Air Entrained meeting **subsection 402.3e.
***Aggregate as specified in **DIVISION 1100**.
****MPC (Moderate Permeability Concrete)

Air entrained concrete with a target air of 6.5 ± 1.5 percent.

Maximum water to cementitious ratio of 0.50 and a minimum cementitious content of 480 lbs per cubic yard. Maximum limit of lb. of water per lb. of cementitious material includes free water in aggregates, but excludes water of absorption of the aggregates.

SILICA FUME MODIFIED CONCRETE

When silica fume is selected for use in structural concrete, meet the mix design and production requirements in **TABLE 402-A2**.

Use MA-6 Aggregate Gradation for Bridge Overlay concrete.

TABLE 402-A2: SILICA FUME BRIDGE OVERLAY CONCRETE CRITERIA

lbs. of Cement per cu. yd. maximum	595
lbs. of Silica Fume per cu. yd., maximum	30
lbs. of water per lbs. of (Cement + Silica Fume), maximum	0.40
Percent of Air by Volume	6.5±1.5
Maximum 28 day Permeable Voids KT-73	9.50%
or Minimum 28 day Surface Resistivity KT-79	27.0 kΩ-cm
or Maximum 56 day Rapid Chloride Permeability T-277	1000 coulombs

SECTION 403

ON GRADE CONCRETE

403.1 DESCRIPTION

Provide the grades of concrete specified in the Contract Documents.

This specification is specific to On Grade Concrete. See **SECTION 401** for general concrete requirements.

403.2 MATERIALS

Provide materials that comply with the applicable requirements.

General Concrete	**SECTION 401**
Aggregate	**DIVISION 1100**
Admixtures and Plasticizers	**DIVISION 1400**
Grade 2 Calcium Chloride	**DIVISION 1700**
Cement, Fly Ash, Silica Fume, Slag Cement and Blended Supplemental Cementitious	**DIVISION 2000**
Water	**DIVISION 2400**

403.3 CONCRETE MIX DESIGN

a. General. Design the concrete mixes for on grade concrete as specified in the Contract Documents.

b. Concrete Mix Design. Use procedures outlined in **SECTION 401**.

c. Portland Cement and Blended Hydraulic Cement and Supplemental Cementitious Materials. Unless specified otherwise in the Contract Documents, select the type of portland cement, blended hydraulic cement and supplemental cementitious materials as specified in **SECTION 401**.

d. On Grade Concrete Specific Requirements. Use Optimized, Air-Entrained Concrete. Provide the Engineer written notification of the selection prior to the pre-construction conference.

(1) Design air-entrained concrete for pavement meeting **TABLE 403-1**.

(2) Design air-entrained concrete for shoulders meeting **TABLE 403-2**.

(3) Design air-entrained concrete for other uses with a maximum water to cementitious ratio of 0.50 and a minimum cementitious content of 480 lbs per cubic yard.

(4) For projects that are not QC/QA paving projects, verify the mix design in the field by performing compressive strength tests on cylinders made from samples taken from concrete produced at the project site before or during the first day that concrete pavement is placed on the project. If the compressive strength tests indicate noncompliance with minimum design values, add additional cement to the mix or make other appropriate mix design changes at no additional cost to KDOT.

(5) Control air content for PCCP by **subsection 403.4**.

(6) The amount of cementitious material listed in **TABLES 403-1** and **403-2** is the designated minimum for concrete pavement and shoulders respectively. It may be necessary to add additional cementitious material or otherwise adjust the mix proportions as permitted by the specifications to provide a mix design that complies with the compressive strength requirement.

(7) Maximum limit of lb. of water per lb. of cementitious material includes free water in aggregates, but excludes water of absorption of the aggregates.

(8) Provide On Grade Concrete that meets either the 28-day Volume of Permeable Voids KT-73, 28-day Surface Resistivity KT-79, **or** 56-day Rapid Chloride Permeability AASHTO T-277. Submit accelerated cure procedures for the Engineer's approval. The field verification test procedure must be the same test procedure as the mix design approval test.

(9) Permeability requirements do not apply for concrete patching material used in **SECTION 833** when existing pavement to be patched is more than 10 years old.

TABLE 403-1: AIR-ENTRAINED CONCRETE FOR PAVEMENT						
lb. of Cementitious per yd^3 of Concrete, minimum	**lb. of Water per lb. of Cementitious, maximum**	**Percent of Air by Volume**	**28-Day Comp Strength, psi minimum**	**Volume of Permeable Voids, maximum**	**Surface Resistivity, minimum**	**Rapid Chloride Permeability, maximum**
517	0.45	See **subsection 403.3e.**	4000	12.0%	9.0 kΩ-cm	3000 Coulombs

TABLE 403-2: AIR-ENTRAINED CONCRETE FOR SHOULDERS					
lb. of Cementitious per yd^3 of Concrete, minimum	**lb. of Water per lb. of Cementitious, maximum**	**Percent of Air by Volume**	**Volume of Permeable Voids, maximum**	**Surface Resistivity, minimum**	**Rapid Chloride Permeability, maximum**
480	0.45	See **subsection 403.3e.**	12.0%	9.0 kΩ-cm	3000 Coulombs

(10) Concrete for shoulders using the same aggregates, gradations, and water to cementitious ratio as the mainline pavement concrete on the same project will be approved without testing for Volume of Permeable Voids, Surface Resistivity or Rapid Chloride Permeability.

e. Design Air Content. Provide a minimum air content that complies with these 2 criteria:

- a minimum by volume of 5.0% behind the paver, and
- a maximum air void spacing factor of 0.0100 inch behind the paver.

For a typical PCCP, design the mix at the minimum air content plus 0.5%.

The target air content is the air content that meets both criteria above.

If the air void spacing factor exceeds 0.0100 inch, use the following formula as a guide to determine the target air content:

Minimum % air content at 0.0100 inch = % air measured + (measured spacing factor – 0.0100)/0.0010.

Mixes with Laboratory or Field Prequalification spacing factors greater than 0.0100 inch will not be approved.

When AVA spacing factors exceed 0.010 inches (0.25 mm) take immediate steps to reduce the spacing factor.

The Field Engineer will conduct an investigation using the following steps. If any one of the steps 1 through 9 corrects the problem, the Field Engineer will stop the investigation. The steps may be completed in combination and/or out of order. For example some may want to conduct steps 5 or 6 before some of the other steps.

1. If the failing sample came from behind the paver, the Engineer will take the following steps. Obtain an AVA sample from a unit weight bucket of concrete obtained from grade in front of the paver. Also, measure the total air content in the concrete on the grade in front of the paver. Obtain AVA and total air samples from behind the paver. Determine the loss of air and spacing factor due to the paving operation. Adjust for air loss due to paving.
2. Verify calibration of the AVA.
3. Change the location of the AVA during testing.
4. Call in the Research Unit or another AVA machine for comparison testing.
5. Check the mix design for compliance with **SECTION 401**.

6. Check all of the gradations.
7. Check the total air content vs. target air content.
8. Check for Contractor compliance with admixture supplier's recommendations on dosage rates and order of introduction of the chemicals into the mix.
9. Check for material compatibility by using different admixtures or sources of admixtures.

Refer to the "11 Strategies to Improve the Air-Void Spacing Factor" in **APPENDIX B**.
If the problem is not corrected, the Field Engineer will take the following steps:
Obtain 2 cores from any area with an AVA spacing factor >0.0125 inches and send to Materials Research Center for hardened air evaluation.

- If the AVA spacing factor > 0.0125 inches and the average hardened air spacing factor is > 0.0080 inches, then suspend paving and submit new mix design.
- If the AVA spacing factor > 0.0125 inches and the average hardened air spacing factor < 0.0080 inches, then accept PCCP.

Take immediate steps to increase the air content whenever the air content behind the paver falls below 5.0%. Suspend paving operations when 2 consecutive air contents behind the paver fall below 4.0% and remove and replace the represented concrete.

Air Void Spacing Factor does not apply to concrete used in **SECTION 833** when existing pavement to be patched is more than 10 years old.

The maximum air content is 10%. Take immediate steps to reduce the air content whenever the air content exceeds 8%.

f. Slump.

(1) Maximum design slump for slip form On Grade Concrete is 2 ½ inches. Do not designate a slump in excess of 5 inches for all other On Grade Concrete

(2) For all other On Grade Concrete placement, designate a slump that is required for satisfactory placement of the concrete application. Reject concrete with a slump that limits the workability or placement of the concrete.

(3) If the designated slump is 3 inches or less, the tolerance is ±3/4 inch, or limited by the maximum allowable slump for the individual type of construction.

(4) If the designated slump is greater than 3 inches the tolerance is ±25% of the designated slump.

403.4 AIR-ENTRAINED ON GRADE CONCRETE

a. Air Content for PCCP. Provide an air content that complies with **subsection 401.3e**.

Using fresh concrete, the Engineer will determine the air void spacing factor using the AVA according to the manufacturer's requirements. Prequalify mixtures by either the laboratory option or the field option. Contact the Engineer to arrange testing by the AVA. Additional AVA testing will be required if the concrete plant is changed during the course of the project.

b. Laboratory Prequalification. Prepare a trial mix using a drum-type mixer according to AASHTO T 126 using all of the materials in the proportions, except the air entraining agent, contemplated for use in the field. Laboratory mixes require more air entraining agent than is needed in the field.

The Engineer will perform the following: Consolidate a sample in the unit weight bucket by vibration according to KT-20. Obtain 3 samples from the unit weight bucket for testing by the AVA. Valid results must have a minimum of 2 spacing factor readings within a range of 0.0025 inch. Test the third sample if the first 2 do not meet these criteria. Determine the air content of the trial mix by KT-19 (Volumetric Method) or KT-18 (Pressure Method) calibrated to yield the same result. Calculate a target percent air content at a maximum air void spacing factor of 0.01 inch using the equation in **subsection 403.3e.**, when applicable.

c. Field Prequalification. Produce a trial batch at a minimum air temperature of 60ºF using the batch plant and project materials.

The Engineer will perform the following: Test for air content by the procedure specified under laboratory prequalification. Correlate this air content to the average of at least 2 valid AVA test results. Valid AVA results have a maximum range of 0.0025 inch.

When necessary, calculate a target percent air content at a maximum air void spacing factor of 0.0100 inch, using the equation in **subsection 403.3e**.

d. Field Verification. Coordinate with the Engineer so production samples may be obtained behind the paver to establish the target air content on the first paving day. Produce concrete using the same materials and proportions that were used in the prequalification mixture. Adjustments may be approved in the dosage of air entraining agent and a 5% adjustment may be approved in the water-cementitious ratio. AVA samples will be taken both in the path of a vibrator and the gap between vibrators.

Perform the test for air content at the delivery site of the concrete KT-19 (Roll-a-meter) or KT-18 (pressure meter), calibrated to yield the same result. Make adjustments in the proportions, types of material or the operation to establish a satisfactory, target air content.

e. Control of the Air Content During Paving Operations. Maintain an air content behind the paver as determined by KT-19 or KT-18, which meets **subsection 403.3e**. Maintain all production parameters established during field verification. The dosage of air-entraining agent may be varied to control the air content. Five percent adjustments will be permitted to the cementitious content and the water-cementitious ratio. With AVA testing, 5% adjustments will be permitted to the aggregate proportions, as well as any adjustment to the water reducer. Comply with all specifications regarding production of fresh concrete.

For all mainline paving, test the concrete at the beginning of the day's operation and approximately every 2 hours thereafter for air content. For all other slipformed pavement, test for air content at the beginning of a day's operation and approximately every 4 hours thereafter. Test hand placements for air content at least once daily.

Determine the air loss due to paving operations once in the AM and once in the PM. Determine the difference between the air content from concrete sampled before the paver, and concrete sampled behind the paver. QC/QA samples may be obtained in front of the paver and then corrected subtracting the difference determined during that ½ days production. Loss of air due to paving operations may adversely affect the spacing factor.

Failure to maintain the minimum required air content will result in suspension of operation. Take immediate steps to increase the air content above the minimum values stated in **subsection 403.3e**.

Other similar designs using higher cementitious contents (this may adversely affect permeability) and the same admixture types and dosage (with the same or lower water-cementitious ratio) may be used in limited areas such as crossovers, etc. Unauthorized changes in any aspect of production are cause for rejection of the pavement.

Random checks of the air void spacing factor of the concrete in the path and gap of the vibrators will be conducted by the Engineer to verify a maximum spacing factor of 0.0100 inch at the measured air content.

APPENDIX A – NON-MANDATORY INFORMATION

GENERAL ON GRADE CONCRETE

Design On Grade Concrete according to **TABLE 403-A1** meeting the applicable requirements for Volume of Permeable Voids, Surface Resistivity or Rapid Chloride Permeability as required in **TABLE 403-1**.

TABLE 403-A1: ON GRADE CONCRETE

Grade of Concrete	lb. of Cementitious per yd of Concrete, minimum	lb. of Water per lb. of Cementitious, maximum
Grade 4.0: MA Gradation	602	0.44
Grade 3.5 and 3.0: MA Gradation	564	0.46
Grade 2.5: MA Gradation	526	0.50

Air Entrained On Grade Concrete meeting **subsection 403.3e**.

Maximum water to cementitious ratio of 0.50 and a minimum cementitious material content of 480 lbs per cubic yard. Maximum limit of lb. of water per lb. of cementitious material includes free water in aggregates, but excludes water of absorption of the aggregates.

APPENDIX B – NON-MANDATORY INFORMATION

STRATEGIES TO IMPROVE THE AIR VOID SPACING FACTOR

Better air-void characteristics are obtained by a more thorough mixing of the sand and the air-entraining agent. Below are listed some strategies to help the mixing process.

1. Increase the mixing time of the plant or mixing revolutions of the truck.
2. Use a higher dosage of water reducer, up to 390 ml per 100 kg (6 oz. per 100 lbs) of cement. Use a non-retarding water reducer above 195 ml per 100 kg (3 oz. per 100 lbs) if needed.
3. Reduce the Paste Content (less water or less cement).
4. Use a higher proportion of rock.
5. Use a third, mid-sized aggregate.
6. Use coarser graded sand, or a finer sand if the current one is extremely coarse.
7. Maintain a higher air content (use more air-entraining agent).
8. Use coarser cement.
9. Change types or brands of the water reducer or the air entraining agent or both.
10. Cool the mix ingredients; i.e., use chilled water.
11. Use a different plant or modify the plant configuration. Introduce aggregates together on the belt feed (multiple weigh hoppers), use live bottoms aggregate bins, use dual drums, etc.

SECTION 404

CONCRETE FOR PRESTRESSED CONCRETE MEMBERS

404.1 DESCRIPTION

Provide concrete with the release and 28 day compressive strengths specified in the Contract Documents.

This specification is specific to Concrete for Prestressed Concrete Members. See **SECTION 401** for general concrete requirements.

404.2 MATERIALS

Provide materials that comply with the applicable requirements.

General Concrete .... **SECTION 401**
Aggregate .... **DIVISION 1100**
Admixtures and Plasticizers .... **DIVISION 1400**
Grade 2 Calcium Chloride .... **DIVISION 1700**
Cement, Fly Ash, Silica Fume, Slag Cement and Blended Supplemental
Cementitious .... **DIVISION 2000**
Water .... **DIVISION 2400**

404.3 CONCRETE MIX DESIGN

a. General. Design concrete mixes specified in the Contract Documents. A mix design must be approved by the Engineer before the mix can be used in the production of prestressed concrete members.

b. Concrete Mix Design. Two options are available for mix design procedures. Use the procedures outlined in **SECTION 401**, or use **TABLE 404-2** to design structural concrete mixes.

c. Concrete Strength Requirements. Unless shown otherwise in the Contract Documents, design concrete to meet the compressive strength requirements of **TABLE 404-1**. For prestressed bridge beams, the Engineer will determine the strength requirements from the table except when specified elsewhere in the Contract Documents.

TABLE 404-1: COMPRESSIVE STRENGTH REQUIREMENTS

Type of Unit	For Stress Application (Release) and/or moving* (Minimum) (psi)	Age 28 Days (Minimum)** (psi)
Prestressed Bridge Beams	5800	7000
	4800	6000
	4000	5000
Prestressed Piles	3000	5000
Prestressed Panels	4000	5000

* From casting bed to producer's storage only. Not a shipping strength.
** Also required for shipping strength.

d. Portland Cement, Blended Hydraulic Cement and Individual and Blended Supplemental Cementitious Materials. Unless specified otherwise in the Contract Documents, select the type of portland cement, blended hydraulic cement and individual and blended supplemental cementitious materials according to **SECTION 401**.

e. Specific Requirements for Concrete used in Prestressed Concrete Members. Design concrete to meet the requirements of **TABLE 404-2**.

TABLE 404-2: CONCRETE REQUIREMENTS						
Self-Consolidating Concrete (SCC)			**Non SCC**	**All Concrete**		
Slump Flow From Target (Inches)	**Blocking Assessment (Inches)**	**Visual Stability Index**	**Maximum Slump (Inches)**	**Minimum Cementitious per Cubic Yard (Lbs)**	**Mixing Water: Maximum lb. per lb. Cementitious**	**Air Content (%)**
± 2	2 maximum	0 or 1	5 or 7 ± 25%	602	0.44	6.5 ± 1.5

(1) Determine the slump flow using ASTM C 1611, "Standard Test Method for Slump Flow of Self-Consolidating Concrete." The target value is determined during the mix design and approval process (see below). At the point of placement, slump flow can deviate from target by no more than 2 inches.

(2) Determine the blocking assessment using ASTM C 1621, "Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring."

(3) Determine the visual stability index (VSI) using Appendix X1 of ASTM C 1611. When approved by the Engineer, the VSI may be determined using additional concrete stability observations.

(4) Designate a slump for each concrete mix design that is no greater than 5 inches when not using mid-range or high-range water reducing admixtures. When a water reducing admixture is being used, designate a slump no greater than 7 inches. The tolerance from design at the point of delivery is ± 25%.

(5) It may be necessary to adjust the mix proportions, as permitted by the specifications, to provide a mix that complies with placement, and the release and 28-day strength requirements.

(6) Maximum limit of lb. of water per lb. of cementitious material includes free water in aggregates, but excludes water of absorption of the aggregates.

(7) Non-air entrained concrete may be used in concrete piling not subject to freezing and thawing and wetting and drying.

(8) There are no permeability requirements.

(9) Determine air content by KT-19 (Volumetric Method). A regularly calibrated KT-18 (Pressure Method) meter may be used for production with random verification by the Volumetric Method. See KT-19 for special requirements when using the Volumetric Method with high cementitious concretes or mixtures with midrange water reducers or plasticizers.

(10) Use Quality Requirements for Structural Aggregates as listed in **SECTION 1102**, Aggregates For Concrete Not Placed on Grade. Keep a copy of the KDOT Official Quality test report from the approved source on file at the prestress plant and available for review by the Engineer.

(11) Use gradation requirements for aggregates as listed in **SECTION 1102**, Aggregates For Concrete Not Placed on Grade.

(12) When used, add silica fume with other cementitious materials during batching procedures. If the silica fume cannot be added to the cementitious materials, add the loose silica fume to the bottom of the stationary drum that is wet, but has no standing water, before adding the dry materials. The Engineer may approve shreddable bags on a performance basis, only when a central batch mixing process is used. If so, add the bags to half of the mixing water and mix before adding cementitious materials, aggregate and remainder of water. The presence of visible chunks or wads of bag paper at the point of placement will be cause for rejection.

Mix silica fume modified concrete for a minimum of 100 mixing revolutions, unless high speed mixing equipment is used.

(13) ASTM C-1567 is required if supplementary cementitious materials (SCMs) are utilized. See **subsection 401.3d.(6)** for requirements. ASTM C 1567 is not necessary for concrete modified with only Silica Fume.

(14) For the approved source of water, keep a copy of the KDOT test report on file at the prestress plant and available for review by the Engineer.

(15) Use admixtures that are prequalified. Maintain a copy of the Type C certification on file at the prestress plant and available for review by the Engineer. No other additives may be used without written approval by the Engineer.

f. Additional Design Requirements for Self-Consolidating Concrete (SCC). SCC is defined as a concrete mixture which can be placed by means of its own weight with little to no vibration. It is accomplished by adjusting traditional mix designs using special admixtures.

(1) Do not rod or vibrate when making test cylinders.

(2) Provide scales capable of determining test block weights for the strand bond test that are calibrated (NIST traceable) and approved by the Engineer.

(3) Perform a strand bond test (KT-83) for each mix and strand to be used in the future production of prestressed beams. Any change in admixture, aggregate source or gradation, cementitious material content or source, and strand producer or size requires that a new strand bond test be completed using the replacement materials. Make 2 test beams for each bond test. Cure the test beams in an environment that is representative of future production (i.e. – moisture and heat until release then ambient conditions).

(a) With the Engineer observing, perform a single Slump Flow test for each pair of test beams cast. This spread establishes a target value from which future point of placement values are to be compared to. Assign a Visual Stability Index (VSI) number to the concrete spread.

(b) With the Engineer observing, perform a single J-Ring test for each pair of test beams cast. Calculate a "blocking assessment" value.

(c) Make a minimum of 2 sets of 3 cylinders for each pair of test beams cast. Cure the cylinders with the test beams they represent.

(i) With the Engineer observing, test 1 set of cylinders at the producer's plant to measure for release (equal to the release strength of future production). De-tension the strand in both test beams only after this cylinder set indicates that release strength has been attained.

(ii) With the Engineer observing, test 1 set of cylinders at the producer's plant to measure for 28-day strength (equal to the 28-day strength of future production). Perform the bond test on both test beams only after this cylinder set indicates that the 28-day strength has been attained.

(iii) In both cases, the required strength is met when the average compressive strength of the 3 cylinders equals or exceeds the required strength, and no more than 1 cylinder in the tested set had a strength that was no more than 5% below the required strength.

(d) With the Engineer observing, measure the dimensions of both test beams to verify the required casting tolerances. Calculate the weight of the required test loads.

(e) With the Engineer observing, load the test beams using the calculated loads and KT-83.

(f) Submit all beam dimensions, calculations (intermediate and final), release and 28-day strengths, observations, measurements, pictures, and test results related to strand bond, cylinder strength, slump flow, and J-ring testing to the Engineer for review.

(g) In addition to the requirements of this section and **SECTION 401**, the mix design represented by this testing may be approved provided there are 2 passing bond tests, and the assigned blocking assessment and the calculated VSI satisfy the requirements of **TABLE 404-2**.

SECTION 405

CURING ENVIRONMENT

405.1 DESCRIPTION

Provide a curing environment for storage of KDOT concrete cylinders made during open span bridge concrete placements. The curing environment would be utilized by KDOT to store the cylinders during the first 48 hours of their initial cure (KT-22). The curing environment needs to be of sufficient size to hold test samples required for the project at any given time. The quantity of test samples will be based on the appropriate sampling and testing frequency chart in Part V.

The curing environment does not apply to test specimens made for PCCP, curb and gutter, sidewalk, etc.

BID ITEM	**UNITS**
Curing Environment	Lump Sum

405.2 MATERIALS

Provide a curing environment that meets the Initial Curing requirements of KT-22.

Provide a thermometer that records the high and low temperatures within the curing environment.

405.3 CONSTRUCTION REQUIREMENTS

During the preconstruction meeting, discuss with the Engineer the necessary capacity and location of the curing environment. Locate the curing environment to allow the Engineer access at all times.

When KDOT cylinders are stored in the curing environment, provide the Engineer with the recorded high and low temperatures within the curing environment, daily.

4005.4 MEASUREMENT AND PAYMENT

The Engineer will measure curing environment by the lump sum.

Payment for "Curing Environment" at the contract unit price is full compensation for the specified work.

SECTION 501

PORTLAND CEMENT CONCRETE PAVEMENT (QC/QA)

Note: PCCP is considered QC/QA when the bid item Quality Control Testing is included in the contract. Note the exceptions in subsection 501.5.

501.1 DESCRIPTION

Construct Portland Cement Concrete Pavement (PCCP) on a prepared subgrade or base course. Develop and perform quality control testing.

Urban PCCP Environment: Projects or sections of the project classified as Urban Type are typically:

- within city limits;
- require pieced construction due to:
  - business and residential entrances;
  - frequency of side streets; or
  - project phasing.

Before paving, meet with the Engineer to determine if the project or sections of the project are classified as Urban Type.

BID ITEMS	UNITS
Concrete Pavement (* Uniform) (AE) (**)	Square Yard
Concrete Pavement (* Variable) (AE) (**)	Square Yard
Early Strength Concrete Pavement (*Uniform) (AE) (**)	Square Yard
Early Strength Concrete Pavement (*Variable) (AE) (**)	Square Yard
Quality Control Testing (PCCP)[+]	Square Yard
Concrete Core (Set Price)	Each

* Thickness

** No entry denotes PCCP with mesh and dowel assemblies. "Plain" denotes PCCP without mesh and dowel assemblies. "NRDJ" denotes non-reinforced dowel jointed PCCP. "Br App" denotes bridge approach pavement.

[+] Br App pavement quantities are not included in this item.

501.2 CONTRACTOR QUALITY CONTROL REQUIREMENTS

a. General. Provide qualified personnel and sufficient equipment complying with the requirements listed in Part V to conduct quality control testing that complies with Appendix B, Sampling and Testing Frequency Chart for Concrete Construction Items for Quality Control/Quality Assurance Projects.

Allow the Engineer access to the Contractor’s laboratory to observe testing procedures, calculations, test documentation and plotting of test results.

Calibrate and correlate the testing equipment with prescribed procedures, and conduct tests in compliance with specified testing procedures as listed in Part V.

Maintain a Quality Manual in the field laboratory showing the calibrations performed on all test equipment and when the next calibration is due for that equipment. As a minimum, follow the calibration/verification interval established in Table 1: Concrete Materials Test Equipment in Section 5.2.7.4-Concrete: Contractor’s Quality Control Plan, Part V. See also Section 5.2.7.5-Example of a Laboratory Quality Manual for Concrete, Part V.

b. Quality Control Plan (QCP). At the pre-construction conference, submit to the Engineer for approval by the DME, a QCP as outlined in Section 5.2.7.4-Concrete: Contractor’s Quality Control Plan, Part V. Follow 5.2.7.4: Concrete: Contractor’s Quality Control Plan in Part V as a general guideline. Keep a printed copy of the approved QCP in the Contractor’s laboratory and make available to the Engineer when requested.

The Contractor's laboratory and equipment will be inspected and approved as outlined in Section 5.2.7-Contractor's Quality Control Plan, Part V.

Include a listing of the names and phone numbers of individuals and alternates responsible for quality control administration and inspection. On the Contractor's organizational chart, show the specified lines of authority relating both to mix design and quality control operations during production. Post the organizational chart in the Contractor's test facility.

Provide a quality control organization or private testing firm having personnel certified according to the Policy and Procedures Manual for The Certified Inspection and Testing (CIT) Training Program. The testing for this type of construction will require personnel certified in Aggregate Field Tester (AGF), Aggregate Lab Technician (AGL), Profilograph (PO), ACI Concrete Field Testing Technician (CF), Nuclear Moisture Density Gauge Tester (NUC) and Hardened Concrete Properties (HCP) classifications. Provide a minimum of 1 employee on the project certified in the QC/QA Concrete/Cement Treated Base Specs (QCS) classification.

Only persons certified in the appropriate classifications covering the specific tests required shall perform such testing. At the beginning of the project, provide the Engineer with the list of certified technicians and alternates, phone numbers and tests/inspection they will be performing. As personnel changes and certifications may expire, continue to provide the Engineer with an accurate list.

Provide an organizational chart showing the specified lines of authority relating to both mix design and quality control operations during production. Identify the company official acting as liaison with KDOT, and the Certified Technician who will direct inspection and testing. Post the chart in the test facility.

c. Required Duties of Certified Technicians. Be available on the project site whenever concrete for pavement is being produced and being placed on the project site. Perform and utilize quality control tests and other quality control practices to assure that delivered materials and proportioning meet the requirements of the mix designs.

Periodically inspect all equipment utilized in transporting, proportioning, mixing, placing, consolidating, finishing and curing to assure it is operating properly and that placement, consolidation, finishing and curing comply with the mix design and other contract requirements.

d. Contractor's Testing Facilities. Describe the testing facility and its accreditation in the QCP.

Locate the testing facility either at the plant site or at the project. Obtain approval of the testing facilities and location from the DME before the commencement of mixture production.

Provide suitable space for the required testing equipment. Also, equip the testing facility with these items for the exclusive use of the testing facility's quality control personnel and the Engineer:

- A telephone with a private line;
- A copying machine; and
- Broadband internet connection (for 1 computer). If the Engineer determines that broadband internet service is not available, provide a fax machine, at no additional cost.

e. Documentation. Include in the QCP procedures, charts and forms to be used to provide the required documentation.

Record and document all test results and calculations. Record all original documentation in a bound field book or other KDOT approved bound record and turn over to KDOT at the end of the project.

At all times, have complete records of all inspections and tests readily available on site for the Engineer. All records documenting the Contractor's quality control inspections and tests become the property of KDOT upon completion of the work.

Indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and the corrective action taken in the records. Examples of quality control forms and charts are available in Part V, or Contractors may design their own. Documentation procedures are subject to approval by the Engineer before the start of the work and to compliance checks during the progress of the work.

Maintain control charts on an ongoing basis. Plot data according to **SECTION 106**.

Record specific test results on a Daily Quality Control Summary sheet designed to facilitate the computation of moving test averages. Base moving averages on 4 consecutive test results. Include a description of quality control actions taken (such as adjustment of aggregate or additive proportions in the mix, moisture adjustments) in the Daily Quality Control Summary Sheet.

Provide forms on a computer-acceptable medium, where required. Document tickets and gradation data according to KDOT requirements.

Complete testing and charting within 1 working day after sampling.

Keep all quality control charts current. Show both individual test results and moving average values. As a minimum on approved control charts, plot the single test values and the 4 test moving average values for these properties:

- Percent air in concrete mixture;
- Slump of concrete mixture;
- Concrete unit weight;
- In-place concrete density on plastic concrete as a percentage of determined unit weight; and
- Combined aggregate gradation (as a minimum, plot the 3/8" and No. 8 sieves).

Also plot the single test values for actual workability and target workability of the combined aggregates.

Provide the following test data to the KDOT Project Representative:

- Copies of all test results and control charts on a weekly basis, representing the prior week's production;
- Copies of the quality control summary sheet on a daily basis. Include, as a minimum, combined aggregate gradations, actual workability and target workability of combined aggregates, percent air content, slump, concrete unit weight and density of fresh concrete in-place; and
- Copies of all failing test results. Include all applicable sieves, actual workability, percent air content, slump and density of fresh concrete in-place.
- Copies of vibrator checks daily to the Inspector. Email a weekly recap to the Construction Engineer.

Email or fax the data to the Field Engineer and DME, weekly.

f. Testing Requirements. In the QCP, identify test methods, procedures and equipment proposed for use. Use standard KDOT test methods and properly calibrated measuring and testing equipment as outlined in Part V. Detail any alternative sampling method, procedure or inspection equipment proposed to be used. Such alternatives are subject to review and approval by the DME.

Take all samples for tests and perform in-place tests at random locations, selected according to the Contractor's QC Plan and at the rates specified in the Sampling and Testing Frequency Chart for Portland Cement Concrete Pavement for Quality Control/Quality Assurance Projects in Appendix B, Part V. Retain the latest 10 gradation samples for use by the Engineer.

g. Corrective Action. In the QCP, identify procedures for notifying the Engineer when corrective measures must be implemented, and for halting production.

Notify the Engineer when the moving average test result trend line for any property approaches the specification limits. Cease operations if 2 consecutive moving average points fall outside the specification limits. Ceasing operations is the Contractor's responsibility. Quality control tests for this determination include aggregate gradation, compliance with the mix design band, percent air content, concrete unit weight and density of fresh concrete in-place.

Failure to cease operations for the conditions cited above will subject all subsequent material to rejection, or acceptance at a reduced price, as determined by the Engineer.

The Engineer may examine materials represented by individual test results, which lie beyond the Contractor's normal quality control testing variation. The investigation may be based on either Contractor or KDOT test results. The information from additional testing (including testing of in-place pavement) may be used to define unacceptable work according to **SECTION 105**. The Engineer will apply appropriate price reductions or initiate corrective action.

If a dispute exists between the Engineer and Contractor about the validity of any test results other than compressive strengths or thickness determination, the KDOT District Materials Laboratory or MRC will perform referee testing. If one of the disputed KDOT test results was generated at the MRC, then an independent laboratory agreeable to both parties will be selected. The AASHTO Accreditation Program shall have approved the selected laboratory for the appropriate test procedure. If referee testing indicates that KDOT test results are correct, the

Contractor is responsible for the cost of additional testing, including referee testing performed at the MRC. If the referee testing indicates that the Contractor test results are correct, KDOT is responsible for the cost of additional testing.

Follow the procedures outlined in **subsection 501.5g.(4)** if a dispute arises for any test determining compressive strengths or thickness.

h. Non-Conforming Materials. In the QCP, specifically address how non-conforming materials will be controlled and identified.

Establish and maintain an effective and positive system for controlling non-conforming material, including procedures for its identification, isolation and disposition. Reclaim or rework non-conforming materials according to procedures acceptable to the Engineer.

Identify all non-conforming materials and products to prevent use, shipment and intermingling with conforming materials and products. Provide holding areas, mutually agreeable to the Engineer and Contractor.

i. Concrete Information. Separately list the grades of concrete involved in the project. For each grade of concrete to be used, include at a minimum, the following:

- Mix designs. List mix design numbers if using existing mixes.
- Aggregate production.
- Quality of components.
- Stockpile management.
- Proportioning, including added water.
- Mixing and transportation.
- Initial mix properties.
- Placement and consolidation.
- Concrete yield.
- Compressive strength.
- Finishing and curing.
- Frequency of sampling and testing.
- How duties and responsibilities are to be accomplished and documented, and if more than one Certified Technician is required.
- The criteria used by the Certified Technician to correct or reject unsatisfactory materials.

501.3 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete and Grout	**SECTIONS 401& 403**
Aggregates for On Grade Concrete	**SECTION 1116**
Reinforcing Steel	**DIVISION 1600**
Epoxy Coated Steel Bars for Concrete Reinforcement	**DIVISION 1600**
Joint Sealants	**DIVISION 1500**
Expansion Joint Filler	**DIVISION 1500**
Concrete Curing Materials	**DIVISION 1400**
Preformed Elastomeric Compression Joint Seals	**DIVISION 1500**
Cold Applied Chemically Cured Joint Sealant	**DIVISION 1500**
Hot Type Joint Sealing Compound	**DIVISION 1500**
Backer Rod	**DIVISION 1500**
Epoxy Resin-Base Bonding System for Concrete	**SECTION 1705**
Bond Breakers	**SECTION 1718**

501.4 CONSTRUCTION REQUIREMENTS

a. Preparation of the Subgrade. Before placing any surfacing material on any section, complete the ditches and drains along that section to effectively drain the highway. Trim the base or subgrade to the line, grade and typical cross-section as shown in the Contract Documents. Maintain the subgrade or base to the as-constructed condition under other bid items, repairing any encountered defects to the specifications of those bid items. Maintain the subgrade surface to readily drain at all times. Protect the subgrade from damage when handling materials, tools and equipment. Do not store or stockpile materials on the subgrade. Do not place material or lay pavement on a frozen or muddy subgrade, or when it is raining or snowing.

Lightly spray the subgrade or base with water to obtain a thoroughly moistened condition when the concrete is deposited on it. Do not puddle water on the grade.

Do not deposit any material until the subgrade or base has been checked and approved by the Engineer.

b. Slip Form Paving. When paving is performed with a slip form paving unit, use equipment as described in **subsection 154.5**.

Pave 24-foot wide mainline pavement in a single operation. Do not exceed 24-foot paving width in a single operation except as follows:

- The Contractor may pave a maximum of 2 lanes plus a 6-foot shoulder (30 feet maximum) in a single operation.
- For pavements of 3 lanes or more, pave a minimum of 2 lanes mainline (with the option of including a single shoulder for a maximum of 30 feet) in a single operation.
- Approval will be based on satisfactory performance of the Contractor's operation.

Place ramps and auxiliary lanes/shoulders as shown in the Contract Documents.

Once the paving operation has started, provide adequate equipment and supply of materials to maintain continuous placement for any given working period. Keep all concrete conveying equipment clean.

Do not apply any tractive forces to the slip form paver, except that which is controlled from the machine.

Trim to grade the subgrade or surface of the base over which the tracks of the paver will travel. Do not disturb this surface with other equipment. If the equipment or method of operation requires the subbase to be wider than shown in the Contract Documents, place additional material to provide an adequate surface for the tracks of the paver. Upon completion of the paving operations, remove or repair any base material damaged by the slip form paver's tracks. All necessary construction and removal of this additional base material is subsidiary to other items of the contract.

Operate the paver continuously, stopping only when absolutely necessary. If the forward motion of the paver is stopped, immediately stop the vibrator and tamping elements.

Deposit the concrete on the grade in successive batches to minimize re-handling. Place concrete over and against any joint assemblies so the joint assembly is retained in its correct position. Spread the concrete using approved mechanical spreaders to prevent segregation and separation of the materials.

After striking the concrete off with the spreader, leave sufficient concrete in place to allow the final shaping by the use of screeds, templates and pans, depending on make, model and type of machines approved for use in the paving train. Adjust the paving units to meet the required final cross-section, minimizing the need to carry back concrete to fill voids or depressions. Adjust each screed or template so a uniform roll of concrete extends the full length of the screed or template and allows just enough concrete to pass under the unit to properly feed the next machine. Do not shove large volumes of concrete with the screed or template. Adjust the screed or template to maintain a uniform cross-section.

Use multiple spreaders for single and multiple lift operations. Place concrete ahead of the initial spreader strikeoff no more than 30 minutes ahead of the final spreader strikeoff.

The use of any paving machine in the paving train is contingent on its ability to finish the pavement satisfactorily to the required grade, section and specified degree of consolidation. The Engineer may at any time require the adjustment, repair or replacement of the machine for unsatisfactory performance.

Correct any edge slump of the pavement in excess of ¼ inch, exclusive of edge rounding, before the concrete hardens. Excessive edge slumping will be sufficient reason to discontinue paving until machinery (or mix) is properly adjusted or removed from the project.

When the machine finishing has been completed, check the surface with a straightedge a minimum of 10 feet in length before texturing. Operate the straightedge parallel to the pavement centerline, starting at the center and progressing outward. Advance in successive stages of less than ½ the length of the straightedge. At the Contractor's option, this requirement may be eliminated when smoothness is to be determined by the profilograph.

Achieve grade control by use of 1 or more of the following grade reference devices. Approval of any of these devices will be based upon satisfactory performance.

Erected Stringline. Use an erected stringline consisting of a tightly stretched wire or string offset from and parallel to the pavement edge on 1 or both sides. Erect the stringline parallel to the established pavement surface grade and support at intervals as necessary to maintain the established grade and alignment.

Stringless Paving. Control line, grade and pavement cross-section as shown in the Contract Documents. Use electronic guidance systems that meet the requirements and tolerances listed in **SECTION 802**. Horizontal control is guided by GPS. Vertical control is guided by Total Stations. GPS will not be allowed for Vertical control.

When paving on a fresh subgrade that has not been trimmed by an automatically controlled machine, use an erected stringline or stringless paving to establish grade. When directed by the Engineer, use an erected stringline or stringless paving to match grade control points such as bridges.

c. Placing Reinforcement. Place pavement reinforcement at the locations shown in the Contract Documents. Use a sufficient number of approved metal, bar supports or pins to hold all dowel bars and tie bars in proper position as required by the Contract Documents. Install tie-bars perpendicular to the concrete face being tied together. Do not use stones, concrete or wood to support the reinforcement.

Joint tie bars may be installed mechanically if approved by the Engineer. The satisfactory placement of the bars depends on the ability of the Contractor's operation to place and maintain the bars in their true position. When satisfactory placement is not obtained by mechanical means, the Engineer may require the tie bars be installed ahead of placing the concrete, and that they be securely held in their exact position by staking and tying.

Do not install dowel bars mechanically. Install the dowel bars ahead of placing the concrete, and hold them securely in their exact position by staking or tying.

Thoroughly coat each dowel with hard grease or other approved bond breaker as shown in the Contract Documents. The bond breaker coating shall not exceed 15 mils ± 5 mils in thickness when averaged over 3 points measured at the ¼ points on the bar at 90º intervals around the bar.

When reinforced concrete pavement is placed in 2 layers, strike off the entire width of the bottom layer to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. Place the reinforcement directly on the concrete, then place the top layer of concrete, strike it off and screed it. Remove any portion of the bottom layer of concrete that has been placed more than 30 minutes, and replace it with fresh mixed concrete at the Contractor's expense. When reinforced concrete is placed in 1 layer, the reinforcement may be positioned in advance of the concrete placement or it may be placed in the plastic concrete after initial spreading, by mechanical or vibratory means.

Place the wire mesh reinforcement in the pavement at the locations shown in the Contract Documents. When 2 layers of wire mesh reinforcement are required, support the bottom layer in the required position with bar chairs. Use separators for the top layer if the strike-off can not be used properly for the operation. Lap the reinforcement as shown in the Contract Documents. Laps parallel to the centerline of the pavement are prohibited except for unusual width of pavement lanes or for irregular areas. If the Contract Documents do not show dimensions for laps, the minimum lap either perpendicular or parallel to the centerline of the pavement is 6 inches. Fasten or tie adjacent wire mesh sheets together to hold all parts of the wire mesh sheets in the same plane.

If a "wire pattern" appears on the surface of the fresh pavement, immediately modify placement procedures to eliminate the problem.

Use reinforcing steel free from detrimental materials that could impair the bond between the steel and concrete.

d. Consolidation and Finishing. Perform hand spreading with shovels, not rakes. Do not allow workers to walk in the fresh concrete with boots or shoes coated with earth or foreign substance.

Do not apply moisture to the surface of the concrete pavement unless the Engineer approves the use of additional water on the fresh concrete surface to lubricate the float of the longitudinal finisher. If unusual weather conditions require the addition of superficial water to the concrete surface, apply it only in the form of a fine, fog mist.

Uniformly consolidate the concrete without voids, and finish to the cross-section and elevation shown in the Contract Documents.

Use vibrators or other approved equipment to consolidate each layer of concrete, when placed in more than 1 lift, or full depth if placed in 1 lift. Uniformly vibrate the concrete across the full width and depth of the pavement so that the density of pavement concrete is a minimum of 98% of the consolidated unit weight. The 98% density requirement may be eliminated on miscellaneous areas such as entrance pavement, median pavement and gore areas.

Vibrators, either of the surface type (pan or screed) or the immersion type (tube or spud) may be attached to the spreader, paver or finishing machine, or may be mounted on a separate carriage. Only operate the vibrators when the machine they are mounted on is moving forward. Do not operate hand vibrators more than 15 seconds, or less than 5 seconds in any one location unless approved otherwise by the Engineer. Place vibrators in and withdraw from concrete vertically in a slow deliberate manner.

On mainline paving, every 4 hours, check the electronic monitoring system vibrator frequencies with the vibrator under load to comply with the frequencies shown in **subsection 154.2e**.

If the system indicates a vibrator is not working properly, manually check the vibrators, immediately. If a vibrator is not functioning properly, immediately replace.

If the electronic monitoring system fails to operate properly, manually check the vibrators, immediately. If the vibrators are functioning properly, paving may continue but make all efforts to correct the problem within 3 paving days. The Engineer may allow additional time if circumstances are beyond the Contractor's control. Perform the vibrator checks manually until the system is fixed.

Document the checks, and give the data to the Inspector, daily. Email a recap of the data to the Engineer, weekly.

Maintain a uniform, continuous roll of concrete over the vibrators ahead of the strike-off. The height of the roll shall be approximately the same height as the thickness of the pavement being vibrated.

In order to obtain concrete consolidation in the vicinity of joint assemblies, the Engineer may require that these areas be hand vibrated with an immersion spud vibrator.

In the event the specified density is not attained, cease paving operations and make necessary adjustments to produce concrete to conform to the density requirements.

Use an approved nuclear density measuring device to monitor in-place density. Provide a moveable bridge and move it to test locations as required to allow the Inspector to work over the fresh concrete.

On projects or areas within projects where the use of conventional equipment is impracticable, other consolidation and finishing equipment may be used with approval of the Engineer.

e. Fixed Form Paving. At the Contractor's option, the fixed form paving method may be used.

(1) Forms. Use straight, metal forms having adequate strength to support the equipment. Each section shall be a minimum of 10 feet in length. Use forms with a depth equal to the prescribed edge thickness of the concrete, a base width at least equal to the depth of the forms and without a horizontal joint. Use flexible or curved forms of proper radius for curves of 150-foot radius or less, except approved straight forms of 5-foot lengths may be used for curves of a radius from 75 to 150 feet. Flexible or curved forms must be approved by the Engineer. The Engineer may approve the use of wood forms in areas requiring hand finishing. Secure the forms in place to withstand the impact and vibration of the consolidating and finishing equipment without visible spring or settlement. Extend flange braces outward on the base a minimum of ⅔ the height of the form. Remove forms with battered top surfaces or bent, twisted or broken forms. Do not use repaired forms until they have been inspected and approved by the Engineer. Do not use buildup forms, except where the total area of pavement of any specified thickness on the project is less the 2,000 square yards. Do not vary the top face of the form from a true plane more than ⅛ inch in 10 feet, and do not vary the vertical face of the form by more than ¼ inch. The forms shall contain provisions for locking the ends of abutting form sections together tightly, and for secure setting.

(2) Base Support. Provide a foundation under the forms that is compact and true to the specified grade so that the whole length of the form will be set firmly in contact with the grade.

(3) Form Setting. Set forms sufficiently in advance of the point where concrete is being placed so that line and grade may be checked. After the forms have been correctly set, thoroughly tamp the grade mechanically at both the inside and outside edges of the base of the forms. Stake forms into place with a minimum of 3 pins for each 10 feet section. Place a pin at each side of every joint. Tightly lock form sections, free from play or movement in any direction. Do not deviate the form from true line by more than ¼ inch at any point. No excessive settlement or springing of forms under the finishing machine is permitted. Clean and oil forms before the placing of concrete.

(4) Grade and Alignment. Check the alignment and grade elevations of the forms immediately before placing the concrete and make any necessary corrections. When any form has been disturbed or any grade has become unstable, reset and recheck the form.

(5) Placing Reinforcement and Consolidating and Finishing Concrete. Meet the requirements in **subsections 501.4c.** and **d**.

(6) Removing Forms. Unless otherwise provided, do not remove forms from freshly placed concrete until it has set for a minimum of 12 hours, except auxiliary forms used temporarily in widened areas. Remove forms carefully to avoid damage to the pavement.

f. Texturing. Use texturing equipment and devices as described in **subsection 154.7**.

Use a burlap drag as soon as all excess moisture has disappeared and while the concrete is still plastic enough to make a granular surface possible.

Following the dragging operation, use a mechanical device to make a final finish or texture by giving the surface of the plastic pavement a longitudinal tining, unless shown otherwise in the Contract Documents. Perform the operation at such time to minimize displacement of larger aggregate particles and before the surface permanently sets.

Small or irregular areas may be tined by hand methods.

On projects of less than 5,000 square yards, or projects with longitudinal tining, the tining and curing devices may be mounted on the same carriage when approved by the Engineer. Operations of this type will be based on satisfactory performance.

Before final texturing, finish the exposed edge of the pavement to a radius of ¼ inch with an edger. Edge the interior longitudinal joints on multiple-lane pavement to a radius of ⅛ inch. Eliminate any tool marks appearing on the slab adjacent to the joints or edge of the slab. Do not disturb the rounding of the corner of the slab.

g. Joints.

(1) General. Construct joints according to the Contract Documents. Failure to construct the joints in the best possible manner will be cause for suspension of work until the cause of the defective work is remedied.

If existing pavement of any type is required to abut with the new pavement, and the termination of the removal is not at an existing joint, make the new joint by sawing the existing pavement full depth with a diamond saw before removal.

The objective is to create or form a plane of weakness in the fresh concrete before uncontrolled or erratic cracking occurs. The following methods are acceptable:

- Use concrete saws to saw all contraction joints no wider than the initial saw cut and to a depth of D/3 ± ¼ inch. Extreme conditions could exist which make it impracticable to prevent erratic cracking by sawing the joints early. At the onset of the project, devise methods, with the approval of the Engineer, to control this cracking.
- Make a “plastic concrete cut” straight and well defined so it can be sawed out by the saw crew. The “plastic concrete cut” would replace the specified initial saw cut. Suggested procedures could be the use of a stiff metal parting strip, with or without handles that would be gently inserted in the fresh concrete and removed, thereby parting the interlocking coarse aggregate and providing a plane of weakness.
- Cut the fresh concrete with a mason’s trowel and straightedge from a worker’s bridge. It is imperative that the “plastic concrete cut” joint and the second stage saw cut are in the same exact location.
- At the Contractor’s option, “early entry” saws may be used based on satisfactory performance and depth of cut recommended by the equipment manufacturer.
- Procedures to control erratic cracking are not limited to these examples.

Edge any transverse joint requiring hand finishing and edging with a tool having a radius of ⅛ inch. Do not indent the surface of the pavement with the horizontal face of the edger.

(2) Pressure Relief Joints. Install pressure relief joints according to the bridge approach details in the Contract Documents.

Form or saw openings for the joint material approximately 1 ¾ inches wide for the 2-inch joint and approximately 3 ¾ inches wide for the 4-inch joint at the locations shown in the Contract Documents. Use the lubricant adhesive as recommended by the manufacturer of the pressure relief joint material.

Just before the installation of the joint material, clean the faces of the joint by sandblasting, followed by an air blast to clean all dust from joint faces.

The Engineer may approve pre-positioning of the 2-inch material if adequate means are taken to obtain proper placement and retention, and if deformation of the material does not occur when the fresh concrete is placed against it.

Use a foam spacer block beneath the 4-inch joint filler material to maintain the specified grade. The spacer block is an easily compressed foam material cut to fill the void beneath the joint filler.

(3) Contraction Joints. Install contraction joints of the type, dimensions and spacing shown in the Contract Documents.

Stretch a stringline along the centerline of the joint, or otherwise adequately mark it to verify dowel bar joint assembly alignment.

Install the dowel bar joint assembly so the centerline of the assembly is perpendicular to the centerline of the slab, and the dowels lie parallel to the slab surface and slab centerline. Place concrete so it will not displace or disarrange the joint assembly. Mark the location of contraction joints to assure the joints are sawed in the proper location.

(4) Longitudinal Joints. Construct longitudinal joints according to the Contract Documents. When sawed joints are specified or used, provide approved guide lines or devices to cut the longitudinal joint on the true line as shown in the Contract Documents. Perform the sawing of longitudinal joints at a time that will prevent erratic or uncontrolled cracking. When "plastic concrete cut" methods are used, no sawing or widening of the joint will be required to make a sealant reservoir.

(5) Construction Joints. Make a butt construction joint perpendicular to the centerline of the pavement at the close of each day's work, or when the process of depositing concrete is stopped for a length of time sufficient for the concrete to take its initial set. Form this joint by using a clean header having a nominal thickness of 2 inches, and minimum cross-sectional area equal to pavement thickness by pavement width. Cut the header true to the crown of the finished pavement. Accurately set and hold it in place in a plane at right angles to centerline and perpendicular to the surface of the pavement.

Protect the top surface of the header with steel. Securely fasten a trapezoidal piece of metal or wood approximately 2 inches wide and a minimum of 1 inch in depth on the face of the header, along the center of the header to form a grooved or keyed joint.

With approval of the Engineer, the Contractor may pave beyond the joint location a distance to maintain the line and grade. Saw the construction joint when the concrete has hardened. Drill holes for reinforcing tie bars and epoxy the bars in-place. Place fresh concrete against the previously placed concrete taking care to avoid injury to the edge. Vibrate the concrete to obtain an interlocking joint and prevent a honeycombed face of the joint. The additional concrete, removal of debris and other work created by this alternative is at the Contractor's expense.

Unless shown otherwise in the Contract Documents, do not place any construction joint within 5 feet of an expansion, contraction or other construction joint.

(6) Special Joint Construction. Construct special joints as shown in the Contract Documents or as ordered by the Engineer around drainage, utility and other structures located within the concrete pavement boundaries. Hold temporary forms securely in place during the concrete placement operation.

(7) Joint Construction. Construct all joints as shown in the Contract Documents. Repair or replace any curing medium damaged during joint construction. Construct joints as follows:

(a) Induced Plane of Weakness. The first saw cut is a relief cut at the proper joint location, approximately ⅛ inch wide and to the full joint depth as shown in the Contract Documents (D/3 ± ¼ inch). Make the relief cut as soon as the concrete has hardened enough so that no excess raveling or spalling occurs, but before any random cracks develop. The sequence of the relief sawing is at the Contractor's option, provided all relief sawing is completed before random cracking develops. Use suitable guide lines or devices to cut the joint straight and in the correct location. Repair curing membrane damaged during sawing as directed by the Engineer. See **subsection 501.4g.(1)** for alternate methods to the first stage sawing.

(b) Reservoir Construction. Do not perform widening of the relief joints to full width until the concrete is a minimum of 48 hours old. Delay it longer if the sawing causes raveling of the concrete. If second stage sawing is performed before completion of the curing period, maintain the cure by use of curing tapes, plastic devices or other materials approved by the Engineer. Center the joint groove over the relief cut, and saw it to the dimensions shown in the Contract Documents. Should any spalling of the sawed edges occur that would detrimentally affect the joint seal, patch it with an approved epoxy patching compound and allow it to harden before installing the joint material. Make each patch true to the intended neat lines of the finished cut joint.

(8) Cleaning Joints.

(a) Immediately clean freshly cut sawed joints by flushing with a jet of water under pressure and other necessary tools to remove the resulting slurry from the joint and immediate area.

(b) To clean joints, use air compressors equipped with suitable traps capable of removing all surplus water and oil from the compressed air. The Engineer will check the compressed air for contamination, daily. When contaminated air is found to exist, work will be stopped until suitable adjustments are made, and the air stream is found to be free of contaminants.

(c) Just before applying the hot or cold joint sealant, complete a final cleaning by air blasting to clean incompressibles from the joint.

(d) Before installing preformed elastomeric joint seals, use water or sandblasting equipment to clean the seal reservoir of the transverse joint a minimum of the vertical height of the installed elastomeric joint material plus ½ inch measured from the pavement surface. Use a multiple pass technique until the surfaces are free of dirt, curing compound or any residue that might prevent ready insertion of the seal, or uniform contact with the concrete. (Note: These seals are held in place by compressive forces and friction acting on the faces of the joint, not chemical bonding as with other joint sealants.) After final cleaning, and immediately before installing the seal, blow out the joint seal reservoir with compressed air until it is free of debris and visible water.

(9) Sealing Joints. The joint location, size and configuration is shown in the Contract Documents. Use applicable materials to obtain the required joint sealant configuration. Seal transverse pavement joints with preformed elastomeric compression joint seals, unless shown otherwise in the Contract Documents. Seal longitudinal pavement joints full depth with either a cold applied chemically cured joint sealant or a hot joint sealing compound. Use only 1 type of longitudinal joint sealant on a project, unless otherwise approved by the Engineer. Seal joints before opening to traffic. For opening to construction traffic, see **subsection 501.4i.(3)(a)**.

When using cold applied chemically cured joint sealant, hot joint sealing compound or preformed elastomeric compression joint seals, arrange for a technical representative of the manufacturer to be present during installation of the joint seal to provide guidance on cleaning, preparation of the joint and installation of the seal.

Keep the manufacturer's technical representative on the project until Contractor and KDOT personnel have been thoroughly trained in the proper installation of the material. The Engineer may waive this requirement for Contractors that are experienced in installing the type and brand of material being used. Provide the Engineer with a résumé of experience for evaluation.

(a) Cold Applied Chemically Cured Joint Sealants. Do not seal joints until they are clean and dry, and the pavement has attained the age recommended by the manufacturer of the sealant. Do not apply sealant to damp concrete, or install it during inclement weather. Do not apply joint sealant when the ambient air temperature is below 40ºF, or as specified by the manufacturer. Place the sealer full depth in close conformity with dimensions shown in the Contract Documents. Any deviation will be cause for rejection of the joint until satisfactory corrective measures are taken.

Apply the joint sealant by an approved mechanical device. Any failure of the joint material in either adhesion or cohesion will be cause for rejection. Repair the joint to the Engineer's satisfaction.

Some cold applied, chemically cured sealants are not self-leveling and will not position properly in the joint under its own weight. Tool the sealant surface as shown in the Contract Documents. Accomplish tooling before a skin forms on the surface. Do not use soap or oil as a tooling aid.

After a joint has been sealed, promptly remove all surplus joint sealer from the pavement or structure surfaces.

Do not permit traffic over sealed joints until the sealer is tack free, or until debris from traffic can not embed into the sealant.

(b) Hot Applied Joint Sealing Compound. Do not seal joints until they are clean and dry, and the pavement has attained the age recommended by the manufacturer of the joint sealing compound. Install joint sealing compound according to the manufacture's recommendations.

Completely clean out the application unit when changing brands of materials, or if the material exhibits any sign of changes in application characteristics, polymer or oil separation, balling or any signs of jelling. If the application unit contains compatible material from a previous project at start-up, provide the Engineer a certification covering the material in the application unit, including the manufacturer, type, etc. Before start-up, completely clean out any material that can not be identified and certified.

After a joint has been sealed, promptly remove all surplus joint sealer from the pavement or structure surfaces.

Do not permit traffic over sealed joints until the sealer is tack free, or until debris from traffic can not embed into the sealant.

(c) Preformed Elastomeric Joint Seals. Concrete that has reached an age that permits proper sawing and cleaning without causing deterioration of the joint edges and joint faces, is considered acceptable for seal installation.

Under normal construction procedures, seal transverse joints full width with no splices made in the preformed joint seal. However, under phased construction of widenings, where the lanes placed earlier have been opened to traffic, the preformed joint seal may be spliced at the construction joint. When the existing seal is peeled back to saw the construction joint, clean it, reapply the lubricant/adhesive and reinstall as soon as possible. After the new seal is installed, place the longitudinal joint sealant through the intersection with the transverse joint, with the transverse seals butted in. Place the longitudinal sealant to encase and seal the ends of the preformed seals.

Install the joint seal with a machine especially designed to compress and install the sealant in an upright position, without cutting, nicking, distorting or otherwise damaging the seal. Apply lubricant to the concrete or the preformed seal (or both), and install the seal in a substantially compressed condition. Place the top of the seal at a depth below the finished surface of the pavement, recommended by the manufacturer.

Use a method of installation such that the joint seal will not be stretched or compressed longitudinally more than 3% of the length, unless stated otherwise in the manufacturer’s instructions. The method of installation will be checked for stretching or compression by comparing the distance between 2 marks on the surface of the seal measured before and after the installation. If the check indicates stretching or compression beyond the limits stated above, modify the method of installation to correct the situation. The Contractor may proceed slightly out of specification for a short distance under the supervision of the manufacturer’s technical representative, while making corrections and adjustments to return to specification limits. This material may remain in place, provided the stretching does not exceed 5%, and the Contractor makes a good faith effort to correct the problem. Once the machine is in proper adjustment and the installation is proceeding satisfactorily, further checks (approximately every 100 joints) will be made to verify proper installation.

Remove any joint seal not conforming to the above stated limits of installation and replace with new material. After being removed for any reason, no seal may be reused.

(10) Sawed (Non-Sealed) Joints.

(a) Joint Construction. The joint location, size and configuration are shown in the Contract Documents. Use concrete saws to saw all joints a nominal 1/8 inch wide to the full joint depth, D/3± ¼ inch, unless shown otherwise in the Contract Documents.

Make the saw cut as soon as the concrete has hardened enough so that no excess raveling or spalling occurs, but before any random cracks develop. The sequence of the sawing is at the Contractor’s option, provided all sawing is completed before random cracking develops. Use suitable guide lines or devices to cut the joint straight and in the correct location.

(b) Cleaning Joints. Immediately clean freshly cut sawed joints by flushing with a jet of water under pressure and other necessary tools to remove the resulting slurry from the joint and immediate area. Repair curing membrane damaged during sawing and cleaning, as directed by the Engineer.

(c) Backer Rod. Install and maintain backer rod (of a size sufficient to prevent debris from entering the joint) in the joint. When major construction traffic is no longer driving on the pavement, and prior to opening to the public, remove the backer rod, and follow with an air blast to remove any debris.

(d) Repair of Joints. If the sawed joint is ≥ ¼ inch, seal the joint using Hot Applied Joint Sealing Compound, according to **subsections 501.4g.(7)** thru **(9)(b)**. Seal transverse joints the full width of pavement. Seal longitudinal joints the full length of the panel. If the joint can not be properly sealed, see **subsection 501.4k**.

(e) Opening to Traffic. When no joints require sealing, disregard **subsection 501.4i.(3)(a)**, third bullet and **501.4i.(3)(b)**.
(f) Side Roads and Entrance Pavement. If the PCCP is designated with sawed (non-sealed joints), construct the side road and entrance pavement joints according to **subsection 501.4g.(10)**, unless otherwise specified in the Contract Documents.
(g) Curb and Gutter/Valley Gutter. Unless specified otherwise in the Contract Documents, if the PCCP is designated with sawed (non-sealed) joints, construct the curb and gutter/valley gutter joints according to **subsections 501.4g.(10)(a)** thru **(c)** with the following exception: saw to a depth a minimum of 1 ¼ inches below the surface of the gutter. If the curb and gutter is placed monolithically with the pavement, saw to the same depth as the pavement.

h. Hand Finishing. Hold hand finishing methods to a minimum. Generally, hand methods of placement and finishing will be permitted as follows:

- For pavement when a breakdown of some portion of the paving train occurs, making the hand finishing of that portion of the concrete already in place necessary.
- For pavement lanes that may be too narrow or a length too short to accommodate a full paving spread.
- For all irregular shaped areas.
- For special approach sections to bridges, widened portions at bridges, intersections and sections widened beyond traffic lanes.
- When the dimensions of the work make the use of a complete power operated paving impossible, or impracticable.

For uniform width areas or transition width areas using false forms, finish handwork with a mechanical finishing machine or approved vibrating screed, whenever possible.

Use spud hand vibrators on any area considered impracticable to vibrate with a vibrating screed. Approved metal or wood floats may be used if needed to help close an open or porous surface condition.

Continue the operation of consolidation and screeding or striking off the concrete until the concrete is uniformly consolidated and the surface is true to line, grade and cross-section.

After the pavement has been properly struck off, straightedge the pavement for trueness and finish it. Use a burlap drag to remove surface straightedge marks. The burlap drag may be pulled by hand, but the results shall be similar to that on the mainline pavement.

Manual methods may be used for texturing hand finished pavement areas. Where applicable, the tined texture applies. Use a metal comb with dimensions and spacing shown in **subsection 154.7c**. Obtain a finished textured surface similar to that produced mechanically.

On miscellaneous areas such as entrance pavement, median pavement and gore areas, texturing with the metal comb may be eliminated. Final finish may be attained by the use of a drag that consists of a seamless strip of damp burlap, cotton fabric or other suitable material capable of producing a uniform surface of gritty texture.

i. Protection and Curing of Concrete. Cure the pavement by using burlap, liquid membrane-forming compounds, white polyethylene sheeting, concrete curing blankets or reinforced white polyethylene sheeting. Failure to provide proper curing is cause for immediate suspension of the concreting operations.

(1) Burlap, Concrete Curing Blankets, White Polyethylene Sheeting and Reinforced White Polyethylene Sheeting. Place the curing material on the pavement immediately after the pavement has been finished, and the concrete has hardened sufficiently to avoid harmful marring of the surface, yet early enough to prevent undue loss of moisture from the concrete. If the pavement becomes dry before the curing material is placed, moisten the concrete with a fine spray of water. Dampen burlap and place on the surface. Place burlap-polyethylene blankets with the dampened burlap side down. Keep burlap damp throughout the entire curing period.

Lap adjacent units of curing materials approximately 18 inches. Upon removal of the forms, extend the material to completely cover the full depth of the exposed pavement.

Weigh the curing material down using continuous windrows of earth placed along the sides and edges of the pavement and transversely across the pavement on the laps to cause the material to remain in contact with the covered surface throughout the curing period. Other methods may be used with approval of the Engineer.

Walking on the pavement surface to place the curing material is prohibited. Walking on the curing material is prohibited until the pavement has cured sufficiently to prevent damage to the surface.

Leave the curing material in place for a minimum of 4 days, unless otherwise directed by the Engineer. Immediately repair any tears or holes appearing in the material during the curing period, or replace it with material in good condition.

The material may be reused, provided it is kept serviceable by proper repairs, and if in the judgment of Engineer it will provide water retention during the curing period.

(2) Type 2 White Liquid Membrane-Forming Compound. After finishing operations have been completed and immediately after the free water has left the surface, completely coat and seal the surface of the slab with a uniform layer of compound. Apply the compound in 1 application at a minimum rate of 1 gallon per 150 square feet of surface. Thoroughly mix the compound at all times during usage. Do not dilute the compound. Daily provide the Inspector documentation of the quantity of curing compound used.

Protect the treated surface from injury a minimum of 4 days, unless otherwise directed by the Engineer. If the newly coated film is damaged in any way, apply a new coat of material to the affected areas equal in coverage to that specified for the original coat. A minimum of foot traffic will be permitted on the dried film as necessary to properly carry on the work, provided any damage to the film is immediately repaired by application of an additional coat of compound.

Immediately after the forms are removed (fixed form and slip form), coat the entire area of the sides of the slab with compound at the rate specified for the pavement surface, regardless of whether or not further concrete placement will be made against the pavement edge. Approved hand spray equipment will be permitted only for the application of compound on the sides of the slab, for repairing damaged areas and for hand finished areas. Repair any damaged areas caused by joint sawing.

(3) Opening to Traffic. No motorized traffic is allowed on the pavement until all of the following conditions are met.

(a) Construction Traffic Only.

- The flexural strength of the pavement shall meet or exceed 450 psi. Determine the flexural strength of the pavement by testing flexural strength specimens utilizing the third point loading method, or by use of a calibrated maturity meter.
- If flexural strength does not meet or exceed 450 psi, observe a 10 day curing period before allowing motorized traffic on the pavement. Provide a strength gain curve of concrete cured at 45°F to justify a curing period of less than 10 days.
- Provide protection to keep foreign material out of the unsealed joints by an approved method.

(b) All Traffic. In addition to **subsection 501.4i.(3)(a)**, seal the joints according to **subsection 501.4g.(9)**.

The Contractor may, at own expense, increase the cement content from the minimum shown in **SECTION 403** to accelerate the strength gain of the PCCP.

(4) Cold Weather Curing. Maintain the concrete pavement at a minimum temperature of 40ºF, as measured along the surface of the concrete, for a minimum of 4 days after placing. When the ambient air temperature is expected to drop below 35ºF anytime during the curing period, take precautions to maintain the concrete temperature. Keep a sufficient supply of approved moisture barrier material, other than liquid curing compound, and suitable blanketing material, such as straw, hay and burlap close by. Be prepared to cover the pavement with a moisture barrier and protect all pavement less than 4 days old with blanketing material. Remove, dispose of and replace concrete damaged by cold weather, as determined by the Engineer.

(5) Early Strength Concrete Curing. The curing period shall conform to the requirements specified for regular concrete pavement in **subsection 501.4.i**. Construct joints according to the manufacturer's recommendations for early strength concrete pavement.

j. Cold Weather Limitations. If concrete is placed in cold weather, comply with **SECTION 401**.

k. Repair of Defective Pavement Slabs. It is the responsibility of the Contractor to repair any spalled, cracked or broken panels as specified hereinafter at no cost to KDOT. Completely remove and replace pavement panels (area between contraction joint and contraction joint) containing both transverse and longitudinal cracks (separating the panel into 4 or more parts) through the full depth of the slab.

Properly seal the joints of the repaired or replaced panels.

(1) Repair of Spalls.

- In no case shall an individual patch of a spall be less than 1 square foot with no dimension less than 1 foot.
- For spalls greater than ¼ inch and less than or equal to ½ inch from edge of the original sawed joint, repair with hot pour.
- For spalls greater than ½ inch and less than or equal to 1 inch from the edge of the original sawed joint, blast clean and repair with epoxy patch material.
- For spalls greater than 1 inch from the edge of original sawed joint, repair by making a saw cut a minimum of 1 inch outside the spalled area to a minimum depth of 2 inches. The interior angles formed by the intersection of adjacent sides of the patch shall be a minimum of 60º. When the spalled area abuts a joint, make the saw cut to a depth of 2 inches or 1/6 the slab thickness, whichever is greater. Chip out the concrete between the saw cut and the joint or primary crack to solid concrete. Do not use chipping hammers greater than 15 pounds. Thoroughly clean all loose material from the formed cavity. Apply a coat of an approved concrete bonding epoxy to the dry, cleaned surface of all sides of the cavity, except the joint. Apply the epoxy by scrubbing the material into the surface with a stiff bristle brush. Place portland cement concrete, epoxy resin concrete or mortar, immediately following application of the epoxy, according to the manufacturer's recommendations. If the spalled area to be patched abuts a working joint, use an insert or other bond breaking medium during the repair work to maintain working joints. Remove and replace major honeycombed areas found after removal of the forms. Removed areas or sections so removed shall be a minimum of 6 feet in length if less than full width of the lane involved. When it is necessary to remove a section of pavement, also remove and replace any remaining portion of the slab adjacent to the joints that is less than 6 feet in length.

(2) Repair of Cracks in New Reinforced, Dowel Jointed PCCP.

(a) Transverse and Diagonal Cracks.

(i) Full Depth.

- When a single full-depth transverse crack falls within the middle ⅓ of the panel, no corrective work will be required.
- Should a second full-depth crack develop within the middle ⅓ of the panel, remove and replace the panel to the nearest planned contraction joint, eliminating both cracks. If the location of the mid-panel full-depth crack is within 6 feet of the boundaries of the area to be repaired, extend the area to be repaired to include the mid-panel crack.
- When any portion of a full-depth crack falls outside the middle ⅓ of the panel, remove and replace the portion of panel between the contraction joint and the crack. Make 1 full-depth saw cut parallel to the contraction joint on the mid-panel side of the crack to be removed. Make another cut in the adjacent panel, parallel to the contraction joint, clear of the basket assembly, but not less than 6 feet from the first cut. Remove the cracked section and basket assembly. Drill holes in both sawed faces, and insert bars to make 2 contraction joints. Use dowels of the same size and spaced the same distance as those shown in the Contract Documents. Drill bar holes ¼ inch ± 0.05 inch larger than the diameter of the bar and fill them with epoxy or grout and insert the new dowel. Support the free ends of the bars parallel to the pavement surface until the epoxy or grout has set, obtaining proper alignment of the bar. Apply grease or an approved bond breaker to the free ends.
- If the boundaries of consecutive areas to be repaired are less than 6 feet apart, also remove and replace the areas between the patches.
- Saw off the longitudinal joint tie bars at the longitudinal joint. Drill holes midway between the existing bars and insert tie bars to make a new tied longitudinal hinged joint. Use tie bars of the same size and spacing as those in the Contract Documents. Drill bar holes ¼ inch ± 0.05 inch larger than the diameter of the bar and fill them with epoxy or grout and insert new tie bars.

(b) Longitudinal Cracks. When a single longitudinal crack falls within a panel, no corrective work will be required.

When a second full-depth longitudinal crack falls within a panel, remove and replace the panel to the nearest planned contraction joint, eliminating both cracks.

(3) Repair of Cracks in both New Non-reinforced Dowel Jointed PCCP and Mainline Plain PCCP.

(a) Transverse and Diagonal Cracks.

(i) Full Depth.

- If a maximum of 4 panels per any lane mile has a crack, repair according to **SECTION 504 - DOWEL BAR RETROFIT-REPAIR**, or remove and replace the pavement.
- If 5 to 18 of the panels per any lane mile has a crack, repair according to **SECTION 504 - DOWEL BAR RETROFIT-REPAIR**. When 2 consecutive panels have a crack, remove and replace the panels from contraction joint to contraction joint.
- If more than 18 of the panels per any lane mile have a crack, remove and replace the pavement bounded by the cracks in that segment. Remove and replace until ¼ mile segment has less than 4 panels cracked, then repair or replace.

(ii) Partial Depth. If coring (at no additional cost to KDOT) verifies the transverse cracks are not full depth, repairs may be made by **SECTION 505 - TIE BAR INSERTION-REPAIR**.

(iii) When required or at the Contractor's option, remove and replace pavement panels containing any transverse or diagonal crack according to the following:

- Make a full-depth saw cut in the abutting panel nearest to the crack, parallel to the contraction joint, just clear of the basket assembly to allow the existing dowel basket assembly to be completely removed. Make a second saw cut parallel with the contraction joint on the opposite side of the crack away from the contraction joint. For plain PCCP, make the saw cut at the joint nearest to the crack. Make the second saw cut opposite the first cut a minimum of 6 feet from the first saw cut to include the crack. Remove the resulting area.
- The minimum longitudinal length of a patch is 6 feet.
- Do not permit a patch to fall within 6 feet of a contraction joint.
- The maximum distance between doweled/non-doweled contraction joints is 18 feet.
- Drill holes and insert dowel bars to make new contraction joints within the vertical faces of both newly created panel ends. Use dowels of the same size and spaced the same distance as shown in the Contract Documents. Drill bar holes ¼ inch ± 0.05 inch larger than the diameter of the bar and fill with epoxy or portland cement grout and insert the new dowel. Support the free ends of the bars until the epoxy or grout has set to obtain proper alignment of the bar. Apply grease or an approved bond breaker to the free ends. Do not use dowel bars in plain PCCP.
- Saw off the longitudinal joint tie bars at the longitudinal joint. Drill holes midway between the existing bars and insert tie bars to make a new tied longitudinal hinged joint. Do not place new tie bars within 12 inches of doweled joint. Use tie bars of the same size and spacing as those in the Contract Documents. Drill bar holes ¼ inch ± 0.05 inch larger than the diameter of the bar and fill them with epoxy or grout and insert new tie bars.

(b) Longitudinal Cracks. Repair or remove and replace pavement panels that contain a single longitudinal crack, according to the following:

- Repair longitudinal cracks that are within 3 inches of the planned longitudinal joint for their entire length with a partial depth patch as specified for spall in **subsection 501.4k.(1)**, except make the transverse dimension of the patch 6 inches and saw cuts to D/3 ± ¼ inch.
- For longitudinal cracks between 3 and 6 inches from the planned longitudinal joint, fill the entire planned longitudinal joint full depth with epoxy through the length of the longitudinal crack.
- Repair longitudinal cracks that are 6 inches or more from the planned longitudinal joint by removing and replacing pavement panels, or repair pavement by **SECTION 505 - TIE BAR INSERTION-REPAIR**.

Remove and replace pavement panels that contain 2 or more longitudinal cracks.

(4) Repair of Cracks in Shoulder Plain PCCP.

(a) Transverse and Diagonal Cracks.

- When a single transverse crack falls within a panel and is within 3 feet of the transverse contraction joint, fill the contraction joint according to the Contract Documents and rout and seal the crack.
- When 2 or more transverse cracks fall within a panel, remove and replace the panels.

(b) Longitudinal Cracks.

- When a single longitudinal crack falls within a panel, repair pavement by **SECTION 505 - TIE BAR INSERTION-REPAIR**.
- When 2 or more longitudinal cracks fall within a panel, remove and replace the panels.

l. Protection of Pavement from Rain. Before placing PCCP, prepare and submit to the Engineer for approval, a Protection Plan to address the onset of rain during concrete placement. As a minimum, the plan shall include protective covering and side forms available at the project site at all times to protect the surfaces and edges of the newly placed concrete pavement. Polyethylene, burlap or other covering materials may be used. Side forms may be of wood or steel and shall have a depth a minimum of the thickness of the pavement. Specify the location of the storage site in order that a review of the protective materials may be conducted by the Engineer.

Include the type and amount of protective materials as well as the methods proposed to protect the pavement.

When rain appears imminent, stop all paving operations and initiate the Protection Plan. Extend the covering back to the point where the rain will not indent the surface. Exercise care to prevent unnecessary damage to the surface with the covering.

m. Pavement Smoothness. Evaluate pavement smoothness for pay according to **SECTION 503**.

501.5 MEASUREMENT AND PAYMENT

a. Plan Quantity Measurement. The quantities of concrete pavement for which payment will be made are the quantities shown in the Contract Documents for the traveled way lanes and the various paved approaches, exits and interchanges, provided the project is constructed essentially to details shown in the Contract Documents.

When the Contract Documents have been altered, or when a disagreement exists between the Contractor and the Engineer as to the accuracy of the Contract Document quantities in any location or the entire project, either party has the right to request and cause the quantities involved to be measured according to **subsection 501.5b**.

b. Measured Quantities. The quantity to be paid for under this item will be the number of square yards of concrete pavement as measured in-place. The width for measurement will be the width of the pavement shown on the typical cross-section of the Contract Documents, additional widening where added, or as otherwise directed in writing by the Engineer. The length will be measured horizontally along the centerline of each roadway or ramp.

c. Excavation Included in Contract. On projects where the grading and the pavement or base construction is included in the same contract, the Engineer will not measure additional excavation required to obtain the specified subgrade elevation.

d. Sawing and Sealing Joints. The Engineer will not measure this work for separate payment. All costs of complying with the requirements specified herein are included in the contract price for the concrete pavement in which the joints are located.

e. Quality Control Testing. The Engineer will measure the Contractor's quality control testing by the square yard of PCCP placed on the project. The Engineer will measure each concrete core when the results from the core information (required for disputed tests) increases payment to the Contractor. All other cores taken as required by this specification are subsidiary to this item.

f. Water. The Engineer will not measure water used in dust control on haul roads, around plant installations, etc.

g. Pavement Thickness and Compressive Strength Determination.

(1) General. Make the required corrections for pavement smoothness before making the pavement thickness determinations. Determination of pavement thickness and pavement compressive strength for the purpose of establishing pay adjustments will be based on test results from cores taken from each lot of pavement.

- For mainline pavement, pay adjustments will be made for both thickness and compressive strength.
- For acceleration lane, deceleration lane, frontage road, side road and ramp pavement, pay adjustments will be made for thickness, but not compressive strength, unless the Contract Documents specifically require compressive strength pay adjustments.
- For gore areas, bridge approach slabs, intersection curb returns, entrances, shoulders, medians and widenings, pay adjustments will not be made for thickness or compressive strength, and pavement cores will not be required.

Where coring is not required, verify that the thickness of the pavement meets or exceeds the Contract Document requirements by use of stringline, survey or other suitable depth measurement. For pavement types not cored for strength, use only concrete mix designs approved for use in the mainline pavement. The Engineer will observe and document the Contractor's measurement or other means of ensuring the appropriate thickness of the plastic concrete, and the Engineer will verify that only approved mixes are used. Prior to placing any pavement not specifically defined above, reach an agreement with the Engineer as to the applicability of pay factors.

(2) Lots and Sublots Defined.

(a) For mainline and other pavement subject to coring for pay adjustments for both thickness and strength, a lot is defined as the surface area of mainline lane placed in a single day. Normally, divide a lot representing a day's production into 5 sublots of approximately equal surface area.

For high daily production rates, rates exceeding 6000 square yards per day, the Contractor may choose to divide the day's production into 2 approximately equal lots consisting of 5 sublots each. Prior to taking any core samples, notify the Engineer of the decision to divide a day's production into 2 equal lots. For low daily production rates (and not in an urban PCCP environment), the Contractor may choose to divide the lot into a lesser number of sublots as shown in **TABLE 501-1**. When daily production rates are less than 1000 square yards, and not in an urban PCCP environment, combine the day's production with the next day's production to form a lot. When a day's production involves less than 1000 square yards while completing a particular mix design or project, combine with the previous day's production and treat as a single lot.

For low daily production rates less than 1000 square yards in an urban PCCP environment, consider each day's production as a separate lot. KDOT's representative will core (or have cored) a minimum of two randomly-determined sublots per day; one in the morning and one in the afternoon. Each randomly-determined location will be cored for both strength and thickness, and results inserted into the "Urban PCCP" worksheet for pay adjustment.

TABLE 501-1: PCCP SUBLOT BREAKDOWN

Daily Production Rate in square yards	Number of Sublots
Under 1000 (Urban)	2
1001 – 2000	3
2001 – 4000	4
4001 or more	5

(b) For pavement that is to be cored for thickness only, group each continuous section of acceleration lane, deceleration lane, side road, frontage road and ramp pavement of equal plan thickness and contract unit price into a lot a maximum of 5000 square yards in area. Divide each lot into a minimum of 3 sublots of approximately equal surface area. Sublots shall be a maximum of 1000 square yards in size. Sample each sublot in a manner so that each square yard of pavement has a chance of being randomly selected for coring.

(3) Coring. The Engineer reserves the right to generate the random locations. If KDOT plans to generate the random locations, the Contractor will be notified before taking cores for thickness determination.

(a) For mainline and other pavement subject to coring for pay adjustments for both thickness and strength, take 1 core sample having a minimum diameter of 4 inches from a randomly selected site within each sublot. The Contractor has the option of taking an additional core sample having a minimum diameter of 2 inches from a randomly selected site within each sublot for the purpose of making an early determination of the pavement thickness only. Select sites according to the approved QCP. Additionally, take 1 companion core having a minimum diameter of 4 inches per each lot at a randomly selected site as designated by the Engineer. Repair all core holes in a manner approved by the Engineer. Perform all coring for the purpose of determining strength a minimum of 21 days after the pavement has been placed, and in time to determine 28-day compressive strengths. Coring prior to the 21-day minimum will be permitted with approval of the Engineer, when opening to early traffic is desired. If the companion cores will be measured and tested by the MRC, the Engineer will deliver the companion cores to the MRC within 25 days after the pavement has been placed. No initial QC compressive strength data will be accepted for concrete paving that is more than 28 days of age, unless approved by the Engineer.

(b) For all other PCCP subject to coring for pay adjustment, thickness only, define the lots prior to placement with the Engineer's approval.

After placement, randomly select each sublot location. Take 1 core sample having a minimum diameter of 2 inches. Repair all core holes in a manner approved by the Engineer. Coring may be performed at any time after all pavement in the lot has been placed.

(4) Mark each core with the lot and sublot number from which it was selected. Transport the cores to the laboratory as soon as possible and perform the thickness determination. Take 3 caliper measurements on each core at approximately 120º apart. Record these 3 measurements to the nearest 0.01 inch, and average them to represent the height of that core.

Do not test 2-inch core samples for compressive strength. Do not measure 4-inch cores for pavement thickness determination if a separate 2-inch core sample was taken in a sublot for that purpose.

The measured core height will represent the constructed pavement thickness for each pavement sublot. The Engineer will witness thickness determinations and initial the Contractor's documentation.

Moist cure the 4-inch cores to be tested for compressive strength as required in KT-49, until they are tested. Perform the 28-day compressive strength testing on the entire length of the core after squaring the ends according to KT-49. The compression machine shall be capable of testing cores up to and including 12 inches in length. Remove only the excess length that exceeds compression machine capabilities from the bottom of the cores. Determine length and diameter to the nearest 0.01 inch. Determine the length/diameter ratio (LD), and round the result to the nearest hundredth using the following formula:

$$LD = \text{Length} / \text{Diameter}$$

After performing the strength test, correct the compressive strength using a correction factor determined by using the appropriate formula in **TABLE 501-2**.

TABLE 501-2: COMPRESSIVE STRENGTH CORRECTION FACTOR FORMULAS	
LD	**Correction Factor**
LD < 2	$\frac{100}{95 + 0.2(1/LD) + 19.5(1/LD)^2}$
LD = 2	1.000
LD >2	$\frac{100}{110 - 5(LD)}$

The compressive strength correction factor may also be obtained by using **TABLE 501-3**. If a discrepancy should arise due to rounding numbers or the appropriate value is not shown in the table, the value determined by the above formulas shall govern.

TABLE 501-3: COMPRESSIVE STRENGTH CORRECTION FACTOR

LD	Compressive Strength Correction Factor	LD	Compressive Strength Correction Factor
1.00	0.872	2.60	1.031
1.10	0.898	2.70	1.036
1.20	0.920	2.80	1.042
1.30	0.937	2.90	1.047
1.40	0.952	3.00	1.053
1.50	0.963	3.10	1.058
1.60	0.973	3.20	1.064
1.70	0.982	3.30	1.070
1.80	0.989	3.40	1.075
1.90	0.995	3.50	1.081
2.00	1.000	3.60	1.087
2.10	1.005	3.70	1.093
2.20	1.010	3.80	1.099
2.30	1.015	3.90	1.105
2.40	1.020	4.00	1.111
2.50	1.026		

Correct the compressive strength determined during testing by multiplying that amount by the compressive strength correction factor.

The Engineer will witness all compressive strength tests for each sublot and initial the Contractor's documentation.

Companion cores will be measured and tested at KDOT's laboratory to verify the Contractor's test results. Supply 28-day compressive strength data to KDOT. Acceptance of the pavement and pay adjustments will be on the basis of Contractor quality control test results on random samples taken from a lot, provided the statistical comparison is favorable.

KDOT will routinely compare the variances (F-test) and the means (t-test) of the verification test results with the quality control test results for thickness and compressive strength as appropriate using a KDOT spreadsheet. The F and t-tests, along with the KDOT Spreadsheet used to compare the Contractor's Quality Control (QC) results and KDOT's verification (QA) results, are described in Section 5.2.6-Comparison of Quality Control and Verification Tests, Part V. If KDOT verification test results do not show favorable comparison with the Contractor's quality control test results, KDOT verification test results will be used for material acceptance, material rejection and the determination of any pay adjustment for thickness and compressive strength. Follow the requirements stated in **subsection 501.5h.(6)** for failing t-tests. If the Contractor disputes KDOT's verification test results, and the Contractor and the Engineer cannot mutually agree on the use of KDOT test results to determine pay adjustments, the test results for the lot in question will be voided. In such case, new cores to represent each sublot will be taken on a 2-for-1 frequency, tested in the presence of the Engineer, and a new pay factor will be calculated using the KDOT spreadsheet. These cores shall be obtained in time to determine the 35-day compressive strengths unless approved by the Engineer. If the new pay factor results in the same or less pay due the Contractor than the voided pay factor, no payment will be made for the additional coring. If the new pay factor results in greater payment to the Contractor, KDOT will pay for each additional core at the contract set unit price.

(5) When the measurement of any core is deficient by more than 1 inch from plan thickness or has a 28-day compressive strength less than 2900 psi, take exploratory cores at a minimum of 10 foot intervals along a line passing through the deficient core and parallel to the centerline of the pavement unit. Continue along this line until an exploratory core taken in each direction is not deficient in length by more than 1 inch, or the compressive strength is a minimum of 2900 psi, depending on which case is being investigated. Exploratory cores will be used only to determine the length of pavement in a unit that is to be removed and replaced as provided below. Discard the original core representing the sublot. Randomly select another core (outside the defective area if left in place) to

represent the remainder of the sublot and use to compute the pay factor for the lot. All exploratory cores will be obtained in time to determine the compressive strengths within 35 days from the time the pavement was placed, unless approved by the Engineer. Obtain all cores representing the remainder of the sublot and used to compute the pay factor for the lot in time to determine the 35-day compressive strengths, unless approved by the Engineer.

When the Engineer determines that deficient pavement must be removed, the Contractor is required to remove the deficient areas and replace them with pavement of satisfactory quality, strength and thickness. When it is necessary to remove and replace a length of pavement and one end of the deficient pavement is less than 10 feet from an expansion, contraction or construction joint, remove and replace the entire pavement up to the joint. Remove the area so that new joints are a minimum of 10 feet apart. No additional compensation for materials or labor involved in the removal or replacement of the deficient concrete pavement will be made.

(6) For sublot thickness results greater than 1 inch more than design thickness, change the sublot thickness result to 1 inch more than the design thickness. The KDOT spreadsheet will calculate a new lot mean and sample standard deviation based on the corrected value.

h. Pay Adjustments for Mainline and Other Specified Pavement.

(1) General. A single combined pay adjustment for thickness and compressive strength will be made on a lot-by-lot basis and will be based on Contractor quality control test results on all quality control samples representing the lot of the completed pavement provided the statistical check is favorable. Otherwise follow **subsection 501.5g.(4)**. Compute the combined pay factor (***P***) (positive or negative) as shown in Equation 1.

Combined Pay Adjustment = ***P*** x (the number of square yards included in the lot) x (the contract unit price per square yard)

The thickness component of the combined pay factor will be based on values determined by using the difference between plan thickness and the measured core sample thickness, and the lower specification limit (*LSL*). *LSL* is defined as 0.2 inch less than plan thickness. The compressive strength component of ***P*** will be based on the corrected measured compressive strength of core samples taken from the pavement (see **subsection 501.5g.(4)** for LD correction). The pay adjustment amount will be added or subtracted as Concrete Pavement Composite Pay Adjustment on the pay estimate.

Note 1: A lot will normally be comprised of the results of 5 tests performed on a day's placement of a given pavement type. Lot and sublot size is defined in **subsection 501.5g.(2)**.

Note 2: The sample standard deviation (***S***) will be computed as shown in Section 5.2.1-Statistics, Part V.

(2) Thickness Quality Index ($\boldsymbol{Q_T}$) Computation. Calculate $\boldsymbol{Q_T}$ for each lot as shown in 5.2.1, Part V, using the following definitions, and round to hundredths.

Where: $\overline{X}$ is the average measured core length of all QC samples representing a lot, rounded to the nearest 0.1 inch.
LSL is the lower specification limit for thickness, and equals plan thickness minus 0.2 inch.
S is the sample standard deviation of the measured core lengths of all QC samples representing a lot, rounded to the nearest hundredth.

(3) Compressive Strength Quality Index ($\boldsymbol{Q_S}$) Computation. Calculate $\boldsymbol{Q_S}$ for each lot as shown in Section 5.2.1-Statistics, Part V, using the following definitions, and round to the nearest 0.1 inch.

Where: $\overline{X}$ is the average measured compressive strength of all QC core samples representing a lot, rounded to 1 psi.
LSL is the lower specification limit for compressive strength and is defined as 3900 psi.
S is the sample standard deviation of the compressive strength of all QC samples representing a lot, rounded to the hundredth.

(4) Determination of the Percent within Limits Values. First, use the computed $\boldsymbol{Q_T}$ to determine the thickness percent within limits value ($\boldsymbol{PWL_T}$) by locating $\boldsymbol{Q_T}$ in the left column of the Percent Within Limits (PWL) Table in Section 5.2.1-Statistics, Part V. Select the appropriate ($\boldsymbol{PWL_T}$) by moving across the selected *Q* row to the

column representing the number of samples in the lot. Next, follow the same procedure using the computed $\boldsymbol{Q_S}$ value to select the appropriate compressive strength percent within limits value ($\boldsymbol{PWL_S}$).

If either computed $\boldsymbol{Q_T}$ or $\boldsymbol{Q_S}$ is a negative value ($\overline{X}$ is less than *LSL*), the Engineer will determine if the material in the lot may remain in place. If the material is left in place, a value of 50.00 is assigned as $\boldsymbol{PWL_T}$ or $\boldsymbol{PWL_S}$, respectively. If both $\boldsymbol{Q_T}$ and $\boldsymbol{Q_S}$ are negative, assign a value of 50.00 for each **PWL** component.

If either $\boldsymbol{Q_T}$ or $\boldsymbol{Q_S}$ is greater than the largest $\boldsymbol{Q}$ shown in the table, a value of 100.00 is assigned as $\boldsymbol{PWL_T}$ or $\boldsymbol{PWL_S}$, respectively, or for both should $\boldsymbol{Q_T}$ and $\boldsymbol{Q_S}$ both exceed the values shown in the table.

(5) Computation of Combined Pay Factor. Compute $\boldsymbol{P}$ for thickness and compressive strength using Equation 1 and round to nearest hundredth.

Equation 1:
$$\boldsymbol{P} = \left(\frac{(\boldsymbol{PWL_T} + \boldsymbol{PWL_S}) * 0.60}{200} \right) - 0.54$$

(6) Failing t-test. If the t-test fails, KDOT's test result will be used to calculate that particular pay factor for the lot. Follow the procedures given in **subsection 501.5h.(4)** to determine the pay factor or disposition of the lot.

Use the following values to determine $\boldsymbol{Q_T}$ or $\boldsymbol{Q_S}$:

Where: $\overline{X}$ will be KDOT's test result for the lot.
N is equal to the number of Contractor's sublots.
S will be ⅜ inch for thickness and 500 psi for strength.
LSL will be as stated in **501.5h.(2)** for determining $\boldsymbol{Q_T}$, and **501.5h.(3)** for determining $\boldsymbol{Q_S}$.

i. Pay Adjustments for Pavements Cored for Thickness Only.

(1) General. A single pay adjustment for thickness only will be made on a lot-by-lot basis. It will be based on Contractor quality control test results on all quality control thickness samples representing the lot of the completed pavement provided the statistical check is favorable. Otherwise, follow **subsection 501.5h.(4)**. Compute the thickness pay factor ($\boldsymbol{P_T}$) (positive or negative) as shown in Equation 2.

Thickness Pay Adjustment = $\boldsymbol{P}_T$ x (the number of square yards included in the lot) x (the contract unit price per square yard)

The thickness component will be based on values determined by using the difference between plan thickness and the measured core sample thickness, and the lower specification limit (*LSL*). The pay adjustment amount will be added or subtracted as Concrete Pavement Composite Pay Adjustment on the pay estimate.

Note: A lot will normally be comprised of the results of tests performed on all sublots within a given pavement type. Lot and sublot size for pavements cored for thickness only is defined in **subsection 501.5g.(4)**.

(2) Determine $\mathbf{PWL}_T$ as shown in **subsection 501.5h.(4)**.

(3) Computation of Thickness Pay Factor. Compute the pay factor for thickness using Equation 2 and round to nearest hundredth.

Equation 2:
$$\boldsymbol{P_T} = \left(\frac{(\boldsymbol{PWL_T}) * 0.30}{100} \right) - 0.27$$

(4) Failing t-test. If the t-test fails, KDOT's test result will be used to calculate that particular pay factor for the lot. Follow the procedures given in **subsection 501.5h.(4)** to determine the pay factor or disposition of the lot.

Use the following values to determine $\boldsymbol{Q_T}$:

Where: $\overline{X}$ will be KDOT's test result for the lot.
N is equal to the number of Contractor's sublots.
S will be ⅜ inch for thickness.
LSL will be as stated in **501.5 i.(2)**.

j. Pay Adjustments for Urban PCCP Environment.

(1) General. A single pay adjustment will be made on a sublot-by-sublot basis. The adjustment will be based on a single randomly-selected (by KDOT) core for both strength and thickness. Compute the pay factor ($\mathbf{P}_U$) (incentive or disincentive) as shown in **Equation 3**.

The thickness component will be based on values determined by using the difference between plan thickness and the measured core sample thickness. When the measured core sample thickness is greater than the plan thickness, the "Δ thickness" of **Equation 3** is positive. When the core thickness is less than the plan thickness, the "Δ thickness" is negative. The compressive strength component will be based on values determined by breaking the core. Pay adjustment amount will be added or subtracted on the pay estimate. Remove and replace when values are less than those stipulated in **subsection 501.5g.(5)**. Maximum individual or combined pay adjustment is 103%.

(2) Computation of Urban PCCP Pay Factor. Compute the pay factor for thickness and strength using **Equation 3** and round to nearest hundredth.

Equation 3: $\mathbf{P}_U = (\mathbf{P}_{UC} + \mathbf{P}_{UT})/2$

Where:

$P_{UC} = 0.0001*(\text{strength}) + 0.59$; where strength is measured to the nearest 1 psi.

$P_{UT} = 0.15*(\Delta\ \text{thickness}) + 1.00$; where Δ thickness is measured to the nearest 0.01 inch from plan thickness.

(3) Computation of Urban PCCP Pay Adjustment. Compute the sublot pay adjustment using **Equation 4**.

Equation 4: Urban PCCP Pay Adjustment = ($\mathbf{P}_U$ – 1) x (the number of square yards included in the sublot) x (the contract unit price per square yard)

This adjustment will be paid for under the bid item Concrete Pavement Composite Pay Adjustment.

k. Computations and Rounding. KDOT will use a MICROSOFT EXCEL spreadsheet program to calculate pay adjustments for thickness and compressive strength and to compare the Contractor's QC and KDOT's verification test results. KDOT will provide a copy of this program to the Contractor, when requested. Additional information on the program may be obtained from the Bureau of Construction and Materials. It is the Contractor's responsibility to obtain the software required to run this program.

Values computed using equations referenced in this specification may vary slightly from the spreadsheet values due to rounding of numbers. In such cases the numbers computed by the spreadsheet take precedence.

l. General Payment. Payment for "Concrete Pavement", "Early Strength Concrete Pavement" and "Quality Control Testing" with pay adjustments as specified above is full compensation for the work specified.

Payment for "Concrete Core (Set Price)" at the contract set unit price will be paid when the results from the core information (required for disputed tests) increases payment to the Contractor.

In the event of overruns or underruns of the Contractor quality control testing, the Engineer will not adjust the contract unit price.

Pay adjustments for thickness-only and pay adjustments for thickness and strength combined will use the bid item "Concrete Pavement Composite Pay Adjustment", and will be shown as an added item to the contract.

SECTION 502

PORTLAND CEMENT CONCRETE PAVEMENT (NON-QC/QA)

Note: PCCP is considered NON-QC/QA when the bid item Quality Control Testing is <u>not</u> included in the contract.

502.1 DESCRIPTION

Construct portland cement concrete pavement (PCCP) on a prepared subgrade or base course.

BID ITEMS	UNITS
Concrete Pavement (* Uniform) (AE) (**)	Square Yard
Concrete Pavement (* Variable) (AE) (**)	Square Yard
Early Strength Concrete Pavement (*Uniform) (AE) (**)	Square Yard
Early Strength Concrete Pavement (*Variable) (AE) (**)	Square Yard

* Thickness

** No entry denotes PCCP with mesh and dowel assemblies. "Plain" denotes PCCP without mesh and dowel assemblies. "NRDJ" denotes non-reinforced dowel jointed PCCP. "Br App" denotes bridge approach pavement.

502.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete and Grout	**SECTIONS 401 & 403**
Aggregates for On Grade Concrete	**SECTION 1116**
Reinforcing Steel	**DIVISION 1600**
Epoxy Coated Steel Bars for Concrete Reinforcement	**DIVISION 1600**
Joint Sealants	**DIVISION 1500**
Expansion Joint Filler	**DIVISION 1500**
Concrete Curing Materials	**DIVISION 1400**
Preformed Elastomeric Compression Joint Seals	**DIVISION 1500**
Cold Applied Chemically Cured Joint Sealant	**DIVISION 1500**
Hot Type Joint Sealing Compound	**DIVISION 1500**
Backer Rod	**DIVISION 1500**
Epoxy Resin-Base Bonding System for Concrete	**SECTION 1705**
Bond Breaker	**SECTION 1718**

502.3 CONSTRUCTION REQUIREMENTS

a. Preparation of the Subgrade. Before placing any surfacing material on any section, complete the ditches and drains along that section to effectively drain the highway. Trim the base or subgrade to the line, grade and typical cross-section as shown in the Contract Documents. Maintain the subgrade or base to the as-constructed condition under other bid items, repairing any encountered defects to the specifications of those bid items. Maintain the subgrade surface to readily drain at all times. Protect the subgrade from damage when handling materials, tools and equipment. Do not store or stockpile materials on the subgrade. Do not place material or lay pavement on a frozen or muddy subgrade, or when it is raining or snowing.

Lightly spray the subgrade or base with water to obtain a thoroughly moistened condition when the concrete is deposited on it. Do not puddle water on the grade.

Do not deposit any material until the subgrade or base has been checked and approved by the Engineer.

b. Slip Form Paving. When paving is performed with a slip form paving unit, use equipment as described in **subsection 154.5**.

Pave 24-foot wide mainline pavement in a single operation. Do not exceed 24-foot paving width in a single operation except as follows:

- The Contractor may pave a maximum of 2 lanes plus a 6-foot shoulder (30 feet maximum) in a single operation.
- For pavements of 3 lanes or more, pave a minimum of 2 lanes mainline (with the option of including a single shoulder for a maximum of 30 feet) in a single operation.
- Approval will be based on satisfactory performance of the Contractor's operation.

Place ramps and auxiliary lanes/shoulders as shown in the Contract Documents.

Once the paving operation has started, provide adequate equipment and supply of materials to maintain continuous placement for any given working period. Keep all concrete conveying equipment clean.

Do not apply any tractive forces to the slip form paver, except that which is controlled from the machine.

Trim to grade the subgrade or surface of the base over which the tracks of the paver will travel. Do not disturb this surface with other equipment. If the equipment or method of operation requires the subbase to be wider than shown in the Contract Documents, place additional material to provide an adequate surface for the tracks of the paver. Upon completion of the paving operations, remove or repair any base material damaged by the slip form paver's tracks. All necessary construction and removal of this additional base material is subsidiary to other items of the contract.

Operate the paver continuously, stopping only when absolutely necessary. If the forward motion of the paver is stopped, immediately stop the vibrator and tamping elements.

Deposit the concrete on the grade in successive batches to minimize re-handling. Place concrete over and against any joint assemblies so the joint assembly is retained in its correct position. Spread the concrete using approved mechanical spreaders to prevent segregation and separation of the materials.

After striking the concrete off with the spreader, leave sufficient concrete in place to allow the final shaping by the use of screeds, templates and pans, depending on make, model and type of machines approved for use in the paving train. Adjust the paving units to meet the required final cross-section, minimizing the need to carry back concrete to fill voids or depressions. Adjust each screed or template so a uniform roll of concrete extends the full length of the screed or template and allows just enough concrete to pass under the unit to properly feed the next machine. Do not shove large volumes of concrete with the screed or template. Adjust the screed or template to maintain a uniform cross-section.

Use multiple spreaders for single and multiple lift operations. Place concrete ahead of the initial spreader strikeoff no more than 30 minutes ahead of the final spreader strikeoff.

The use of any paving machine in the paving train is contingent on its ability to finish the pavement satisfactorily to the required grade, section and specified degree of consolidation. The Engineer may at any time require the adjustment, repair or replacement of the machine for unsatisfactory performance.

Correct any edge slump of the pavement in excess of ¼ inch, exclusive of edge rounding, before the concrete hardens. Excessive edge slumping will be sufficient reason to discontinue paving until machinery (or mix) is properly adjusted or removed from the project.

When the machine finishing has been completed, check the surface with a straightedge a minimum of 10 feet in length before texturing. Operate the straightedge parallel to the pavement centerline, starting at the center and progressing outward. Advance in successive stages of less than ½ the length of the straightedge. At the Contractor's option, this requirement may be eliminated when smoothness is to be determined by the profilograph.

c. Placing Reinforcement. Place pavement reinforcement at the locations shown in the Contract Documents. Use a sufficient number of approved metal, bar supports or pins to hold all dowel bars and tie bars in proper position as required by the Contract Documents. Install tie bars perpendicular to the concrete face being tied together. Do not use stones, concrete or wood to support the reinforcement.

Joint tie bars may be installed mechanically if approved by the Engineer. The satisfactory placement of the bars depends on the ability of the Contractor's operation to place and maintain the bars in their true position. When satisfactory placement is not obtained by mechanical means, the Engineer may require the tie bars be installed ahead of placing the concrete, and that they be securely held in their exact position by staking and tying.

Do not install dowel bars mechanically. Install the dowel bars ahead of placing the concrete, and hold them securely in their exact position by staking or tying.

Thoroughly coat each dowel with hard grease or other approved bond breaker as shown in the Contract Documents. The bond breaker coating shall not exceed 15 mils ± 5 mils in thickness when averaged over 3 points measured at the ¼ points on the bar at 90º intervals around the bar.

When reinforced concrete pavement is placed in 2 layers, strike off the entire width of the bottom layer to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. Place the reinforcement directly on the concrete, then place the top layer of concrete, strike it off and screed it. Remove any portion of the bottom layer of concrete that has been placed more than 30 minutes, and replace it with fresh mixed concrete at the Contractor's expense. When reinforced concrete is placed in 1 layer, the reinforcement may be positioned in advance of the concrete placement or it may be placed in the plastic concrete after initial spreading, by mechanical or vibratory means.

Place the wire mesh reinforcement in the pavement at the locations shown in the Contract Documents. When 2 layers of wire mesh reinforcement are required, support the bottom layer in the required position with bar chairs. Use separators for the top layer if the strike-off can not be used properly for the operation. Lap the reinforcement as shown in the Contract Documents. Laps parallel to the centerline of the pavement are prohibited except for unusual width of pavement lanes or for irregular areas. If the Contract Documents do not show dimensions for laps, the minimum lap either perpendicular or parallel to the centerline of the pavement is 6 inches. Fasten or tie adjacent wire mesh sheets together to hold all parts of the wire mesh sheets in the same plane.

If a "wire pattern" appears on the surface of the fresh pavement, immediately modify placement procedures to eliminate the problem.

Use reinforcing steel free from detrimental materials that could impair the bond between the steel and concrete.

d. Consolidation and Finishing. Perform hand spreading with shovels, not rakes. Do not allow workers to walk in the fresh concrete with boots or shoes coated with earth or foreign substance.

Do not apply moisture to the surface of the concrete pavement unless the Engineer approves the use of additional water on the fresh concrete surface to lubricate the float of the longitudinal finisher. If unusual weather conditions require the addition of superficial water to the concrete surface, apply it only in the form of a fine, fog mist.

Uniformly consolidate the concrete without voids, and finish to the cross-section and elevation shown in the Contract Documents.

Use vibrators or other approved equipment to consolidate each layer of concrete, when placed in more than 1 lift, or full depth if placed in 1 lift. Uniformly vibrate the concrete across the full width and depth of the pavement so that the density of pavement concrete is a minimum of 98% of the vibrated unit weight. The 98% density requirement may be eliminated on miscellaneous areas such as entrance pavement, median pavement and gore areas.

Vibrators, either of the surface type (pan or screed) or the immersion type (tube or spud) may be attached to the spreader, paver or finishing machine, or may be mounted on a separate carriage. Only operate the vibrators when the machine they are mounted on is moving forward. Do not operate hand vibrators more than 15 seconds, or less than 5 seconds in any one location unless approved otherwise by the Engineer. Place vibrators in and withdraw from concrete vertically in a slow deliberate manner.

On mainline paving, every 4 hours, check the electronic monitoring system vibrator frequencies with the vibrator under load to comply with the frequencies shown in **subsection 154.2e**.

If the system indicates a vibrator is not working properly, manually check the vibrators, immediately. If a vibrator is not functioning properly, immediately replace.

If the electronic monitoring system fails to operate properly, manually check the vibrators, immediately. If the vibrators are functioning properly, paving may continue but make all efforts to correct the problem within 3 paving days. The Engineer may allow additional time if circumstances are beyond the Contractor's control. Perform the vibrator checks manually until the system is fixed.

Maintain a uniform, continuous roll of concrete over the vibrators ahead of the strike-off. The height of the roll shall be approximately the same height as the thickness of the pavement being vibrated.

In order to obtain concrete consolidation in the vicinity of joint assemblies, the Engineer may require that these areas be hand vibrated with an immersion spud vibrator.

In the event the specified density is not attained, cease paving operations and make necessary adjustments to produce concrete to conform to the density requirements.

Use an approved nuclear density measuring device to monitor in-place density. Provide a moveable bridge and move it to test locations as required to allow the Inspector to work over the fresh concrete.

On projects or areas within projects where the use of conventional equipment is impracticable, other consolidation and finishing equipment may be used with approval of the Engineer.

e. Fixed Form Paving. At the Contractor's option, the fixed form paving method may be used.

(1) Forms. Use straight, metal forms having adequate strength to support the equipment. Each section shall be a minimum of 10 feet in length. Use forms with a depth equal to the prescribed edge thickness of the concrete, a base width at least equal to the depth of the forms and without a horizontal joint. Use flexible or curved forms of proper radius for curves of 150-foot radius or less, except approved straight forms of 5-foot lengths may be used for curves of a radius from 75 to 150 feet. Flexible or curved forms must be approved by the Engineer. The Engineer may approve the use of wood forms in areas requiring hand finishing. Secure the forms in place to withstand the impact and vibration of the consolidating and finishing equipment without visible spring or settlement. Extend flange braces outward on the base a minimum of ⅔ the height of the form. Remove forms with battered top surfaces or bent, twisted or broken forms. Do not use repaired forms until they have been inspected and approved by the Engineer. Do not use buildup forms, except where the total area of pavement of any specified thickness on the project is less the 2,000 square yards. Do not vary the top face of the form from a true plane more than ⅛ inch in 10 feet, and do not vary the vertical face of the form by more than ¼ inch. The forms shall contain provisions for locking the ends of abutting form sections together tightly, and for secure setting.

(2) Base Support. Provide a foundation under the forms that is compact and true to the specified grade so that the whole length of the form will be set firmly in contact with the grade.

(3) Form Setting. Set forms sufficiently in advance of the point where concrete is being placed so that line and grade may be checked. After the forms have been correctly set, thoroughly tamp the grade mechanically at both the inside and outside edges of the base of the forms. Stake forms into place with a minimum of 3 pins for each 10-foot section. Place a pin at each side of every joint. Tightly lock form sections, free from play or movement in any direction. Do not deviate the form from true line by more than ¼ inch at any point. No excessive settlement or springing of forms under the finishing machine is permitted. Clean and oil forms before the placing of concrete.

(4) Grade and Alignment. Check the alignment and grade elevations of the forms immediately before placing the concrete and make any necessary corrections. When any form has been disturbed or any grade has become unstable, reset and recheck the form.

(5) Placing Reinforcement and Consolidating and Finishing Concrete. Meet the requirements in **subsections 502.3 c.** and **d**.

(6) Removing Forms. Unless otherwise provided, do not remove forms from freshly placed concrete until it has set for a minimum of 12 hours, except auxiliary forms used temporarily in widened areas. Remove forms carefully to avoid damage to the pavement.

f. Texturing. Use texturing equipment and devices as described in **subsection 154.7**.

Use a burlap drag as soon as all excess moisture has disappeared and while the concrete is still plastic enough to make a granular surface possible.

Following the dragging operation, use a mechanical device to make a final finish or texture by giving the surface of the plastic pavement a longitudinal tining, unless shown otherwise in the Contract Documents. Perform the operation at such time to minimize displacement of larger aggregate particles and before the surface permanently sets.

Small or irregular areas may be tined by hand methods.

On projects of less than 5,000 square yards, or projects with longitudinal tining, the tining and curing devices may be mounted on the same carriage when approved by the Engineer. Operations of this type will be based on satisfactory performance.

Before final texturing, finish the exposed edge of the pavement to a radius of ¼ inch with an edger. Edge the interior longitudinal joints on multiple-lane pavement to a radius of ⅛ inch. Eliminate any tool marks appearing on the slab adjacent to the joints or edge of the slab. Do not disturb the rounding of the corner of the slab.

g. Joints.

(1) General. Construct joints according to the Contract Documents. Failure to construct the joints in the best possible manner will be cause for suspension of work until the cause of the defective work is remedied.

If existing pavement of any type is required to abut with the new pavement, and the termination of the removal is not at an existing joint, make the new joint by sawing the existing pavement full depth with a diamond saw before removal.

The objective is to create or form a plane of weakness in the fresh concrete before uncontrolled or erratic cracking occurs. The following methods are acceptable:

- Use concrete saws to saw all contraction joints no wider than the initial saw cut and to a depth of D/3 ± ¼ inch. Extreme conditions could exist which make it impracticable to prevent erratic cracking by sawing the joints early. At the onset of the project, devise methods, with the approval of the Engineer, to control this cracking.
- Make a "plastic concrete cut" straight and well defined so it can be sawed out by the saw crew. The "plastic concrete cut" would replace the specified initial saw cut. Suggested procedures could be the use of a stiff metal parting strip, with or without handles that would be gently inserted in the fresh concrete and removed, thereby parting the interlocking coarse aggregate and providing a plane of weakness.
- Cut the fresh concrete with a mason's trowel and straightedge from a worker's bridge. It is imperative that the "plastic concrete cut" joint and the second stage saw cut are in the same exact location.
- At the Contractor's option, "early entry" saws may be used based on satisfactory performance and depth of cut recommended by the equipment manufacturer.
- Procedures to control erratic cracking are not limited to these examples.

Edge any transverse joint requiring hand finishing and edging with a tool having a radius of ⅛ inch. Do not indent the surface of the pavement with the horizontal face of the edger.

(2) Pressure Relief Joints. Install pressure relief joints according to the bridge approach details in the Contract Documents.

Form or saw openings for the joint material approximately 1 ¾ inches wide for the 2 inch joint and approximately 3 ¾ inches wide for the 4 inch joint at the locations shown in the Contract Documents. Use the lubricant adhesive as recommended by the manufacturer of the pressure relief joint material.

Just before the installation of the joint material, clean the faces of the joint by sandblasting, followed by an air blast to clean all dust from joint faces.

The Engineer may approve pre-positioning of the 2 inch material if adequate means are taken to obtain proper placement and retention, and if deformation of the material does not occur when the fresh concrete is placed against it.

Use a foam spacer block beneath the 4 inch joint filler material to maintain the specified grade. The spacer block is an easily compressed foam material cut to fill the void beneath the joint filler.

(3) Contraction Joints. Install contraction joints of the type, dimensions and spacing shown in the Contract Documents.

Stretch a stringline along the centerline of the joint, or otherwise adequately mark it to verify dowel bar joint assembly alignment.

Install the dowel bar joint assembly so the centerline of the assembly is perpendicular to the centerline of the slab, and the dowels lie parallel to the slab surface and slab centerline. Place concrete so it will not displace or disarrange the joint assembly. Mark the location of contraction joints to assure the joints are sawed in the proper location.

(4) Longitudinal Joints. Construct longitudinal joints according to the Contract Documents. When sawed joints are specified or used, provide approved guide lines or devices to cut the longitudinal joint on the true line as shown in the Contract Documents. Perform the sawing of longitudinal joints at a time that will prevent erratic or uncontrolled cracking. When "plastic concrete cut" methods are used, no sawing or widening of the joint will be required to make a sealant reservoir.

(5) Construction Joints. Make a butt construction joint perpendicular to the centerline of the pavement at the close of each day's work, or when the process of depositing concrete is stopped for a length of time sufficient for the concrete to take its initial set. Form this joint by using a clean header having a nominal thickness of 2 inches, and minimum cross-sectional area equal to pavement thickness by pavement width. Cut the header true to the crown of the finished pavement. Accurately set and hold it in place in a plane at right angles to centerline and perpendicular to the surface of the pavement.

Protect the top surface of the header with steel. Securely fasten a trapezoidal piece of metal or wood approximately 2 inches wide and a minimum of 1 inch in depth on the face of the header, along the center of the header to form a grooved or keyed joint.

With approval of the Engineer, the Contractor may pave beyond the joint location a distance to maintain the line and grade. Saw the construction joint when the concrete has hardened. Drill holes for reinforcing tie bars and epoxy the bars in-place. Place fresh concrete against the previously placed concrete taking care to avoid injury to the edge. Vibrate the concrete to obtain an interlocking joint and prevent a honeycombed face of the joint. The additional concrete, removal of debris and other work created by this alternative is at the Contractor's expense.

Unless shown otherwise in the Contract Documents, do not place any construction joint within 5 feet of an expansion, contraction or other construction joint.

(6) Special Joint Construction. Construct special joints as shown in the Contract Documents or as ordered by the Engineer around drainage, utility and other structures located within the concrete pavement boundaries. Hold temporary forms securely in place during the concrete placement operation.

(7) Joint Construction. Construct all joints as shown in the Contract Documents. Repair or replace any curing medium damaged during joint construction. Construct joints as follows:

(a) Induced Plane of Weakness. The first saw cut is a relief cut at the proper joint location, approximately ⅛ inch wide and to the full joint depth as shown in the Contract Documents (D/3 ± ¼ inch). Make the relief cut as soon as the concrete has hardened enough so that no excess raveling or spalling occurs, but before any random cracks develop. The sequence of the relief sawing is at the Contractor's option, provided all relief sawing is completed before random cracking develops. Use suitable guide lines or devices to cut the joint straight and in the correct location. Repair curing membrane damaged during sawing as directed by the Engineer. See **subsection 502.3g.(1)** for alternate methods to the first stage sawing.

(b) Reservoir Construction. Do not perform widening of the relief joints to full width until the concrete is a minimum of 48 hours old. Delay it longer if the sawing causes raveling of the concrete. If second stage sawing is performed before completion of the curing period, maintain the cure by use of curing tapes, plastic devices or other materials approved by the Engineer. Center the joint groove over the relief cut, and saw it to the dimensions shown in the Contract Documents. Should any spalling of the sawed edges occur that would detrimentally affect the joint seal, patch it with an approved epoxy patching compound and allow it to harden before installing the joint material. Make each patch true to the intended neat lines of the finished cut joint.

(8) Cleaning Joints.

(a) Immediately clean freshly cut sawed joints by flushing with a jet of water under pressure and other necessary tools to remove the resulting slurry from the joint and immediate area.

(b) To clean the joints, use air compressors equipped with suitable traps capable of removing all surplus water and oil from the compressed air. The Engineer will check the compressed air for contamination, daily. When contaminated air is found to exist, work will be stopped until suitable adjustments are made, and the air stream is found to be free of contaminants.

(c) Just before applying the hot or cold joint sealant, complete a final cleaning by air blasting to clean incompressibles from the joint.

(d) Before installing preformed elastomeric joint seals, use water or sandblasting equipment to clean the seal reservoir of the transverse joint a minimum of the vertical height of the installed elastomeric joint material plus ½ inch measured from the pavement surface. Use a multiple pass technique until the surfaces are free of dirt, curing compound or any residue that might prevent ready insertion of the seal, or uniform contact with the concrete. (Note: These seals are held in place by compressive forces and friction acting on the faces of the joint, not chemical bonding as with other joint sealants.) After final cleaning, and immediately before installing the seal, blow out the joint seal reservoir with compressed air until it is free of debris and visible water.

(9) Sealing Joints. The joint location, size and configuration is shown in the Contract Documents. Use applicable materials to obtain the required joint sealant configuration. Seal transverse pavement joints with preformed elastomeric compression joint seals, unless shown otherwise in the Contract Documents. Seal longitudinal pavement joints full depth with either a cold applied chemically cured joint sealant or a hot joint sealing compound. Use only 1 type of longitudinal joint sealant on a project, unless otherwise approved by the Engineer. Seal joints before opening to traffic. For opening to construction traffic, see **subsection 502.3i.(3)(a)**.

When using cold applied chemically cured joint sealant, hot joint sealing compound or preformed elastomeric compression joint seals, arrange for a technical representative of the manufacturer to be present during installation of the joint seal to provide guidance on cleaning, preparation of the joint and installation of the seal.

Keep the manufacturer's technical representative on the project until Contractor and KDOT personnel have been thoroughly trained in the proper installation of the material. The Engineer may waive this requirement for Contractors that are experienced in installing the type and brand of material being used. Provide the Engineer with a résumé of experience for evaluation.

(a) Cold Applied Chemically Cured Joint Sealants. Do not seal joints until they are clean and dry, and the pavement has attained the age recommended by the manufacturer of the sealant. Do not apply sealant to damp concrete, or install it during inclement weather. Do not apply joint sealant when the ambient air temperature is below 40ºF, or as specified by the manufacturer. Place the sealer full depth in close conformity with dimensions shown in the Contract Documents. Any deviation will be cause for rejection of the joint until satisfactory corrective measures are taken.

Apply the joint sealant by an approved mechanical device. Any failure of the joint material in either adhesion or cohesion will be cause for rejection. Repair the joint to the Engineer's satisfaction.

Some cold applied, chemically cured sealants are not self-leveling and will not position properly in the joint under its own weight. Tool the sealant surface as shown in the Contract Documents. Accomplish tooling before a skin forms on the surface. Do not use soap or oil as a tooling aid.

After a joint has been sealed, promptly remove all surplus joint sealer from the pavement or structure surfaces.

Do not permit traffic over sealed joints until the sealer is tack free, or until debris from traffic can not embed into the sealant.

(b) Hot Applied Joint Sealing Compound. Do not seal joints until they are clean and dry, and the pavement has attained the age recommended by the manufacturer of the joint sealing compound. Install joint sealing compound according to the manufacture's recommendations.

Completely clean out the application unit when changing brands of materials, or if the material exhibits any sign of changes in application characteristics, polymer or oil separation, balling or any signs of jelling. If the application unit contains compatible material from a previous project at start-up, provide the Engineer a certification covering the material in the application unit, including the manufacturer, type, etc. Before start-up completely clean out any material that can not be identified and certified.

After a joint has been sealed, promptly remove all surplus joint sealer from the pavement or structure surfaces.

Do not permit traffic over sealed joints until the sealer is tack free, or until debris from traffic can not embed into the sealant.

(c) Preformed Elastomeric Joint Seals. Concrete that has reached an age that permits proper sawing and cleaning without causing deterioration of the joint edges and joint faces, is considered acceptable for seal installation.

Under normal construction procedures, seal transverse joints full width with no splices made in the preformed joint seal. However, under phased construction of widenings, where the lanes placed earlier have been opened to traffic, the preformed joint seal may be spliced at the construction joint. When the existing seal is peeled back to saw the construction joint, clean it, reapply the lubricant/adhesive and reinstall as soon as possible. After the new seal is installed, place the longitudinal joint sealant through the intersection with the transverse joint, with the transverse seals butted in. Place the longitudinal sealant to encase and seal the ends of the preformed seals.

Install the joint seal with a machine especially designed to compress and install the sealant in an upright position, without cutting, nicking, distorting or otherwise damaging the seal. Apply lubricant to the concrete or the preformed seal (or both), and install the seal in a substantially compressed condition. Place the top of the seal at a depth below the finished surface of the pavement recommended by the manufacturer.

Use a method of installation such that the joint seal will not be stretched or compressed longitudinally more than 3% of the length, unless stated otherwise in the manufacturer's instructions. The method of installation will be checked for stretching or compression by comparing the distance between 2 marks on the surface of the seal measured before and after the installation. If the check indicates stretching or compression beyond the limits stated above, modify the method of installation to correct the situation. The Contractor may proceed slightly out of specification for a short distance under the supervision of the manufacturer's technical representative, while making corrections and adjustments to return to specification limits. This material may remain in place, provided the stretching does not exceed 5% and the Contractor makes a good faith effort to correct the problem. Once the machine is in proper adjustment and the installation is proceeding satisfactorily, further checks (approximately every 100 joints) will be made to verify proper installation.

Remove any joint seal not conforming to the above stated limits of installation and replace with new material. After being removed for any reason, no seal may be reused.

(10) Sawed (Non-Sealed) Joints.

(a) Joint Construction. The joint location, size and configuration are shown in the Contract Documents. Use concrete saws to saw all joints a nominal 1/8 inch wide to the full joint depth, D/3± ¼ inch, unless shown otherwise in the Contract Documents.

Make the saw cut as soon as the concrete has hardened enough so that no excess raveling or spalling occurs, but before any random cracks develop. The sequence of the sawing is at the Contractor's option, provided all sawing is completed before random cracking develops. Use suitable guide lines or devices to cut the joint straight and in the correct location.

(b) Cleaning Joints. Immediately clean freshly cut sawed joints by flushing with a jet of water under pressure and other necessary tools to remove the resulting slurry from the joint and immediate area. Repair curing membrane damaged during sawing and cleaning, as directed by the Engineer.

(c) Backer Rod. Install and maintain backer rod (of a size sufficient to prevent debris from entering the joint) in the joint. When major construction traffic is no longer driving on the pavement, and prior to opening to the public, remove the backer rod, and follow with an air blast to remove any debris.

(d) Repair of Joints. If the sawed joint is ≥ ¼ inch, seal the joint using Hot Applied Joint Sealing Compound, according to **subsections 502.4g.(7) thru (9)(b)**. Seal transverse joints the full width of pavement. Seal longitudinal joints the full length of the panel. If the joint can not be properly sealed, see **subsection 502.4k**.

(e) Opening to Traffic. When no joints require sealing, disregard **subsection 502.4i.(3)(a)**, third bullet and **502.4i.(3)(b)**.

(f) Side Roads and Entrance Pavement. If the PCCP is designated with sawed (non-sealed joints), construct the side road and entrance pavement joints according to **subsection 502.4g.(10)**, unless otherwise specified in the Contract Documents.

(g) Curb and Gutter/Valley Gutter. Unless specified otherwise in the Contract Documents, if the PCCP is designated with sawed (non-sealed) joints, construct the curb and gutter/valley gutter joints according to **subsections 502.4g.(10)(a)** thru **(c)** with the following exception: saw to a depth a minimum of 1 ¼ inches below the surface of the gutter. If the curb and gutter is placed monolithically with the pavement, saw to the same depth as the pavement.

h. Hand Finishing. Hold hand finishing methods to a minimum. Generally, hand methods of placement and finishing will be permitted as follows:

- For pavement when a breakdown of some portion of the paving train occurs, making the hand finishing of that portion of the concrete already in place necessary.
- For pavement lanes that may be too narrow or a length too short to accommodate a full paving spread.
- For all irregular shaped areas.
- For special approach sections to bridges, widened portions at bridges, intersections and sections widened beyond traffic lanes.
- When the dimensions of the work make the use of a complete power operated paving impossible, or impracticable.

For uniform width areas or transition width areas using false forms, finish handwork with a mechanical finishing machine or approved vibrating screed, whenever possible.

Use spud hand vibrators on any area considered impracticable to vibrate with a vibrating screed. Approved metal or wood floats may be used if needed to help close an open or porous surface condition.

Continue the operation of consolidation and screeding or striking off the concrete until the concrete is uniformly consolidated and the surface is true to line, grade and cross-section.

After the pavement has been properly struck off, straightedge the pavement for trueness and finish it. Use a burlap drag to remove surface straightedge marks. The burlap drag may be pulled by hand, but the results shall be similar to that on the mainline pavement.

Manual methods may be used for texturing hand finished pavement areas. Where applicable, the tined texture applies. Use a metal comb with dimensions and spacing shown in **subsection 154.7c**. Obtain a finished textured surface similar to that produced mechanically.

On miscellaneous areas such as entrance pavement, median pavement and gore areas, texturing with the metal comb may be eliminated. Final finish may be attained by the use of a drag that consists of a seamless strip of damp burlap, cotton fabric or other suitable material capable of producing a uniform surface of gritty texture.

i. Protection and Curing of Concrete. Cure the pavement by using burlap, liquid membrane-forming compounds, white polyethylene sheeting, concrete curing blankets or reinforced white polyethylene sheeting. Failure to provide proper curing is cause for immediate suspension of the concreting operations.

(1) Burlap, Concrete Curing Blankets, White Polyethylene Sheeting and Reinforced White Polyethylene Sheeting. Place the curing material on the pavement immediately after the pavement has been finished, and the concrete has hardened sufficiently to avoid harmful marring of the surface, yet early enough to prevent undue loss of moisture from the concrete. If the pavement becomes dry before the curing material is placed, moisten the concrete with a fine spray of water. Place burlap-polyethylene blankets with the dampened burlap side down. Dampen burlap and place on the surface. Keep burlap damp throughout the entire curing period.

Lap adjacent units of curing materials approximately 18 inches. Upon removal of the forms, extend the material to completely cover the full depth of the exposed pavement.

Weigh the curing material down using continuous windrows of earth placed along the sides and edges of the pavement and transversely across the pavement on the laps to cause the material to remain in contact with the covered surface throughout the curing period. Other methods may be used with approval of the Engineer.

Walking on the pavement surface to place the curing material is prohibited. Walking on the curing material is prohibited until the pavement has cured sufficiently to prevent damage to the surface.

Leave the curing material in place for a minimum of 4 days, unless otherwise directed by the Engineer. Immediately repair any tears or holes appearing in the material during the curing period, or replace it with material in good condition.

The material may be reused, provided it is kept serviceable by proper repairs, and if in the judgment of Engineer it will provide water retention during the curing period.

(2) Type 2 White Liquid Membrane-Forming Compounds. After finishing operations have been completed and immediately after the free water has left the surface, completely coat and seal the surface of the slab with a uniform layer of compound. Apply the compound in 1 application at a minimum rate of 1 gallon per 150 square feet of surface. Thoroughly mix the compound at all times during usage. Do not dilute the compound. Daily provide the Inspector with documentation of the quantity of curing compound used.

Protect the treated surface from injury a minimum of 4 days, unless otherwise directed by the Engineer. If the newly coated film is damaged in any way, apply a new coat of material to the affected areas equal in coverage to that specified for the original coat. A minimum of foot traffic will be permitted on the dried film as necessary to properly carry on the work, provided any damage to the film is immediately repaired by application of an additional coat of compound.

Immediately after the forms are removed (fixed form and slip form), coat the entire area of the sides of the slab with compound at the rate specified for the pavement surface, regardless of whether or not further concrete placement will be made against the pavement edge. Approved hand spray equipment will be permitted only for the application of compound on the sides of the slab, for repairing damaged areas and for hand finished areas. Repair any damaged areas caused by joint sawing.

(3) Opening to Traffic. No motorized traffic is allowed on the pavement until all of the following conditions are met.

(a) Construction Traffic Only.

- The flexural strength of the pavement shall meet or exceed 450 psi. Determine the flexural strength of the pavement by testing flexural strength specimens utilizing the third point loading method, or by use of a calibrated maturity meter.
- If flexural strength does not meet or exceed 450 psi, observe a 10 day curing period before allowing motorized traffic on the pavement. Provide a strength gain curve of concrete cured at 45°F to justify a curing period of less than 10 days.
- Provide protection to keep foreign material out of the unsealed joints by an approved method.

(b) All Traffic. In addition to **subsection 502.3i.(3)(a)**, seal the joints according to **subsection 502.3g.(9)**.

The Contractor may, at own expense, increase the cement content from the minimum shown in **DIVISION 400** to accelerate the strength gain of the PCCP.

(4) Cold Weather Curing. Maintain the concrete pavement at a minimum temperature of 40ºF, as measured along the surface of the concrete, for a minimum of 4 days after placing. When the ambient air temperature is expected to drop below 35ºF anytime during the curing period, take precautions to maintain the concrete temperature. Keep a sufficient supply of approved moisture barrier material, other than liquid curing compound, and suitable blanketing material, such as straw, hay and burlap close by. Be prepared to cover the pavement with a moisture barrier and protect all pavement less than 4 days old with blanketing material. Remove, dispose of and replace concrete damaged by cold weather, as determined by the Engineer.

(5) Early Strength Concrete Curing. The curing period shall conform to the requirements specified for regular concrete pavement in **subsection 502.3.i.(3)**. Construct joints according to the manufacturer's recommendations for early strength concrete pavement.

j. Cold Weather Limitations. If concrete is placed in cold weather, comply with **DIVISION 400**.

k. Repair of Defective Pavement Slabs. It is the responsibility of the Contractor to repair any spalled, cracked or broken panels as specified hereinafter at no cost to KDOT. Completely remove and replace pavement panels (area between contraction joint and contraction joint) containing both transverse and longitudinal cracks (separating the panel into 4 or more parts) through the full depth of the slab.

Properly seal the joints of the repaired or replaced panels.

(1) Repair of Spalls.

- In no case shall an individual patch of a spall be less than 1 square foot with no dimension less than 1 foot.
- For spalls greater than ¼ inch and less than or equal to ½ inch from edge of the original sawed joint, repair with hot pour.
- For spalls greater than ½ inch and less than or equal to 1 inch from the edge of the original sawed joint, blast clean and repair with epoxy patch material.
- For spalls greater than 1 inch from the edge of original sawed joint, repair by making a saw cut a minimum of 1 inch outside the spalled area to a minimum depth of 2 inches. The interior angles formed by the intersection of adjacent sides of the patch shall be a minimum of 60º. When the spalled area abuts a joint, make the saw cut to a depth of 2 inches or 1/6 the slab thickness, whichever is greater. Chip out the concrete between the saw cut and the joint or primary crack to solid concrete. Do not use chipping hammers greater than 15 pounds. Thoroughly clean all loose material from the formed cavity. Apply a coat of an approved concrete bonding epoxy to the dry, cleaned surface of all sides of the cavity, except the joint. Apply the epoxy by scrubbing the material into the surface with a stiff bristle brush. Place portland cement concrete, epoxy resin concrete or mortar, immediately following application of the epoxy, according to the manufacturer's recommendations. If the spalled area to be patched abuts a working joint, use an insert or other bond breaking medium during the repair work to maintain working joints. Remove and replace major honeycombed areas found after removal of the forms. Removed areas or sections so removed shall be a minimum of 6 feet in length if less than full width of the lane involved. When it is necessary to remove a section of pavement, also remove and replace any remaining portion of the slab adjacent to the joints that is less than 6 feet in length.

(2) Repair of Cracks in New Reinforced, Dowel Jointed PCCP.

(a) Transverse and Diagonal Cracks.

(i) Full Depth.

- When a single full-depth transverse crack falls within the middle ⅓ of the panel, no corrective work will be required.
- Should a second full-depth crack develop within the middle ⅓ of the panel, remove and replace the panel to the nearest planned contraction joint, eliminating both cracks. If the location of the mid-panel full-depth crack is within 6 feet of the boundaries of the area to be repaired, extend the area to be repaired to include the mid-panel crack.
- When any portion of a full-depth crack falls outside the middle ⅓ of the panel, remove and replace the portion of panel between the contraction joint and the crack. Make 1 full-depth saw cut parallel to the contraction joint on the mid-panel side of the crack to be removed. Make another cut in the adjacent panel, parallel to the contraction joint, clear of the basket assembly, but not less than 6 feet from the first cut. Remove the cracked section and basket assembly. Drill holes in both sawed faces, and insert bars to make 2 contraction joints. Use dowels of the same size and spaced the same distance as those shown in the Contract Documents. Drill bar holes ¼ inch ± 0.05 inch larger than the diameter of the bar and fill them with epoxy or grout and insert the new dowel. Support the free ends of the bars parallel to the pavement surface until the epoxy or grout has set, obtaining proper alignment of the bar. Apply grease or an approved bond breaker to the free ends.
- If the boundaries of consecutive areas to be repaired are less than 6 feet apart, also remove and replace the areas between the patches.
- Saw off the longitudinal joint tie bars at the longitudinal joint. Drill holes midway between the existing bars and insert tie bars to make a new tied longitudinal hinged joint. Use tie bars of the same size and spacing as those in the Contract Documents. Drill bar holes ¼ inch ± 0.05 inch larger than the diameter of the bar and fill them with epoxy or grout and insert new tie bars.

(b) Longitudinal Cracks. When a single longitudinal crack falls within a panel, no corrective work will be required.
When a second full-depth longitudinal crack falls within a panel, remove and replace the panel to the nearest planned contraction joint, eliminating both cracks.

(3) Repair of Cracks in both New Non-reinforced Dowel Jointed PCCP and Mainline Plain PCCP.

(a) Transverse and Diagonal Cracks.

(i) Full Depth.

- If a maximum of 4 panels per any lane mile has a crack, repair according to **SECTION 504 - DOWEL BAR RETROFIT-REPAIR**, or remove and replace the pavement.
- If 5 to 18 of the panels per any lane mile has a crack, repair according to **SECTION 504 - DOWEL BAR RETROFIT-REPAIR**. When 2 consecutive panels have a crack, remove and replace the panels from contraction joint to contraction joint.
- If more than 18 of the panels per any lane mile have a crack, remove and replace the pavement bounded by the cracks in that segment. Remove and replace until ¼ mile segment has less than 4 panels cracked, then repair or replace.

(ii) Partial Depth. If coring (at no additional cost to KDOT) verifies the transverse cracks are not full depth, repairs may be made by **SECTION 505 - TIE BAR INSERTION-REPAIR**.

(iii) When required or at the Contractor's option, remove and replace pavement panels containing any transverse or diagonal crack according to the following:

- Make a full-depth saw cut in the abutting panel nearest to the crack, parallel to the contraction joint, just clear of the basket assembly to allow the existing dowel basket assembly to be completely removed. Make a second saw cut parallel with the contraction joint on the opposite side of the crack away from the contraction joint. For plain PCCP, make the saw cut at the joint nearest to the crack. Make the second saw cut opposite the first cut a minimum of 6 feet from the first saw cut to include the crack. Remove the resulting area.

- The minimum longitudinal length of a patch is 6 feet.
- Do not permit a patch to fall within 6 feet of a contraction joint.
- The maximum distance between doweled/non-doweled contraction joints is 18 feet.
- Drill holes and insert dowel bars to make new contraction joints within the vertical faces of both newly created panel ends. Use dowels of the same size and spaced the same distance as shown in the Contract Documents. Drill bar holes ¼ inch ± 0.05 inch larger than the diameter of the bar and fill with epoxy or portland cement grout and insert the new dowel. Support the free ends of the bars until the epoxy or grout has set to obtain proper alignment of the bar. Apply grease or an approved bond breaker to the free ends. Do not use dowel bars in plain PCCP.
- Saw off the longitudinal joint tie bars at the longitudinal joint. Drill holes midway between the existing bars and insert tie bars to make a new tied longitudinal hinged joint. Do not place new tie bars within 12 inches of doweled joint. Use tie bars of the same size and spacing as those in the Contract Documents. Drill bar holes ¼ inch ± 0.05 inch larger than the diameter of the bar and fill them with epoxy or grout and insert new tie bars.

(b) Longitudinal Cracks. Repair or remove and replace pavement panels that contain a single longitudinal crack, according to the following:

- Repair longitudinal cracks that are within 3 inches of the planned longitudinal joint for their entire length with a partial depth patch as specified for spall in **subsection 502.3k.(1)**, except make the transverse dimension of the patch 6 inches and saw cuts to D/3 ± ¼ inch.
- For longitudinal cracks between 3 and 6 inches from the planned longitudinal joint, fill the entire planned longitudinal joint full depth with epoxy through the length of the longitudinal crack.
- Repair longitudinal cracks that are 6 inches or more from the planned longitudinal joint by removing and replacing pavement panels, or repair pavement by **SECTION 505 - TIE BAR INSERTION-REPAIR**.

Remove and replace pavement panels that contain 2 or more longitudinal cracks.

(4) Repair of Cracks in Shoulder Plain PCCP.

(a) Transverse and Diagonal Cracks.

- When a single transverse crack falls within a panel and is within 3 feet of the transverse contraction joint, fill the contraction joint according to the Contract Documents and rout and seal the crack.
- When 2 or more transverse cracks fall within a panel, remove and replace the panels.

(b) Longitudinal Cracks.

- When a single longitudinal crack falls within a panel, repair pavement by **SECTION 505 - TIE BAR INSERTION-REPAIR**.
- When 2 or more longitudinal cracks fall within a panel, remove and replace the panels.

l. Protection of Pavement from Rain. Before placing PCCP, prepare and submit to the Engineer for approval, a Protection Plan to address the onset of rain during concrete placement. As a minimum, the plan shall include protective covering and side forms available at the project site at all times to protect the surfaces and edges of the newly placed concrete pavement. Polyethylene, burlap or other covering materials may be used. Side forms may be of wood or steel and shall have a depth a minimum of the thickness of the pavement. Specify the location of the storage site in order that a review of the protective materials may be conducted by the Engineer.

Include the type and amount of protective materials as well as the methods proposed to protect the pavement.

When rain appears imminent, stop all paving operations and initiate the Protection Plan. Extend the covering back to the point where the rain will not indent the surface. Exercise care to prevent unnecessary damage to the surface with the covering.

m. Pavement Thickness and Tolerance. Make the required corrections for pavement smoothness before making the pavement thickness determinations. Thickness will be determined by average caliper measurements of cores taken by the Engineer. Random cores will be taken for each 1,000 square yard section paved per day. The 1,000 square yard sections will be calculated on a lane (9 to 15 feet wide) basis for main line paving, ramp driving areas, lane widenings, and acceleration or deceleration lanes. When sections would require taking cores with an area less than 250 square yards, include that area with the days full section. Sections with an area greater than 250 square yards will stand as individual sections. The Engineer will not include bridge deck wearing surfaces or bridge approach paving in the 1,000 square yard calculation. Cores will not be taken in gore areas, intersection curb returns, entrances, shoulders, median, widenings less than 5 feet in uniform width and irregular areas less than 500 square yards.

Cores will not be taken for projects with less than 2,500 square yards of concrete pavement. Treat pavement less than the thickness specified in the Contract Documents as described in **TABLE 502-1**.

TABLE 502-1: PCCP THICKNESS TOLERANCE

Core Thickness in a Section (inch)	Action
Core measurement is 0.00 to 0.20 inches less than specified thickness.	Take no additional cores. Pay as per **TABLE 502-2**.
Core measurement is (>0.20) to 0.99 inches less than specified thickness.	Take 2 additional cores at random intervals a minimum of 200 feet apart and average. Note: If the measured thickness is greater than 0.20 + the specified thickness, the measured thickness value will be 0.20 + specified thickness, when calculating the average. Use the calculated average, and pay as per **TABLE 502-2**.
Core measurement is a minimum of 1.00 inch less than the specified thickness.	Take exploratory cores on 10 foot intervals parallel to the centerline in each direction to define the length of deficient pavement. Deficient pavement for removal is any pavement less than the specified thickness minus 1.0 inch. Remove all deficient pavement identified in the exploratory cores and replace with pavement of satisfactory quality and thickness at own expense. When removing and replacing a length of pavement, and one end of the deficient pavement is less than 10 feet from an expansion, contraction or construction joint, remove and replace the entire pavement up to the joint. Remove the area so that new joints are a minimum of 10 feet apart. After the deficient area and removal and replacement area is defined, take an additional core at a random location within the section and apply **subsection 502.3m**. The replaced deficient pavement area will be included for pay in the section. For monetary deductions found in the measurement of the thickness cores, see **subsection 502.4f**.

n. Pavement Smoothness. Evaluate pavement smoothness for pay according to **SECTION 503**.

502.4 MEASUREMENT AND PAYMENT

a. Plan Quantity Measurement. The quantities of concrete pavement for which payment will be made are the quantities shown in the Contract Documents for the traveled way and the various paved approaches, exits and interchanges, provided the project is constructed essentially to details shown in the Contract Documents.

When the Contract Documents have been altered, or when a disagreement exists between the Contractor and the Engineer as to the accuracy of the Contract Document quantities in any location or the entire project, either party has the right to request and cause the quantities involved to be measured according to **subsection 502.4b**.

b. Measured Quantities. The quantity to be paid for under this item will be the number of square yards of concrete pavement as measured in-place. The width for measurement will be the width of the pavement shown on the typical cross-section of the Contract Documents, additional widening where added or as otherwise directed in writing by the Engineer. The length will be measured horizontally along the centerline of each roadway or ramp.

c. Excavation Included in Contract. On projects where the grading and the pavement or base construction is included in the same contract, the Engineer will not measure additional excavation required to obtain the specified subgrade elevation.

d. Sawing and Sealing Joints. The Engineer will not measure this work for separate payment. All costs of complying with the requirements specified herein are included in the contract price for the concrete pavement in which the joints are located.

e. Water. The Engineer will not measure water used in dust control on haul roads, around plant installations, etc.

f. Price Adjustments. When the average thickness of the pavement determined in **subsection 502.3m.** is deficient by more than 0.2 inch based on the thickness required by the Contract Documents a price adjustment for deficient concrete pavement thickness will be made according to **TABLE 502-2** for the for the entire section represented. The pay adjustment amount will be subtracted as "Concrete Pavement Thickness Deficiency" on the pay estimate.

TABLE 502-2: PCCP CONCRETE PAVEMENT THICKNESS DEFICIENCY PRICE ADJUSTMENT	
Deficiency in thickness as determined by cores (inches)	**Percent of contract unit price for pay**
0.00 to 0.20	100
0.21 to 0.30	75
0.31 to 0.40	65
0.41 to 0.50	55
0.51 to 0.75	45
0.76 to 1.00	35

g. General Payment. Payment for "Concrete Pavement" and "Early Strength Concrete Pavement" with pay adjustments as specified above is full compensation for the work specified.

SECTION 503

PORTLAND CEMENT CONCRETE PAVEMENT SMOOTHNESS

503.1 DESCRIPTION

Determine the smoothness of the pavement surface. Correct the smoothness deficiencies discovered in the pavement surface.

BID ITEM	UNITS
Concrete Pavement Smoothness	Lump Sum

503.2 MATERIALS - None specified.

503.3 CONSTRUCTION REQUIREMENTS

a. General. Determine the pavement smoothness by profiling the pavement surface of through traffic lanes and ramps. Excluded from profilograph testing, and not eligible for pay adjustments, on all projects are:

- bridge decks;
- acceleration and deceleration lanes of at-grade intersections;
- turning lanes;
- shoulders;
- pavement on horizontal curves with centerline radius of curvature of less than 1000 feet, and pavement within the superelevation transition of such curves;
- individual sections of pavement less than 50 feet in length;
- sideroads less than 250 feet in length; and
- the first (or last) 15 feet of a pavement section where the Contractor is not responsible for the adjoining surface
- county secondary projects

b. Equipment. Use a California type profilograph, prequalified by the Bureau of Construction and Materials, to determine the pavement profile. If approved by the Bureau of Construction and Materials, other types of profilographs that produce results compatible to the California type profilograph may be used. If the profilograph has a mechanical recorder, provide a ProScan electronic scanner with motorized paper transport to reduce the trace. Use the motorized paper transport when scanning the profilograph traces. The Bureau of Construction and Materials can provide the information necessary for the Contractor to obtain a ProScan electronic scanner. If approved by the Bureau of Construction and Materials, other types of automated trace reduction equipment may be used. If the profilograph has a computerized recorder, the trace produced is evaluated without further reduction.

Provide a self-propelled grinding machine specifically designed to grind and texture portland cement concrete pavement using diamond blades mounted on a multi-blade arbor. The arbor must contain enough blades to provide at least a 36-inch wide cutting head and provide 55 to 60 evenly spaced grooves per foot.

Do not use equipment that causes excessive ravels, aggregate fractures or spalls. Use equipment that provides a flat plane surface without crown and a uniform texture for the full width of the lane. Grind a nominal depth of 3/16 inch.

When grinding is performed, use vacuum equipment or other continuous methods to remove grinding slurry and residue. Remove from the project and properly dispose of the material. Do not allow the grinding slurry to flow across lanes being used by traffic, onto shoulder slopes, into streams, lakes, ponds or other bodies of water, or gutters or other drainage facilities. Do not place grinding slurry on foreslopes.

Bush hammers or other impact devices will not be permitted.

c. Profilograph Operation. Provide an operator for the profilograph certified according to KT-46, Part V.

Determine the pavement profiles for each lane according to the procedures for 1 lane shown in Kansas Test Method KT-46. Additional profiles may be taken only to define the limits of an out-of-tolerance surface variation. The

Engineer may use a 10-foot straightedge (or other means) to detect irregularities outside the required trace paths. The Engineer may also use the straightedge to delineate the areas that require corrective action.

Determine a profile index (in./mi.) for each pavement section of finished pavement. A pavement section is a continuous area of pavement surface 0.1 mile long by 1 lane wide (12 feet nominal). A partial pavement section resulting from an interruption (such as a bridge) of the continuous pavement surface is subject to the same testing and evaluation as a whole section.

During the initial paving operations (and after long shutdown periods), profile the pavement as soon as the concrete has cured sufficiently to permit testing. The Engineer and the Contractor will use the results of the initial testing to evaluate the paving methods and equipment. If the initial paving operation produces acceptable results, the Contractor may continue paving. Repair or replace any PCCP curing medium that is damaged or removed during the testing.

On surfaces excluded from profilograph testing, the Engineer will determine the pavement smoothness using a 10-foot straightedge. The Engineer will select the locations to be tested. The variation of the surface from the testing edge of the straightedge shall not exceed ⅛ inch between any 2 contacts, longitudinal or transverse.

Correct all irregularities exceeding the specified tolerance using equipment and methods approved by the Engineer. After the irregularities are corrected, the Engineer will retest the area to verify compliance with the specified tolerance.

d. Profilograph Evaluation and Corrective Actions. Evaluate the profilograph results according to KT-46. Provide the Engineer with the profilograms and their evaluation within 2 working days after placement of the pavement.

Determine and evaluate the profile index (in./mi.) for each trace and the average profile index (in./mi.) for each section to identify required corrective action.

Determine the daily average profile index (in./mi.) for each day's paving operation. A day's paving operation is the pavement placed in a day (a minimum of 1 pavement section).

- If less than 1 pavement section is placed in a day, the day's production is grouped with the next day's production.
- If the production of the last day of project paving is less than 1 pavement section, it is grouped with the previous day's production.
- The Contractor has the option of profiling the final portion of a day's production (not to exceed 5 sections) the first working day that paving is continued in the same lane. If the Contractor opts to profilograph the final portion of a day's paving the next working day that paving is continued in the same lane, those results (the final portion of the previous day's paving) are grouped with the day's paving as the lane is continued.

Make the required corrections for pavement smoothness before making the pavement thickness determinations. Take the required corrective actions according to **TABLE 503-1**.

TABLE 503-1: PCCP SURFACE CORRECTIONS		
Pavement Surface Tolerances (in./mi.)		Required Corrective Action
Through Lanes Speed Limit Greater than 45 mph	**Acceleration Lanes[1] Deceleration Lanes[1] Ramps[1] Through Lanes Speed Limit 45 mph or Less**	
Profile Index per Section of 30 or less for an individual trace	Profile Index per Section of 40 or less for an individual trace	Correct all bumps and dips[2]
Profile Index per Section of greater than 30for an individual trace		Correct the Profile Index of each individual trace to 30 or less per section[3]
	Profile Index per Section of greater than 40 for an individual trace	Correct the Profile Index of each individual trace to 40 or less per section[3]
Daily Average Profile Index greater than 40	Daily Average Profile Index greater than 65	Suspend the paving operations until corrective actions are taken to improve the paving operations

[1]Acceleration/deceleration lanes include the taper. Acceleration lanes that become through lanes are limited to 500 feet from the noes of the ramp. Ramps are from the nose to the intersection of the adjoining road.
[2]Correct all areas within each section having high points (bumps) with deviations in excess of 0.3 inches in a length of 25 feet or less regardless of the profile index value.
[3] Contractor has the option to replace the section when the Profile Index per Section is greater than 65.

After the profilograph traces have been evaluated, make corrections according to **TABLE 503-2**.

TABLE 503-2: GRINDING REQUIREMENTS	
Condition	**Action***
Greater than 25% (132 feet) of the 0.1 mi. section requires correction	Continuously grind the entire 0.1 mi. section.**
Greater than 25% (1320 feet) of 1.0 mi. segment require correction	Continuously grind the entire 1.0 mi. segment, when the areas requiring correction are dispersed throughout the 1.0 mi. segment. If the areas requiring correction are isolated to 1/3 or ½ mi. within the 1.0 mi. segment, then only grind that 1/3 or ½ mi.

* Continuously grinding requires a minimum of 98% of the pavement be ground.
**If the skip length between areas to be ground (either within a 0.1 mi. section or between 0.1 mi. sections) is less than either grind length, combine the grinds so the area between is also ground. This additional ground area (area between) will apply to the computation of the 25% of the 0.1 mi. section.

If the Contractor elects or is required by **TABLE 503-2** to continuously grind the entire project, the following apply:

- the areas excluded in **subsection 503.3a.** are not required to be ground;
- at intersections constructed with multiple transitions for drainage (especially in urban areas), if smoothness meets **SECTION 503**, the intersection is not required to be ground; and
- when transitioning from a ground area to an unground area, feather the grinding a uniform distance throughout the project.

Grind and texture the entire surface of the pavement in the longitudinal direction. Provide positive lateral drainage by maintaining a constant cross slope between grinding passes in each lane.

Maintain a uniform transverse slope that matches the existing cross slope to the extent possible with no depressions or humps greater than 1/4 inch in 12 feet when tested with a string line or straightedge. Do not exceed by more than 1/16 inch the vertical alignment between adjacent passes of the cutting head. Begin and end grinding lines normal to the direction of vehicle travel. Grind the surface so corrugations are parallel to the pavement edge with ridges 1/16 inch, ±1/32 inch higher than the valleys of the corrugations.

Use the following methods for corrections:

- Diamond grinding or other profiling devices approved by the Engineer,
- Remove and replace the entire pavement thickness

Apply the corrective measure to the full lane width of the pavement. The corrected areas shall have uniform texture and appearance. The beginning and ending of the corrected areas shall be squared normal to centerline of the paved surface.

e. Profilograms. After pavement sections are corrected, re-profile the pavement surface to verify compliance with the specified pavement smoothness. Provide the Engineer with the profilograms and their evaluation within 2 working days after correcting the pavement surface.

The Engineer may perform profilograph testing on the pavement surface for monitoring and comparison purposes. If the Engineer determines that the Contractor's certified test results are inaccurate, the Engineer may choose to test the entire project length. The Engineer will charge the Contractor for such testing at the rate of $500 per mile per profile track, with a minimum charge of $1000. Providing inaccurate test results may result in de-certification of the Contractor's certified operator.

503.4 MEASUREMENT AND PAYMENT

Pay adjustments will be based on the initial average profile index determined for the "sections" prior to performing any corrective work, unless the surface of the entire project is continuously ground.

If the Contractor elects or is required by **TABLE 503-2** to continuously grind the entire project, pay adjustments will be based on the average profile index determined after all grinding is performed.

If the Contractor elects to remove and replace the sections, the Contractor will be paid the price adjustment that corresponds to the initial average profile index obtained on the pavement sections after replacement.

The Engineer will apply the contract price adjustment according to **TABLE 503-3.**

Payments made for "Concrete Pavement Smoothness" will be shown as an added item to the contract.

TABLE 503-3: CONCRETE PAVEMENT SMOOTHNESS PAY ADJUSTMENT NEW CONSTRUCTION

Average Profile Index (in./mi. per lane per 0.1 mi. section)	Contract Price Adjustment (per 0.1 mi. section per lane)
6.0 or less	+$1000.00
6.0 to 10.0	+$835.00
10.1 to 15.0	+$625.00
15.1 to 18.0	+$310.00
18.1 to 30.0	0.00
30.1 to 40.0	0.00*
40.1 or more	-$615.00*

***Correct to 30.0 inch/mile (40.0 in./mi. as noted in **TABLE 503-1**).

The pay adjustments in **TABLE 503-3** are for 12-inch thick hot mix asphalt and 8-inch thick portland cement concrete pavements. Pay adjustments for pavements of different thicknesses will be reduced or increased proportionally, based on the typical section for the extent. (i.e. pay adjustment for a 12-inch portland cement concrete pavement is equal to the adjustment from the TABLE multiplied by 1.5).

SECTION 504

DOWEL BAR RETROFIT-REPAIR NEW PCCP

504.1 DESCRIPTION

Cut slots normal to the transverse cracks and place epoxy-coated steel dowel bars to repair the newly constructed Portland Cement Concrete Pavement (PCCP) that is damaged. See Standard Drawing RD723, latest version.

504.2 MATERIALS

a. Epoxy-Coated Dowel Bars. Provide epoxy-coated steel dowel bars that comply with **DIVISION 1600**.

Provide a tight fitting nonmetallic expansion cap on one end of the dowel bars. The Engineer must approve the expansion cap before it is used.

Provide epoxy-coated or nonmetallic chair devices to support and hold the dowel bars. The Engineer must approve the chair devices before they are used.

b. Bondbreaker for Dowel Bars. Provide a bondbreaker that complies with **DIVISION 1700**.

c. Caulking Filler. Provide a silicone sealant caulking filler intended for filling cracks in PCCP. The Engineer must approve the caulking filler before it is used.

d. Board Filler. Provide a closed-cell foam core board filler (the width of the joint thick) faced with poster board material on each side. The Engineer must approve the board filler before it is used.

e. Grout. Provide a product that complies with **DIVISION 1700** and is prequalified as “very rapid hardening” when extended. The grout may be extended as the manufacturer recommends. The extender aggregate must be of size to allow complete distribution and consolidation around the bar. For practical purposes the maximum aggregate size should be no more than 1/2 the size of the distance between the dowel bar and the adjacent concrete pavement. All extender aggregate used on contracts must be from a source that has a current Official Quality approval status for Mixed Aggregate per **DIVISION 1100**.

f. Liquid Membrane-Forming Compound. Provide a liquid membrane-forming compound that complies with **DIVISION 1400**.

504.3 CONSTRUCTION REQUIREMENTS

Cut slots for the dowel bars into the PCCP as needed to repair the damaged PCCP. Use a gang saw capable of simultaneously cutting all the slots at one location (one wheel path). A single or dual blade saw may be used provided the production rate for sawing equals or exceeds 15 slots per hour. Hand saws are prohibited. Make the slots large enough to provide the minimum clearances shown in the Contract Documents. If necessary, make multiple parallel saw cuts to remove the existing concrete from the slot.

If jackhammers are used to break the concrete loose, do not use jackhammers larger than the nominal 15 pound class.

Sandblast and clean all surfaces of the slot. Sandblast and clean all cracks in the slot. Remove all broken concrete and debris from the project.

Fill the transverse crack in the bottom and sides of the slot with caulking filler. Prevent the caulking filler from contacting the surfaces outside the crack.

Before the dowel bar is placed in the slot, cut a piece of the board filler material to fit tightly around the dowel bar and against the bottom and sides of the slot. Place the board filler material vertically above the transverse crack in the bottom of the slot and prevent it from being displaced in the slot. Keep the board filler material in this position during placement of the grout.

Use chair devices to position and hold the dowel bars parallel (± 1/8 inch) to the pavement centerline and the pavement surface, and at the depth shown in the Contract Documents. Coat the dowel bars with an approved bondbreaker before the grout is placed.

Place and consolidate the grout as recommended by the manufacturer. Cure the surface of the grouted slots with a liquid membrane-forming compound.

The extended grout must obtain a minimum of 2000 psi compressive strength before the roadway can be opened to traffic, but no sooner than 2 hours. Provide data that accounts for actual temperatures work is being performed.

Saw the transverse joint through the patched areas within 24 hours of the placement of the grout. Saw and seal the joint as shown in the Contract Documents.

504.4 MEASUREMENT AND PAYMENT

This work is subsidiary to bid items in **DIVISIONS 501** and **502**.

SECTION 505

TIE BAR INSERTION-REPAIR NEW PCCP

505.1 DESCRIPTION

Drill holes and anchor deformed tie bar reinforcement diagonally across all longitudinal cracks and only those transverse cracks that extend partial depth, as determined through coring, to repair the newly constructed Portland Cement Concrete Pavement (PCCP) that is damaged. See Standard Drawing RD723, latest version.

505.2 MATERIALS

a. Tie Bars. Provide epoxy-coated (including the ends) deformed reinforcing steel bars, hereafter referred to as tie bars that comply with **SECTION 1600**.

b. Anchoring System. Use Type IV, Grade 1 - low viscosity Epoxy-Resin-Based Bonding System and the Class that complies with **SECTION 1700**.

505.3 CONSTRUCTION REQUIREMENTS

a. Equipment. Use hydraulic or handheld pneumatic or electric drills with tungsten carbide bits. Control the forward and reverse travel of the drills by mechanically applied pressure. Mount the drill on a suitable piece of equipment such that it is quickly transported and positioned. Rest and reference the drill rig frame on and to the pavement surface such that the drilled holes are cylindrical and repeatable in terms of position and alignment on the surface being drilled. Handheld drills may be used when they can be demonstrated to produce the same results as hydraulic drills with regard to drilling cylindrical holes and repeatable in terms of position and alignment. The Engineer may establish production rates for the hand-held drills.

b. General. Drill the holes in a slab at the offset, depth and angle shown in the Contract Documents.
Drill such that the:

- Centerline of the holes is perpendicular to the crack/joint (in plan view) at each location being drilled.
- Adjacent holes are drilled in opposite directions across the crack/joint.

Repair cracks and spalls that result from drilling with a partial or full-depth repair as directed by the Engineer.

Clean the drilled holes (and chipped areas at the surface resulting from drilling) in accordance with the anchoring material manufacturer's written recommendations. Submit recommendations to the Engineer before drilling any holes. As a minimum, clean holes with oil-free and moisture-free compressed air. The Engineer will check the compressed air stream purity with a clean white cloth. Use a compressor that delivers air at a minimum flow volume of 120 cubic feet per minute and develops a minimum nozzle pressure of 90 psi. Insert the nozzle to the back of the hole to force out all dust and debris.

Place the anchoring system material into the back of the hole using a nozzle or wand of sufficient length. Insert the tie bar such that the anchoring material is evenly distributed around the tie bar. Use an amount that slightly extrudes out the hole as the tie bar is inserted. Remove the excess and trowel the anchoring material smooth to the pavement surface, filling any chipped areas. Do not allow traffic on the repaired area until the anchoring material is cured as recommended by the manufacturer's specifications.

505.4 MEASUREMENT AND PAYMENT

This work is subsidiary to bid items in **DIVISIONS 501** and **502**.

SECTION 601

ASPHALT APPLICATION TEMPERATURES

601.1 DESCRIPTION

The application temperatures for the various type and grades of asphalts shall be within the ranges listed in **TABLE 601-1** or as specified on the asphalt producer's Bill of Lading.

TABLE 601-1: ASPHALT APPLICATION TEMPERATURES

TYPE AND GRADE	TEMPERATURE RANGE (ºF)			
	Spraying		Plant Mixing	
	Min.	Max.	Min.	Max.
Asphalt Binder	275	340	*	*
Asphalt Cement (AC-20-5TR)	325	350	NA	NA
Asphalt Cement (AC-20-XP)	325	350	NA	NA
Asphalt Cement (AC-10-2TR)	300	350	NA	NA
Asphalt Cement (AC-10-XP)	300	350	NA	NA
Cutback Asphalt, MC 30	88	125	88	125
Cutback Asphalt, MC & RC 70 &250	125	200	125	200
Cutback Asphalt, MC & RC 800 & 3000	150	250	150	250
Asphalt Rejuvenating Agent, ARA-1P	70	150	70	150
Emulsified Asphalt, CRS-1H, RS-1H, SS-1HP, CMS-1, MS-1, HFMS-1, RS-1HP, CRS-1HP	100	180	100	180
Emulsified Asphalt, SS-1H, CSS-1H	None	150	None	150
Emulsified Asphalt, CSS-1HM, CSS-Special	None	120	None	120
EBL	120	180	NA	NA

* Use the Producer's recommended mixing temperature range.

All asphalt binders and cutback asphalts reheated to temperatures 50ºF more than the maximum in **TABLE 601-1** will be considered overheated and may be rejected pending re-sampling and re-testing of the material at the discretion of the Engineer.

All emulsified asphalts reheated to temperatures above the maximum shown above will be considered overheated and may be rejected pending re-sampling and re-testing of the material at the discretion of the Engineer.

602 - HOT MIX ASPHALT (HMA) CONSTRUCTION
(Quality Control/Quality Assurance (QC/QA))

SECTION 602

HOT MIX ASPHALT (HMA) CONSTRUCTION
(Quality Control/Quality Assurance (QC/QA))

602.1 DESCRIPTION

Mix and place 1 or more courses of plant produced HMA mixture on a prepared surface as shown in the Contract Documents. Demonstrate quality control by providing the quality control testing.

BID ITEMS	UNITS
HMA Base (*)(**)(***)	Ton
HMA Surface (*)(**)(***)	Ton
HMA Overlay (*)(**)(***)	Ton
HMA Pavement (#) (##)	Square Yard
HMA Pavement (#) Shoulder	Square Yard
Emulsified Asphalt (****)	Ton
Asphalt Core (Set Price)	Each
Material for HMA Patching (Set Price)	Ton
Quality Control Testing (HMA)	Ton

*Mix Designation
**Grade of Asphalt Binder
***Shoulder
****Type and Grade of Emulsified Asphalt
Thickness
##Type of surface course HMA mixture

602.2 CONTRACTOR QUALITY CONTROL REQUIREMENTS

a. General. Provide qualified personnel and sufficient equipment complying with the requirements listed in Part V to conduct quality control testing that complies with Appendix B, Sampling and Testing Frequency Chart for Asphalt Construction Items for Quality Control/Quality Assurance Projects.

Allow the Engineer access to the Contractor's laboratory to observe testing procedures, calculations, test documentation and plotting of test results.

Calibrate and correlate the testing equipment with prescribed procedures, and conduct tests in compliance with specified testing procedures as listed in Part V.

Maintain a Quality Manual in the field laboratory showing the calibrations performed on all test equipment and when the next calibration is due for that equipment. As a minimum, follow the calibration/verification interval established in Table 2: HMA Materials Test Equipment in Section 5.2.7.1-HMA: Contractor's Quality Control Plan, Part V. See also, Section 5.2.7.3-Example of a Laboratory Quality Manual for HMA, Part V.

Store and retain the most recent 2 lots per mix designation of quality control samples for KDOT. KDOT will retain the most recent 2 lots per mix designation gyratory compacted air voids (Va) verification samples and the remaining material not previously used for testing (back half of sample). Do not retain more than the previous 3 lots per mix designation of quality control or verification samples. When the hot mix plant shuts down for the winter, discard the samples after 7 days.

b. Quality Control Plan (QCP). At the pre-construction conference, submit to the Engineer for approval, a QCP as outlined in Section 5.2.7-Contractor's Quality Control Plan, Part V. Follow 5.2.7.1-HMA: Contractor's Quality Control Plan in Part V as a general guideline. The Contractor's laboratory and equipment will be inspected and approved as outlined in Section 5.2.7-Contractor's Quality Control Plan, Part V.

Include a listing of the names and phone numbers of individuals and alternates responsible for quality control administration and inspection. On the Contractor's organizational chart, show the specified lines of authority relating both to mix design and quality control operations during production. Post the organizational chart in the Contractor's test facility.

Provide a quality control organization or private testing firm having personnel certified according to the Policy and Procedures Manual for The Certified Inspection and Testing (CIT) Training Program. The testing for this type of construction will require personnel certified in Aggregate Field Tester (AGF), Aggregate Lab Technician (AGL), Superpave Field (SF), Profilograph (PO) and Nuclear Moisture Density Gauge Tester (NUC) classifications. Provide a minimum of 1 employee on the project certified in the QC/QA Asphalt Specs (QCA) classification.

Only persons certified in the appropriate classifications covering the specific tests required shall perform such testing. At the beginning of the project, provide the Engineer with the list of certified technicians and alternates, phone numbers and tests/inspection they will be performing. As personnel changes and certifications may expire, continue to provide the Engineer with an accurate list.

Provide an organizational chart showing the specified lines of authority relating to both mix design and quality control operations during production. Identify the company official acting as liaison with KDOT, and the Certified Technician who will direct inspection and testing. Post the chart in the test facility.

c. Required Duties of Certified Technicians. Be available on the project site whenever HMA is being produced and being placed on the project site. Perform and utilize quality control tests and other quality control practices to assure that delivered materials and proportioning meet the requirements of the mix designs.

Periodically inspect all equipment utilized in transporting, proportioning, mixing, placing and compacting to assure it is operating properly and that placement and compaction comply with the contract requirements.

d. Contractor's Testing Facilities. Describe the testing facility and its accreditation in the QCP.

Locate the testing facility either at the plant site or at the project. Obtain approval of the testing facilities and location from the DME before the commencement of mixture production.

Provide suitable space for the required testing equipment. Also, equip the testing facility with these items for the exclusive use of the testing facility's quality control personnel and the Engineer:

A telephone with a private line for the exclusive use of the testing facility's quality control personnel; and

A copying machine for use by the Contractor's personnel and the Engineer.

Broadband internet connection (for 1 computer). If the Engineer determines that broadband internet service is not available, provide a fax machine, at no additional cost.

An air conditioner capable of maintaining a temperature below 77°F in the main part of the Field Office and Laboratory.

Locate the KDOT field laboratory near the Contractor's testing facility and have it fully functional 2 working days before placement of the pre-production mix.

e. Documentation. Include in the QCP procedures, charts and forms to be used to provide the required documentation.

Record all original documentation in a bound field book or other KDOT approved bound record and turn over to KDOT at the end of the project.

At all times, have complete records of all inspections and tests available on site for the Engineer. All records documenting the Contractor's quality control inspections and tests become the property of KDOT upon completion of the work.

Indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and the corrective action taken in the records. Examples of quality control forms and charts are available in Part V, or Contractors may design their own. Documentation procedures are subject to approval by the Engineer before the start of the work and to compliance checks during the progress of the work.

Maintain control charts on an ongoing basis.

Provide the following test data to the KDOT Project Representative:

- Copies of all test results and control charts on a weekly basis, representing the prior week's production;
- Copies of the quality control summary sheet on a daily basis. Include, as a minimum, mix gradation, binder content, theoretical maximum specific gravity (G_{mm}), air voids (V_a) at N_{des}, percent G_{mm} at N_{ini} and N_{max}, voids in mineral aggregate (VMA), voids filled with asphalt (VFA) and dust to effective binder content (D/B) ratio; and
- Copies of all failing test results (based on a moving average of 4 tests, when appropriate). Include all applicable sieves, VMA, VFA, density at N_{ini} and N_{max}, and D/B ratio.

f. Testing Requirements. In the QCP, identify test methods, procedures and equipment proposed for use. Use standard KDOT test methods and properly calibrated measuring and testing equipment as outlined in Part V.

Detail any alternative sampling method, procedure or inspection equipment proposed to be used. Such alternatives are subject to review and approval by the DME.

Take all samples for tests and perform in-place tests at random locations, selected according to the Contractor's QCP and at the rates specified in the Sampling and Testing Frequency Chart for Hot Mix Asphalt for Quality Control/Quality Assurance Projects in Appendix B, Part V.

g. Pre-Production Testing Requirements.

(1) The Engineer will observe the Contractor obtaining and splitting the pre-production test section sample into 3 representative portions. Each sample set shall consist of enough material for 2 gyratory specimens, theoretical G_{mm} and ignition burnoff.

(2) Mold 2 gyratory specimens from the 1st sample set immediately, while still hot. Additional heating may be required to raise the temperature of the sample to compaction temperature. Determine G_{mm}, perform ignition burnoff and complete calculations.

(3) Provide the KDOT Field Representative with the 2nd sample set. The KDOT Field Representative will mold 2 gyratory specimens, determine G_{mm}, perform ignition burnoff and complete calculations.

(4) Retain or provide the 3rd sample set to the KDOT District Materials Representative.

(5) The results of the testing will be compared. If Contractor and KDOT field laboratory test results do not compare favorably, the District Materials Laboratory will test their ⅓ of the sample. This sample will be transported to the District Materials Laboratory, after it has cooled to ambient air temperature. KDOT personnel will reheat the sample to compaction temperature, mold 2 gyratory specimens, determine G_{mm}, perform ignition burnoff and complete calculations. If the 3rd sample set is collected, transported while hot to the District Materials Laboratory and compacted in less than 2 hours, then, at the DME's discretion, the requirement to cool the sample may be waived.

If results are not acceptable to either party, repeat the above steps in **subsections 602.2g.(1)** through **(5)** for the Contractor's Field Laboratory, KDOT's Field Laboratory, and District Materials Laboratory until the issues may be resolved satisfactorily by all parties.

h. Lot 1 Testing Requirements.

(1) Sequence of Sampling. KDOT field personnel will determine the random truckload for the Contractor for sublots A, B, C and D, and the KDOT verification test.

The verification sample will be sampled and tested by KDOT field personnel. The verification sample shall be randomly taken within the lot and shall not be the same truckload as selected for the Contractor's sublot A, B, C or D.

KDOT field personnel will:

- provide the random spots to sample from behind the paving operations before compaction (KT-25);
- not supply the Contractor the identity of the truckload to be sampled ahead of time;
- notify the Contractor's laboratory of which truck to sample after the aggregate has left the cold feeds, and before the truck is finished loading; and
- determine whether the split sample will be taken from sublot A or B and notify the Contractor.

(2) Split Samples. The Contractor shall:

- obtain a sample large enough to split 3 ways for testing;
- retain and test ⅓ of the sample;
- supply ⅓ of the sample to the KDOT field laboratory for testing; and
- supply ⅓ of the sample to the KDOT District Materials Laboratory for testing.

(3) Results. At a minimum, compare G_{mm} and V_a results. The acceptable differences are 0.019 and 0.5%, respectively. If the results exceed these differences, take an additional split sample in Lot 1 from sublot C or D, as time permits.

If test results do not compare favorably, KDOT and the Contractor will investigate the differences in test results together and take appropriate action. The Contractor's test results will be used for quality control. KDOT Field Laboratory test results and District Materials Laboratory test results will be reported as "information only" samples.

i. Testing Requirements for Lots 2 and Greater.

(1) Take all samples for tests at random locations as designated in the approved QCP at the rates specified in Appendix B, Part V.

Provide the Engineer with the random locations before going to the roadway to determine density or sample the HMA. The Engineer reserves the right to generate the random locations. If the Engineer generates the random locations, the Contractor will be notified before going to the roadway to sample the HMA or determine density.

(2) Conduct the tests for mixture properties, aggregate gradation and binder content on representative portions of the HMA, quartered from the larger sample of HMA. Take a random sample weighing a minimum of 55 pounds from behind the paver and transport it to the test facility, using a method to retain heat to facilitate sample quartering procedures.

(3) Record and document all test results and calculations on data sheets provided by KDOT. Record specific test results on a daily summary sheet provided by KDOT to facilitate the computation of moving test averages. Base moving averages on 4 consecutive test results. Calculations are to be based on the precision displayed on the data sheets. Use "precision displayed" when calculating within Excel. Appendix B, Part V shows the accuracy to "record to" for the tests listed. Include a description of quality control actions taken (adjustment of cold feed percentages, changes in Job Mix Formulas (JMF), etc.) in the Daily Quality Control Summary Sheet. In addition, post and keep current quality control charts, showing both individual test results and moving average values. As a minimum, plot the single test values and the 4 test moving average values, as applicable, on KDOT approved control charts for the mix characteristics shown in **TABLE 602-12**.

(4) If the Contractor and Engineer agree, the procedures shown for sampling, testing and evaluation of Lot 1 in **subsection 602.2h.** may be used for any other Lot produced on the project.

g. Corrective Action. In the QCP, identify procedures for notifying the Engineer when corrective measures must be implemented, and for halting production.

h. Non-Conforming Materials. In the QCP, specifically address how non-conforming materials will be controlled and identified. Establish and maintain an effective and positive system for controlling non-complying material, including procedures for its identification, isolation and disposition. Reclaim or rework non-complying materials according to procedures acceptable to the Engineer. This could include removal and replacement of in-place pavement.

Positively identify all non-conforming materials and products to prevent use, shipment and intermingling with complying materials and products. Provide holding areas, mutually agreeable to the Engineer and Contractor.

602.3 MATERIALS

a. Asphalt Binder. Provide Asphalt Binder that complies with **DIVISION 1200**. Post a legible copy of the latest bill of lading for the Asphalt Binder on or near the gyratory compactor. Use the mixing and compaction temperatures shown on the bill of lading; however, the maximum mixing or compaction temperature is 340ºF, unless otherwise approved by the Field Materials Engineer. Notify the Engineer if the mixing or compaction temperature changes.

Exception: The mixing temperature may be increased no more than 10°F above the maximum mixing temperature shown on the bill of lading provided all the following are met:

- The air temperature is below 70°F.
- The plant has not produced mix earlier in the day.
- Do not exceed a mix temperature of 350°F.
- No truck has returned for its second load of the day.

Once a previously loaded truck returns for its next load, reduce the temperature to not higher than the maximum mix temperature shown on the bill of lading, not to exceed 340°F.

b. Reclaimed Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS). Provide RAP and RAS that comply with **SECTION 1103**.

c. Aggregates. Provide aggregates that comply with **SECTION 1103**.

d. Combined Aggregates. Provide combined aggregates for the mixes required in the Contract Documents as shown in **TABLE 602-1**.

Mixes may use any combination of aggregate and mineral filler supplements complying with the applicable requirements in **TABLES 1103-1** and **1103-2**.

Provide materials with less than 0.5% moisture in the final mixture.

The maximum quantity of crushed steel slag used in the mix is 50% of the total aggregate weight.

For all mixes used on the traveled way, the maximum quantity of natural sand is 35%.

Natural sand shall be called SSG-1, SSG-2, etc. in the mix design.

Additional requirements for SM-9.5T and SR-9.5T:

- Traveled way mixes shall include a minimum of 40% primary aggregate based on total aggregate weight;
- A minimum of 50% of the plus No. 4 mesh sieve material in the mixture shall be from the primary aggregate;
- A minimum of 45% of the plus No. 8 mesh sieve material in the mixture shall be from the primary aggregate; and
- Primary aggregates are designated as CS-1 (excluding limestone), CS-2 (excluding limestone), CG, CH-1 and CSSL as described in **subsection 1103.2a.(1)**. Primary aggregate requirements do not apply to the mixture used on the shoulder.

e. Contractor Trial Mix Design. A minimum of 10 working days before the start of HMA production, submit in writing to the DME for review and approval, a proposed JMF for each combination of aggregates. For each JMF submitted, include test data to demonstrate that mixtures complying with each proposed JMF shall have properties specified in **TABLE 602-1** for the designated mix type at the Recommended Percent Asphalt (P_{br}). Submit the proposed JMF on forms provided by KDOT. Submit the worksheets used in the design process to include at a minimum the mix properties listed in **TABLE 602-2**. Contact the DME to determine if additional information should be submitted. Provide sufficient material as identified in **TABLE 602-3**. Contact the DME to determine if additional material is needed for additional design checks such as the modified Lottman test (KT-56).

When more than 25% of the mix is comprised of siliceous virgin aggregates and/or RAP, add anti-strip to the mix. The minimum amount of anti-strip required in the mix is 0.01% for every percent of natural sand and RAP in the mix. Thus, if 25% natural sand and 10% RAP is in a mix, then 0.35% anti-strip by weight of virgin asphalt binder is required in the mix.

If during production, the Tensile Strength Ratio (TSR) values (both KDOT and Contractor) exceed 85%, then the Contractor and the DME, working together, may decide on a lower amount of anti-strip.

Submit for the Engineer's review and approval, the test data listed in **TABLE 602-4** for each blend and the proposed JMF. In addition, for mixes containing RAP or RAS, submit for the Engineer's review and approval, the test data listed in **TABLE 602-5** for each blend and the proposed JMF. Submit a mix design for each blend and the proposed JMF as outlined in **TABLE 602-6**.

For each aggregate used in the mix design, determine the specific gravity using KT-6. This may be accomplished while the project is being constructed or anytime during the 12 months preceding the start of construction on a project. If construction has not yet begun, notify the DME 5 working days prior to obtaining the material for the specific gravity test so that companion samples may be obtained at the same time. If construction has already begun on the project, then determine the specific gravity values of the individual aggregates before 10,000 tons of HMA is produced. Provide the test results to the DME within 14 days of sampling the material. If the producer of the aggregate has been required to submit material to KDOT for a new Official Quality test, since the time the Contractor ran the specific gravity tests, then perform KT-6 on the aggregate currently produced. Do not use the specific gravity values obtained from these tests in the mix design calculations for current projects, unless mutually agreeable to both parties. Use the information, as soon as it becomes available, as part of the process to verify and update the "Monthly Hot Mix Aggregate Specific Gravity Values" posted on KDOT's Internet site.

TABLE 602-1: COMBINED AGGREGATE REQUIREMENTS											
Nom. Max. Size Mix Designation	Percent Retained – Square Mesh Sieves									Min. VMA (%)	D/B Ratio
	1½"	1"	¾"	½"	⅜"	No. 4	No. 8	No. 16	No. 200		
SM-4.75A				0	0-5	0-10		40-70	88.0-94.0	16.0	0.9 – 2.0
SR-4.75A			0	0-2	0-5	0-10		40-70	88.0-94.0	16.0	0.9 – 2.0
SM-9.5A				0	0-10	10 min.	33-53		90.0-98.0	15.0	0.6 – 1.2
SR-9.5A			0	0-2	0-10	10 min.	33-53		90.0-98.0	15.0	0.6 – 1.2
SM-9.5B				0	0-10	10 min.	53-68		90.0-98.0	15.0	0.8 – 1.6
SR-9.5B			0	0-2	0-10	10 min.	53-68		90.0-98.0	15.0	0.8 – 1.6
SM-9.5T				0	0-10	10 min.	53-68		90.0-98.0	15.0	0.8 – 1.6
SR-9.5T			0	0-2	0-10	10 min.	53-68		90.0-98.0	15.0	0.8 – 1.6
SM-12.5A			0	0-10	10 min.		42-61		90.0-98.0	14.0	0.6 – 1.2
SR-12.5A		0	0-2	0-10	10 min.		42-61		90.0-98.0	14.0	0.6 – 1.2
SM-12.5B			0	0-10	10 min.		61-72		90.0-98.0	14.0	0.8 – 1.6
SR-12.5B		0	0-2	0-10	10 min.		61-72		90.0-98.0	14.0	0.8 – 1.6
SM-19A		0	0-10	10 min.			51-65		92.0-98.0	13.0	0.6 – 1.2
SR-19A	0	0-2	0-10	10 min.			51-65		92.0-98.0	13.0	0.6 – 1.2
SM-19B		0	0-10	10 min.			65-77		92.0-98.0	13.0	0.8 – 1.6
SR-19B	0	0-2	0-10	10 min.			65-77		92.0-98.0	13.0	0.8 – 1.6

1. The requirements for Coarse Aggregate Angularity (CAA); Fine Aggregate Angularity (FAA); Sand Equivalent (SE); Gyratory compaction revolutions N_{ini}, N_{des}, $N_{max,}$ N_{ini} level of compaction and VFA shall be as shown in the Contract Special Provisions for each mix designation.
2. The flat and elongated particles in the combined coarse aggregate shall not exceed 10% for the total sample.
3. The maximum percent moisture in the final mixture shall not exceed 0.5 for any mix designation.
4. The target air voids (V_a) for any mix designation shall be 4.0% at N_{des} gyrations.
5. The minimum tensile strength ratio (%TSR) shall be 80% for any mix designation.
6. The level of compaction of the mix when compacted to N_{ini} gyrations shall be less than the percent of the G_{mm} shown in the Contract Special Provision, and when compacted to N_{max} gyrations shall be a maximum of 98.0% of the G_{mm}.

TABLE 602-2: MIX PROPERTIES			
Property	**Abbreviation**	**Test Method**	**Additional Information**
Air Voids	V_a	KT-15 & KT-58	Calculated from G_{mm} and G_{mb}. Run at the P_{br}.
Recommended Percent Asphalt	P_{br}		Produce a mix with a V_a of 3.5% to 4.5%.
Theoretical Maximum Specific Gravity	G_{mm}	KT-39	Rice Test.
Percent Tensile Strength Ratio	%TSR	KT-56	Run test at P_{br} or at 0.3% to 0.5% less than P_{br}
Sand Equivalent	SE	KT-55	
Bulk Specific Gravity of HMA	G_{mb}	KT-15	Compacted Mix Property.
Percent G_{mm} at N_{ini} and N_{des} and N_{max}	$\%G_{mm}$ @ N_{ini} $\%G_{mm}$ @ N_{des} $\%G_{mm}$ @ N_{max}	KT-15	Use G_{mm} value from KT-39. Calculated from Gyratory Compaction height data, G_{mm}, and G_{mb}.
Voids in Mineral Aggregate	VMA	KT-15 & KT-6	Calculated from G_{mb}, G_{sb}, P_b.
Voids Filled with Asphalt	VFA		Calculated from VMA and V_a @ N_{des}.
Coarse Aggregate Angularity	CAA	KT-31	
Fine Aggregate Angularity	FAA	KT-50	

Formulas for calculations are in the Superpave Volumetric Mixture Design and Analysis Handbook.

TABLE 602-3: MATERIAL SUBMITTALS			
Submittal	**Quantity**	**Description**	**Additional Information**
Aggregate for KT-15	3 Samples	Sized for 6 inch Plugs	Comply with Job Mix Gradation.
Aggregate for KT-39	2 Samples	Sized for G_{mm} Testing	Comply with Job Mix Gradation.
Binder for KT-15	As Needed	Sized for 3 Plugs at P_{br}	
Binder for KT-39	As Needed	Sized for 2 G_{mm} Tests	
Each Aggregate for KT-6	As Needed	Specific Gravity Test	
Uncompacted HMA Sample	35 lbs	Cool sample to room temperature	If transported hot and compacted within 2 hours, then requirement to cool sample may be waived by the DME.
Gyratory Plugs at N_{max}	2 Plugs	Compacted at P_{br}	Compacted to N_{max}.

TABLE 602-4: TEST DATA SUBMITTALS	
Submittal	**Information**
Asphalt Binder	Source, Grade, Specific Gravity, Mixing and Compaction Temperature from the Producer of the asphalt binder.
Each Aggregate	Source and Producer, including Legal Description.
Gradation of Each Aggregate	Percentage Retained to nearest 1% (except nearest 0.1% for No. 200 sieve) Derive RAP gradation after residual binder is removed. Derive RAS gradation after residual binder is removed or from the Shingle Aggregate Gradation table in **SECTION 1103**.
Material Proportioning	Proportion of each material is shown in percentage of aggregate.
Composite Gradation	Based on Gradation of Each Aggregate and Material Proportioning.
Composite Gradation Plot	Plotted on KDOT Form 712 (0.45 power graph paper).
Asphalt Binder Added	Percentage to nearest 0.01% based on total weight of the mixture.
Aggregate	Percentage of flat and elongated particles in the coarse aggregate, CAA and FAA.
%TSR	Percent Tensile Strength Ratio of the Mixture (Modified Lottman Test).
Sand Equivalent	SE for the combined virgin aggregates.

TABLE 602-5: RAP AND RAS TEST DATA SUBMITTALS	
Submittal	**Information**
RAP and RAS	Source and location where RAP will be obtained. Source and location where RAS will be obtained.
RAP Aggregate	Bulk Specific Gravity (G_{sb}). Use the G_{sb} provided on the Contract Special Provision. If no value is provided, the Effective Specific Gravity (G_{se}) shall be calculated as shown in subsection 5.10.4, Part V and used as the G_{sb}.
RAS Aggregate	Bulk Specific Gravity (G_{sb}). The Effective Specific Gravity (G_{se}) shall be calculated as shown in subsection 5.10.4, Part V and used as the G_{sb}.
Asphalt Binder Content of RAP Asphalt Binder Content of RAS	Determined from ignition oven analysis using KT-57.
RAP G_{mm} RAS G_{mm}	Determined by KT-39.
Asphalt Binder Specific Gravity	Specific Gravity of the asphalt binder in the RAP and RAS (G_b) shall be set equal to 1.035.
Corrected Asphalt Binder Content of the total recycled mixture	Determined from ignition oven analysis using KT-57.

TABLE 602-6: MIX DESIGN TEST DATA SUBMITTALS	
Submittal	**Information**
Minimum of 2 Mix Designs	As a minimum, 1 mix design at the P_{br} and 1 mix design at 0.3% to 0.5% below the P_{br}
G_{mm}	Determined at each binder content.
Individual and Bulk Specific Gravity Tests	Provide results for a minimum of 2 specimens at each binder content.
Percent Air Voids	Provide % V_a in the mixture for each binder content when compacted to N_{ini}, N_{des} and N_{max} gyratory revolutions along with copies of the Gyratory graphs.
Percent VMA	Provide %VMA at each binder content. (Note: The Contractor is cautioned that plant produced material generally yields a mixture with less VMA than predicted by the design. In such case, the design VMA should be increased above the specified minimum accordingly.)
D/B Ratio	Calculate to the nearest 0.1% at each binder content.

f. Additives. Provide Warm Mix Asphalt (WMA) additives or processes that comply with **SECTION 1203**. The Contractor is permitted to use WMA, unless otherwise shown in the Contract Documents.

For mixes containing Warm Mix Asphalt (WMA) additives, submit for the Engineer's review and approval, the additive or process used, the recommended rate of application, and the temperature ranges for mixing and compaction.

Mixing temperature range is provided by the Asphalt Binder Supplier. When using WMA, the mixing temperature may be reduced no more than 30°F for WMA water foaming processes, and no more than 70°F for WMA chemical and organic additives. The minimum mixing temperature for WMA is 220°F.

602.4 CONSTRUCTION REQUIREMENTS

a. Plant Operation. Adjust all plant operations to operate continuously.

(1) Preparation of the Asphalt Binder. Heat the asphalt binder to within a range as specified in **SECTION 601**. When heating the asphalt binder to the specified temperature, avoid local overheating. At all times, provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. Asphalt binder received from the refinery at temperatures less than 375°F may be used as received, if the requirements regarding the reheating of asphalt binder in **SECTION 601** are met.

(a) Commingling of Asphalt Binders. Do not add or commingle asphalt binders from 2 or more sources into a storage tank. If this occurs, the contents of the storage tank are considered contaminated. Do not use the contents of the storage tank on the project, except as follows: It is permissible, at the Contractor's option, to thoroughly mix the contents of the tank and request sampling of the mixture. Submit the sample to the MRC for testing. Do not use the asphalt binder until approved, and when needed, a new mix design evaluation is completed.

(b) Asphalt Binder Sources. Before changing asphalt binder sources on a project, obtain approval from the DME. A new JMF may be required.

(c) Anti-Strip Additives. If liquid anti-strip additives are added at the Contractor's plant, install a "totalizer" to monitor the quantity of anti-strip additive being added. The Engineer may approve alternative methods for including anti-strip additives in a batch plant. If added at the plant, the anti-strip will be added in line with the asphalt binder as it is being transferred from the transit unit to the asphalt binder storage tank. Provide a method for the Engineer to monitor the percent of additive being added.

If hydrated lime is added, mix it in an approved pug mill to coat the combined aggregates. Moisten the combined virgin aggregate to a minimum of 3% above the saturated surface dry condition prior to, or during the addition of the hydrated lime.

(d) WMA Additives. If WMA additives are added at the Contractor's plant, install a "totalizer" to monitor the quantity of WMA additive being added. The Engineer may approve alternative methods for including chemical and organic WMA additives in a batch plant. If added at the plant, chemical and organic WMA additives will be added in line with the asphalt binder as it is being transferred from the transit unit to the asphalt binder storage tank. Provide a method for the Engineer to monitor the percent of additive being added.

(2) Preparation of Mineral Aggregate. When the mineral aggregate is composed of 2 or more ingredients, combine as shown in the approved JMF.

(a) Temperature Requirements. Dry the aggregate for the mixture and heat to a temperature to obtain an asphalt-aggregate mixture temperature immediately after mixing within the 75 to 150 second Saybolt viscosity range of the asphalt binder used. Obtain the temperature for this viscosity range from the MRC or the Asphalt Binder Producer. No mixing or compaction temperatures are to exceed 340ºF without approval from the Field Materials Engineer. The minimum temperature may be revised by the DME provided it is demonstrated that satisfactory results may be obtained at a lower temperature. In such event, deliver the HMA to the paver at a temperature sufficient to allow the material to be satisfactorily placed and compacted to the specified density and surface tolerance requirements.

(3) Preparation of HMA. Introduce asphalt binder into the prepared aggregate in the proportionate amount determined by the P_{br} in the JMF.

(a) Basis of Rejection. HMA will be rejected if the aggregate, as it is discharged from the drum or the pugmill, contains sufficient moisture to cause foaming of the mixture, or if the temperature of the aggregate is such that the asphalt-aggregate mixture temperature is outside the range specified in **SECTION 601**.

(b) Mixing Time. Operate drum mixers at a rate to provide uniform aggregate coating in a continuous operation. For batch and continuous type plants, the minimum wet mixing time is 40 seconds. In all cases, mix a sufficient time to produce a uniform mixture in which all the aggregate particles are thoroughly coated. On batch plants, begin the timing at the start of the asphalt binder introduction into the pugmill, and end upon the opening of the discharge gate. For continuous flow plants, mixing time in seconds shall equal:

[pugmill dead capacity in pounds] divided by [pugmill output in pounds per second].

(c) Manufacturer's Specifications. Operate all drying, pumping and mixing equipment within the limits specified by the manufacturer, unless it can be demonstrated to the satisfaction of the Engineer that such limits may be exceeded without detriment to the HMA.

(d) Batcher Operation. Coordinate HMA batchers (Gob Hoppers) with the plant production rate at all times so the hopper is more than ¾ full before the gates open, and the gates close before material can drop through the gob hopper directly into the surge bin, weigh hopper or truck.

(e) Wasted Material. Wasted material is not measured for pay.

If after an interruption of production, the drum-mixer contains cold, uncoated or otherwise unsuitable material, waste material through a diversion chute. In a continuous or batch plant drier, waste unsuitable material through the pugmill.

At the end of a production run, waste any segregated material in the cone of the storage bin.

(4) End of Day Quantities. At the end of each day of production provide the Engineer with a document signed by the Plant Foreman or the Project Manager listing the dry weight of each aggregate, mineral filler, RAP, and WMA chemical or organic additive; the tons of asphalt binder, the tons of anti-strip agent used for the project during the day, and the tons of water used in the WMA foaming process. The dry weight is the tons of the material less the water content.

b. Road Surface Preparation.

(1) Preparation of Earth Subgrade. When the HMA is placed on a prepared subgrade, and unless other subgrade preparation is called for in the Contract Documents, perform the following:

At all grade control points, such as existing pavements and bridges, excavate the subgrade according to the specified grades and lines, prior to any subgrade treatment. Prior to the delivery of materials for the base course, prepare the subgrade surface by sprinkling with water, lightly scarifying where necessary, and blading and rolling, until the proper crown is obtained. Disturb the originally compacted crust or top portion of the subgrade as little as possible.

Maintain the subgrade as prepared until it is covered with the base course. Repair any defects which may develop, at the Contractor's expense, to the satisfaction of the Engineer.

(2) Trimming of Subgrade (Untreated, Treated or Modified), Aggregate Base or Granular Sub-base for HMA Pavement. Before placing the subsequent layer of the pavement structure, trim the subgrade (untreated, treated or modified), aggregate base or granular subbase. Use an automated, electronically controlled machine that trims with a rotary cross-shaft trimmer to establish and control the line, grade and typical cross-section as shown in the Contract Documents. The Engineer may waive the use of automatically controlled equipment on areas of narrow width or

irregular dimensions. Operate all trimming equipment far enough in advance of the paving operation to allow ample opportunity to check the grade and make any needed corrections.

Prior to paving, construct ditches and drains to drain the highway effectively. Maintain the finished subgrade in a smooth and compacted condition to readily drain.

Do not place pavement upon a frozen or muddy subgrade.

(3) Preparation of an Existing Asphalt Pavement. Clean the surface to remove all foreign material and broom to remove dust. Excavate areas shown in the Contract Documents to be patched to a depth directed by the Engineer. Fill with HMA and compact.

(4) Preparation of an Existing Concrete or Brick Pavement. Clean all foreign material and broom to remove dust. Clean and fill cracks and joints, and construct surface leveling as shown in the Contract Documents.

(5) Tack Coat. Prior to placing the HMA, apply a tack coat to the existing surface, as shown in the Contract Documents. When warranted by weather conditions, the Engineer may authorize a change in the asphalt for tack coat. When such changes are made, the price per ton of material being used will be the unit price bid for the material designated in the contract plus or minus the difference in the invoice price per ton of the 2 materials at the refinery as determined at the time of application.

c. Weighing Operations. See **SECTION 109** for details regarding weighing operations.

d. Hauling Operations. Schedule operations to minimize hauling over a surface course.

Deliver HMA to the paver at a temperature sufficient to allow the material to be placed and compacted to the specified density and surface tolerance.

e. Paving Operations. Except when placing SM-4.75A, SM-9.5A or SR-9.5A asphalt mixtures, remix the material transferred from the hauling unit, prior to placement. Use equipment such as a mobile conveyor, material transfer device, shuttle buggy material transfer vehicle, material transfer paver or paver with remixer conveyor system. After starting the project with the equipment listed above, and after producing HMA pavement density within the limits specified in **TABLE 602-7**, the Engineer will consider other types of equipment or modifications to pavers that will produce less segregation. The use of equipment as noted above shall not relieve the Contractor of the responsibility to comply with **TABLE 602-7**. The Engineer will check the pavement for longitudinal streaks and other irregularities. Make every effort to prevent or correct any irregularities in the pavement, such as changing pavers or using different and additional equipment.

Do not raise (dump) the wings of the paver receiving hopper at any time during the paving operation. The Engineer may waive this requirement if it is determined that raising (dumping) the wings will not produce detrimental segregation. If segregation or irregularities in the pavement surface or density are noted, review the plant, hauling and paving operations and take corrective action. The recommendations made in KDOT's "Segregation Check Points" should reduce the segregation and irregularities to an acceptable level. Copies of KDOT's "Segregation Check Points" may be obtained from the KDOT District Office or Field Engineer.

Spread the HMA and finish to the specified crown and grade using an automatically controlled HMA paver. Operate the paver at a speed to provide a uniform rate of placement without undue interruption. At all times, keep the paver hopper sufficiently full to prevent non-uniform flow of the HMA to the augers and screed.

If the automatic grade control devices break down, the Engineer may allow the paver to operate to the close of the working day, provided the surface is satisfactory. Do not operate the paver without working automatic control devices upon another lift that was laid without automatic controls.

(1) Surface Quality. Spread the HMA without tearing the surface. Strike a finish that is smooth, free of segregation, true to cross section, uniform in density and texture and free from surface irregularities. If the pavement does not comply with all of these requirements, plant production and paving will be suspended until the deficiency is corrected.

The Engineer will check segregation and uniformity of density using methods outlined in Section 5.8.3 - Segregation Check Using the Nuclear Density Gauge, Part V. For shoulders with a plan width of less than or equal to 3 feet, and placed at the same time as the traveled way, do not take nuclear density readings on the shoulder nor within 1 foot of the shoulder unless the pavement section is uniform across the entire roadway. The acceptable criteria for density uniformity are in **TABLE 602-7**.

TABLE 602-7: SEGREGATION AND UNIFORMITY OF DENSITY CHECK		
Mix Designation	**Maximum Density Range (highest minus lowest)**	**Maximum Density Drop (average minus lowest)**
All	4.4 lbs./cu. ft.	2.2 lbs./cu. ft.

Whenever the results from 2 consecutive density profiles fail to comply with both of the requirements listed in **TABLE 602-7**, plant production and paving will be suspended. Follow the procedures listed in the Profile Evaluation Subsection of Section 5.8.3-Segregation Check Using the Nuclear Density Gauge, Part V until production may be resumed.

Joint density testing and the associated requirements listed below do not apply for HMA lift thicknesses less than or equal to 1 inch.

Evaluate the longitudinal joint density using methods outlined in Section 5.8.4-Joint Density Evaluation Using the Nuclear Density Gauge, Part V. Although it is the Contractor's responsibility to perform the joint density evaluation, the Engineer may make as many independent joint density verifications as deemed necessary at the random sample locations. The Engineer's results will be used for acceptance for joint density, whenever available. The acceptable criteria for joint density are in **TABLE 602-8**.

TABLE 602-8: JOINT DENSITY REQUIREMENTS	
Nuclear Gauge Readings	**Requirement**
Interior Density minus Joint Density	≤ 3.0 lbs./cu. ft.
OR	
Joint Density	≥ 90.00% of G_{mm}

If the results of 2 consecutive density profiles fail to comply with **TABLE 602-8**, the plant production and paving operations will be suspended. Follow the procedures listed in the Joint Evaluation Subsection of Section 5.8.4-Joint Density Evaluation Using the Nuclear Density Gauge, Part V, until production may be resumed.

(2) Leveling Courses. In general, spread leveling course mixtures by the method to produce the best results under prevailing conditions to secure a smooth base of uniform grade and cross section. The leveling course may be spread with a properly equipped paver or motor grader.

(3) Lift Thickness. Except for leveling courses or when shown otherwise in the Contract Documents, **TABLE 602-9** applies. The Engineer may adjust lift thickness to utilize the most efficient method of acquiring specified density and surface quality. The minimum lift thickness for any HMA mixture is 3 times the nominal maximum aggregate size, unless otherwise designated in the Contract Documents or approved by the Engineer.

TABLE 602-9: NOMINAL COMPACTED THICKNESS	
Lift	**Maximum Nominal Compacted Thickness**
Surface	2 inches
Base	4 inches

(4) Grade Control. Achieve grade control by use of 1 or more of the following grade reference devices. Approval of any of these devices will be based upon satisfactory performance.

(a) Traveling Stringline. Attach a traveling stringline or ski type attachment, a minimum length of 30 feet, to the paver and operate parallel with its line of travel.

(b) Reference Shoe. Attach a short reference shoe or joint matching device to the paver for control in matching surface grades along longitudinal joints.

(c) Erect Stringline. Use an erected stringline consisting of a tightly stretched wire or string offset from and parallel to the pavement edge on 1 or both sides. Erect the stringline parallel to the established pavement surface grade and support at intervals as necessary to maintain the established grade and alignment.

(d) Stringless Paving. Control line, grade and pavement cross-section as shown in the Contract Documents. Use electronic guidance systems that meet the requirements and tolerances listed in **SECTION 802**. Horizontal control is guided by GPS. Vertical control is guided by Total Stations. GPS will not be allowed for Vertical control.

When paving on a fresh subgrade that has not been trimmed by an automatically controlled machine, use an erected stringline or stringless paving to establish grade. Use either of these options on the first or second lift. When directed by the Engineer, use an erected stringline or stringless paving to match grade control points such as bridges.

(5) Compaction of Mixtures. Uniformly compact the HMA as soon after spreading and strike-off as possible without shoving or tearing. Use self-propelled rollers operated at speeds slow enough to avoid displacement of the HMA. Equipment and rolling procedures which result in excessive crushing of the aggregate are prohibited. Use a sufficient number and weight of rollers to compact the HMA to the required density, using a minimum of 2 rollers. See **subsections 602.4e.(6)** for exceptions to the minimum number of rollers. Perform final rolling with a steel roller unless otherwise specified. On the final pass, operate finishing, vibratory rollers in the static mode.

Coordinate the frequency, amplitude and forward speed of the vibratory roller to achieve satisfactory compaction without objectionable undulations. For HMA lifts with a compacted thickness less than 1¼ inch, operate vibratory rollers in the static mode.

Keep rollers in operation as necessary so all parts of the pavement receive substantially equal compaction at the proper time. The Engineer will suspend HMA delivery to the project at any time proper compaction is not being performed.

Remove, replace with suitable material and finish according to these specifications any mixture that becomes loose, broken, mixed with foreign material or which does not comply in all respects with the specifications.

(6) Density Requirements.

(a) For mixes with a specified thickness greater than or equal to 1 ½ inches:

For lots 1 and 2, control density as shown in **subsection 602.4e.(6)(b)**. Before beginning production, the Contractor has the option to accept the pay adjustment for density on both Lots 1 and 2, or only Lot 2. If the Contractor chooses to accept the pay adjustments for density on both Lots 1 and 2, or only Lot 2, control the density as shown in **subsections 602.4e.(6)(a)(i-ii)**. If the Contractor chooses to accept pay adjustment for density on Lot 1, the pay adjustment can not be rejected on Lot 2.

(i) HMA Overlay. For lots 3 and greater, the lot density requirements and appropriate density pay adjustment factors are shown in **subsection 602.9b.** as the percent of the G_{mm} value based on the average of the density tests. The standard lot size is 10 density tests. Smaller lot sizes may result as outlined in **TABLE 602-10**. Normally, the G_{mm} value used to calculate the density percentage is the average value of all G_{mm} tests conducted the same day the lot was placed and compacted. If less than 3 G_{mm} values were obtained that day, use the moving average value (last 4 tests prior to the end of the day). When starting a mix and less than 4 G_{mm} values have been determined, use the average value of those available at the end of each day.

(ii) HMA Surface, HMA Base and HMA Pavement. For lots 3 and greater, the lower specification limit (LSL) value for density is given in **subsection 602.9c.** along with the appropriate density pay adjustment factor equations. The LSL value is given as a percentage of G_{mm}. Lot density is determined using the measured density values for all sublots in a lot. The standard lot size is 10 density tests. Smaller lot sizes may result as outlined in **TABLE 602-10**. Normally, the G_{mm} value used to calculate the density percentage is the average value of all G_{mm} tests conducted the same day the lot was placed and compacted. If less than 3 G_{mm} values were obtained that day, use the moving average value (last 4 tests prior to the end of the day). When starting a mix and less than 4 G_{mm} values have been determined, use the average value of those available at the end of each day.

(b) For mixes with a specified thickness less than 1½ inches:

These mixes will not have a density pay adjustment. Control density using an approved rolling procedure with random nuclear gauge density determinations. Include a method for controlling density in the QCP.

Designate a "Compaction Foreman". This person shall control compaction procedures, review nuclear gauge results as they are obtained, adjust compaction procedures as needed to optimize compaction and report any changes in the compaction process and results of nuclear gauge testing to the Engineer. The compaction foreman may also be the nuclear gauge operator. The nuclear gauge operator shall continuously monitor compaction procedures. As a minimum, take 10 random nuclear gauge density determinations per day and report results to the Engineer. Throughout the day, nuclear gauge results shall be available for review by the Engineer. The compaction foreman shall document at a minimum of once every 2 hours that the approved rolling sequence is being followed. Documentation includes roller passes, the mat temperature at each pass, amplitude setting of rollers and roller speed. Provide the documentation to the Engineer.

Determine and periodically update an approved rolling procedure and periodically, as outlined in this section. As a minimum, evaluate the initial rolling procedure using 3 rollers. If the hot mix plant is operating at over 275 tons per hour, use a minimum of 4 rollers in the initial evaluation. Operate vibratory rollers according to **SECTION 151**. Evaluate HMA paver screed operation with the nuclear gauge at various vibration settings. For screed evaluation, take the nuclear gauge readings directly behind the screed and before rolling. The Compaction Foreman and Engineer will evaluate the densities obtained with the various roller combinations and screed settings to determine the initial approved rolling procedure.

Together, the Compaction Foreman and Engineer will determine when new rolling procedures are required. HMA production may be stopped by the Compaction Foreman or Engineer whenever rolling is not being performed according to the approved rolling procedure.

(c) For all lots, achieve the maximum density before the temperature of the HMA falls below 175°F. When using WMA, achieve the maximum density before the temperature of the WMA falls below 165°F. Do not crush the aggregate. When the mat temperature falls below 175°F or 165°F for WMA, roller marks may be removed from the mat with a self-propelled static steel roller.

TABLE 602-10: DAILY PRODUCTION VS NUMBER OF SUBLOTS AND TEST REQUIREMENTS

Daily Production (tons)	Number of Sublots	No. of Cores or Nuclear Density Tests**	No. of Verification Cores or Nuclear Density Tests**
0-599	3*	6*	3*
600-999	4*	8*	4*
1000 or more	5	10	5

*Minimum number for mixes with a specified thickness of 1½ inches or greater: The Contractor may choose to obtain the number required for 1000 or more tons. If the Contractor chooses to test 5 sublots (10 tests), KDOT will obtain 5 verification tests.

**For mixes with a specified thickness less than 1½ inch: Verification testing may be performed, but is not required. Additional testing may be performed by the Contractor. A minimum of 10 tests are required.

(7) Contact Surfaces. Coat contact surfaces of curbing, gutters, manholes and similar structures with a thin uniform coating of asphalt material. Place the HMA uniformly high near the contact surfaces so that after compaction it shall be approximately ¼ inch above the edge of such structures.

(8) Adjustment of Manholes (Set Price). When required, this work will be performed and paid for under **SECTION 816**.

(9) Construction Joints.

(a) Transverse Construction Joints. Use a method of making transverse construction joints to provide a thorough and continuous bond, provide an acceptable surface texture and meet density requirements. Do not vary the surface elevation more than 3/16 inch in 10 feet, when tested longitudinally across the joint. When required, repair the joints or paving operations will be suspended.

(b) Longitudinal Joints. Construct well bonded and sealed longitudinal joints to obtain maximum compaction at the joint. If deemed necessary by the Engineer to properly seal the joint, apply a light coat of asphalt emulsion or asphalt binder to the exposed edge before the joint is made.

Before placing the fresh HMA against a cut joint or against old pavement, spray or paint the contact surface with a thin uniform coat of asphalt emulsion or asphalt binder. Where a finishing machine is used, make the longitudinal joint by depositing a sufficient amount of HMA to form a smooth and tight joint.

Offset the longitudinal joint in successive courses by 6 to 12 inches. Comply with traffic lane edges for the width of the surface of top course placement.

(10) Shoulder Surfacing and Widening. When the placement width of shoulders or uniform width widenings is less than can be accomplished with a regular paver, spread each course with a mechanical spreading device.

(11) Rumble Strips. When designated, construct rumble strips according to the Contract Documents.

f. Maintenance of Traffic. Maintain traffic according to **DIVISION 800** and the following:

Maintain one-way traffic, and restrict traffic speeds to 20 miles per hour in the vicinity of workers, unless otherwise designated. Use pilot cars to lead traffic through the area of paving and rolling operations, and if directed, through a curing area. The use of flaggers is allowed through patching operations, unless the patching area or distance between flaggers exceeds ½ mile, in which case the use of a pilot car shall be required. On overlay projects with 2 lanes or more in each direction for traffic use, the Engineer may waive the pilot car requirements.

Station one flagger ahead of the application of the tack coat and one flagger ahead of the area being protected from traffic. Take adequate protection for traffic on side roads approaching the tack area.

g. Treatment of Adjacent Areas. Pave sideroads, entrances and turnouts for mailboxes as shown in the Contract Documents. Overlay all widening areas designated in the Contract Documents or ordered by the Engineer.

h. Pavement Smoothness. Evaluate pavement smoothness according to **SECTION 603** and the following:

TABLE 602-11: MAXIMUM VARIATION OF THE SURFACE

Length (feet)	Maximum Variation of the Surface (inches)
10	3/16
25	5/16

Correct all humps or depressions exceeding the specified tolerance by removing the defective work and overlaying with new material, or by other means approved by the Engineer. All necessary corrections are at the Contractor's expense.

602.5 PROCESS CONTROL

a. General. Establish gradation limits and proportions for each individual aggregate, mineral filler and RAP and RAS, when applicable. Specify the limits and proportions such that the material produced complies with the applicable requirements of the designated mix type. The Contractor is responsible for all process control operations including testing. At no time will KDOT's representative issue instructions to the Contractor or producer as to setting of dials, gauges, scales and meters. KDOT will collect and test verification samples and assurance samples and inspect the Contractor's quality control operations.

b. JMF Adjustments. Produce a mixture of uniform composition closely complying with approved design JMF to obtain the specified properties when compacted. If, during production, results from quality control tests demonstrate a need to make adjustments to the mix design, then make adjustments to the design JMF single point gradation and binder content to achieve the specified properties. The JMF adjustments shall produce a mix that complies with **TABLE 602-1** for the specified mix designation. When necessary, adjust on a sublot basis. Report the new JMF to KDOT's field representative and the DME before making such changes, and submit a new mix design for review and approval if required by the DME.

c. Specification Working Ranges. Establish acceptable limits for field test results by applying the tolerances shown in **TABLE 602-12** to the JMF or adjusted JMF for binder content. Establish acceptable limits for the other listed mix characteristics by applying the tolerances shown in **TABLE 602-12** to the requirements of **TABLE 602-1**.

TABLE 602-12: SPECIFICATION WORKING RANGES (QC/QA)				
Mix Characteristic	Tolerance from JMF			
	Single Test Value	Plot	4 Point Moving Average Value	Plot
Binder Content	±0.6%	*	±0.3%	*
Mix Characteristic	Tolerance for Specification Limits			
	Single Test Value	Plot	4 Point Moving Average Value	Plot
Gradation (applicable sieves in **TABLE 602-1**)	N/A	*	zero tolerance	*
Air Voids @ N_{des} gyrations	±2.0%	*	N/A	
Voids in Mineral Aggregate (VMA)	1.0% below min.	*	zero tolerance	*
Voids Filled with Asphalt (VFA)	N/A		zero tolerance	*
Course Aggregate Angularity (CAA)	zero tolerance		N/A	
Sand Equivalent (SE)	zero tolerance		N/A	
Fine Aggregate Uncompacted Voids (FAA)	zero tolerance		N/A	
%Tensile Strength Ratio (%TSR)	zero tolerance	*	N/A	
Density @ N_{ini} and N_{max}	N/A		zero tolerance	
Dust to Effective Binder (D/B) Ratio	zero tolerance	*	zero tolerance	*

* Plot data according to **subsection 106.4**.
For gradations, as a minimum, plot the No. 4, 8, 30 and 200 sieves.
Plot G_{mm} to third decimal point.
Indicate Job Mix Formula (JMF) and specification working range limits for single test results on the control charts using a green ink dotted line.
Indicate the specification working range limits for the 4-point moving average results with a green ink solid line.

d. Mixes with Reclaimed Asphalt Pavement (RAP). The intent of this section is to prevent more RAP going into a mix than is allowed in the Contract Documents. Totalizers are used to determine the %RAP in mix; however, this does not preclude the Engineer from using other methods for determining the %RAP in a mix.

Provide the Engineer with the totalizer readings at the end of each day of production. These shall include the final daily readings for the RAP, virgin aggregates and asphalt binder.

The %RAP will be checked a minimum of twice a day by the Engineer. Take the readings a minimum of 2 hours apart and a maximum of 6 hours apart. Do not take the readings within the first hour of start-up as adjustments to the plant are most frequent within this time frame.

Calculate RAP percentages using the plant totalizers for the virgin aggregates (AGG_v), and the RAP as follows:

Equation A: $$\%RAP = \frac{RAP * 100}{RAP + AGGv}$$

%RAP is the percent RAP in the total aggregates (Virgin and RAP) rounded to the nearest tenth.
RAP is the difference between the current and last reading of the RAP totalizer in tons.
AGG_v is the difference between the current and last reading of the Virgin Aggregate totalizer in tons.

%RAP is considered out of compliance when any of the following occurs:

- Any single test exceeds the maximum percentage allowed by specs by 3%.
- The 4-point moving average exceeds the maximum percentage allowed by specifications.

Actions to be taken if the %RAP is out of compliance:

- If any single test exceeds 3% of the maximum allowed %RAP stop production, perform the “0 check run” on the belts in the presence of the Engineer, and make adjustments to correct the discrepancy.
- If the 4-point moving average exceeds the maximum allowed %RAP three consecutive times, stop production, perform the “0 check run” on the belts in the presence of the Engineer, and make adjustments to correct the discrepancy.

- If the 4-point moving average exceeds the maximum allowed %RAP by more than 1% then the Contractor will be assessed the following penalty.

Equation B: $$\text{Contract Deduct} = \frac{BP * Q * (\%RAP_4 - \%RAP_{max})}{100}$$

Contract Deduct is the Dollar amount to be subtracted from the contract.
BP is the Bid Price of the mix.
Q is the Quantity, in tons, of material represented by the 4-point moving average. This value shall be based on the weigh tickets taken from the time of the 1st test of the 4-point moving average through the time of 4th test.
$\%RAP_4$ is the 4-point moving average of %RAP.
$\%RAP_{max}$ is the Maximum %RAP from the Project Special Provision.

Contract Deducts for RAP will be an item added to the contract.

Any time production is stopped due to non-compliant %RAP, restart the 4-point moving average provided the belt had the "0 check run" performed in the presence of the Engineer, and adjustments were made to the mix proportioning to correct previous discrepancies. The initial start-up at the beginning of each work day does not constitute a stop in production due to non-compliant %RAP.

If at any time the Contractor chooses to stop production in order to correct discrepancies in the mix proportioning concerning the %RAP, the most recent data (not to exceed 4 points) will be averaged. If the average exceeds the maximum allowed %RAP by more than 1% then a Contract Deduct will be assessed as calculated above with the following substitutions:

In the case where less than 4-points are available for the 4-point moving average, the most recent test is substituted for the 4th test, and the $\%RAP_4$ may be a single test, a 2-point moving average or a 3-point moving average.

e. Mixes with Reclaimed Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS). The intent of this section is to prevent more RAP and RAS going into a mix than is allowed in the Contract Documents. Totalizers are used to determine the %RAP and %RAS in a mix; however, this does not preclude the Engineer from using other methods for determining the %RAP and %RAS in a mix.

Provide the Engineer with the totalizer readings at the end of each day of production. These shall include the final daily readings for the RAP, RAS, virgin aggregates and asphalt binder.

The %RAP and %RAS will be checked a minimum of twice a day by the Engineer. Take the readings a minimum of 2 hours apart and a maximum of 6 hours apart. Do not take the readings within the first hour of start-up as adjustments to the plant are most frequent within this time frame.

Calculate RAP percentages using the plant totalizers for the virgin aggregates (AGG_v), RAP and the RAS as follows:

Equation C: $$\%RAP = \frac{RAP * 100}{RAP + RAS + AGGv}$$

%RAP is the percent RAP in the total aggregates (Virgin, RAP and RAS) rounded to the nearest tenth.
RAP is the difference between the current and last reading of the RAP totalizer in tons.
RAS is the difference between the current and last reading of the RAS totalizer in tons.
AGG_v is the difference between the current and last reading of the Virgin Aggregate totalizer in tons.

%RAP is considered out of compliance when any of the following occurs:

- Any single test exceeds 13%.
- The 4-point moving average exceeds 10%.

Actions to be taken if the %RAP is out of compliance:

- If any single test exceeds 13% stop production, perform the "0 check run" on the belts in the presence of the Engineer, and make adjustments to correct the discrepancy.

- If the 4-point moving average exceeds 10% three consecutive times, stop production, perform the "0 check run" on the belts in the presence of the Engineer, and make adjustments to correct the discrepancy.
- If the 4-point moving average exceeds 11% then the Contractor will be assessed the following penalty.

Equation D:

$$\text{Contract Deduct} = \frac{BP * Q * (\%RAP_4 - \%RAP_{max})}{100}$$

Contract Deduct is the Dollar amount to be subtracted from the contract.
BP is the Bid Price of the mix.
Q is the Quantity, in tons, of material represented by the 4-point moving average. This value shall be based on the weigh tickets taken from the time of the 1st test of the 4-point moving average through the time of 4th test.
$\%RAP_4$ is the 4-point moving average of %RAP.
$\%RAP_{max}$ is 10%.

Calculate RAS percentages using the plant totalizers for the virgin aggregates (AGG_v), RAP and the RAS as follows:

Equation E:

$$\%RAS = \frac{RAS * 100}{RAP + RAS + AGGv}$$

%RAS is the percent RAS in the total aggregates (Virgin, RAP and RAS) rounded to the nearest tenth.
RAP is the difference between the current and last reading of the RAP totalizer in tons.
RAS is the difference between the current and last reading of the RAS totalizer in tons.
AGG_v is the difference between the current and last reading of the Virgin Aggregate totalizer in tons.

%RAS is considered out of compliance when any of the following occurs:

- Any single test exceeds 6%.
- The 4-point moving average exceeds 5%.

Actions to be taken if the %RAS is out of compliance:

- If any single test exceeds 6% stop production, perform the "0 check run" on the belts in the presence of the Engineer, and make adjustments to correct the discrepancy.
- If the 4-point moving average exceeds 5% three consecutive times, stop production, perform the "0 check run" on the belts in the presence of the Engineer, and make adjustments to correct the discrepancy.
- If the 4-point moving average exceeds 6% then the Contractor will be assessed the following penalty.

Equation F:

$$\text{Contract Deduct} = \frac{BP * Q * 5 * (\%RAS_4 - \%RAS_{max})}{100}$$

Contract Deduct is the Dollar amount to be subtracted from the contract.
BP is the Bid Price of the mix.
Q is the Quantity, in tons, of material represented by the 4-point moving average. This value shall be based on the weigh tickets taken from the time of the 1st test of the 4-point moving average through the time of 4th test.
$\%RAS_4$ is the 4-point moving average of %RAS.
$\%RAS_{max}$ is 5%.

The deduct for RAP and RAS will each be paid for under a separate Contract Deduct bid item.

Any time production is stopped due to non-compliant %RAP or %RAS, restart the 4-point moving average provided the belt had the "0 check run" performed in the presence of the Engineer, and adjustments were made to the mix proportioning to correct previous discrepancies. The initial start-up at the beginning of each work day does not constitute a stop in production due to non-compliant %RAP or %RAS.

If at any time the Contractor chooses to stop production in order to correct discrepancies in the mix proportioning concerning the %RAP or %RAS, the most recent data (not to exceed 4 points) will be averaged. If the average exceeds the maximum allowed %RAP or %RAS by more than 1% then a Contract Deduct will be assessed as calculated above with the following substitutions:

In the case where less than 4-points are available for the 4-point moving average, the most recent test is substituted for the 4th test, and the moving average may be a single test, a 2-point moving average or a 3-point moving average.

602.6 COMPACTION TESTING

a. General. Make the density determination of the compacted mixture using test results on random samples selected by the Contractor or Engineer (see **subsection 602.2i.(1)**) from each lift placed. Select sites according to the approved QCP. Take the nuclear density tests or core samples before placement of the next lift and before opening to construction or public traffic, and no later than the next working day following the date of placement.

Exception to coring after any traffic on the overlay. Do not use this procedure more than twice on any one project or tied projects, unless approved by the Engineer. The Contractor may request re-evaluation by coring. (Testing and coring shall be subsidiary items.) When coring is requested, the follow these procedures for the lot under re-evaluation.

(1) Immediately prior to coring, determine nuclear gauge densities in the presence of the Engineer in the locations previously tested. The average nuclear gauge density after traffic will be determined. A Contractor density correction factor will be calculated as follows: the average nuclear gauge density after traffic minus the average nuclear gauge density before traffic. If the calculated Contractor density correction factor is a negative value, the Contractor’s density correction factor will be set equal to zero (normally the density correction factor will be a positive number).

(2) Immediately before coring, nuclear gauge densities will be determined by the Engineer in the presence of the Contractor in the locations previously tested. The average nuclear density after traffic will be determined. A KDOT density correction factor will be calculated as follows, the average nuclear gauge density after traffic minus the average nuclear gauge density before traffic. If the calculated KDOT density correction factor is a negative number, KDOT’s density correction factor will be set equal to zero.

(3) Determine the Traffic Density Correction Factor. It will be the larger of the Contractor’s density correction factor or KDOT’s density correction factor determined in **subsections 602.6a.(1)** and **(2)**.

(4) With the Engineer present, obtain 1 core from each of the Contractor and KDOT nuclear gauge locations. Mark each core as they are taken. Take the cores to KDOT’s field laboratory for drying and evaluation. Together, the Contractor and Engineer will determine the density of each core. Determine the corrected core density for each Contractor and KDOT core as follows: the core density minus the Traffic Density Correction Factor.

(5) Using the corrected Contractor core densities and the corrected KDOT core densities, the Engineer will re-evaluate this lot using the procedures outlined in **subsection 602.9**. Based on this re-evaluation, the Engineer will inform the Contractor of the lots disposition and density pay adjustment factor.

For shoulders with a plan width of less than or equal to 3 feet and placed at the same time as the traveled way, the density pay adjustment factors for the traveled way applies. Acceptance of or pay adjustment for density on all shoulders with a plan width greater than 3 feet and any shoulder not placed at the same time as the traveled way shall be according to **subsection 602.9**.

A lot consists of a day’s production for each lift placed and contains the number of density locations as outlined in **TABLE 602-11**. Base lot acceptance on 2 test results from each sublot unless the Engineer’s results (1 test per sublot) are used. V_a lots and density lots are normally of different sizes.

If the lane being placed is to be opened to traffic that day, the Engineer and the Contractor may predetermine the sublot size based on anticipated production. If actual production does not meet anticipated production, the sublot size will be adjusted. The number of tests shall be as outlined in **TABLE 602-11**.

The minimum number of density tests is as listed in **TABLE 602-11**. The Contractor has the option to take additional tests to provide 10 test results to determine payment. The density pay adjustment factors are computed using formulas in **subsection 602.9**. The density pay adjustment factors do not apply to sideroads, entrances, crossovers and other incidental surfacing.

b. Nuclear Density Tests (For mixes with a specified thickness of 1½ inches or greater.). Take 2 nuclear density tests at random within each sublot. The Engineer will take 1 random nuclear density verification test per sublot. Perform nuclear density testing to be used in the determination of the traveled way pay adjustment factors and control of shoulder density. Do not take nuclear gauge readings within 1 foot of a longitudinal joint or edge, nor within 20 feet of a transverse joint. For shoulders with a plan width of less than or equal to 3 feet, and placed at the same time as the traveled way, do not take nuclear density readings on the shoulder nor within 1 foot of the shoulder unless the pavement section is uniform across the entire roadway. Mark the outline of the nuclear gauge on the pavement at each location tested with a method of marking that shall last a minimum of 24 hours. Take the nuclear density test at the random location. Do not move the gauge from this location to maximize or minimize the density results. If the Contractor doubts the accuracy of any of the nuclear density test results, the pavement may be cored at the nuclear gauge test locations. If coring is chosen to determine the density for pay adjustment purposes, then all nuclear density test results representing the lot shall be voided and cores taken as prescribed in **subsection 602.6c**.

Take verification nuclear density tests, 1 per sublot, at random locations selected by the Engineer. Payment factors will be based on the Contractor's nuclear density test results, provided those results are validated by KDOT's nuclear density tests.

The Engineer will determine a calibration factor for the Contractor's nuclear density device at the same time as a calibration factor is determined for KDOT's device. The Contractor will be afforded the opportunity to observe the calibration procedure whether it is performed at the district laboratory or on the project site. The Engineer should provide calibration factors by the end of the working day following the date of collecting the cores. In cases where this is not possible, the Contractor and the Engineer may agree in advance to accept a zero pay adjustment for the concerned lots.

The Engineer and Contractor will compare nuclear density test results before any traffic is allowed on the roadway. If the Contractor or KDOT density values are suspect, the Engineer may approve re-testing the locations in question. When re-testing is approved, substitute the new nuclear density values for the values in question. Before traffic is allowed on the roadway, the Contractor needs to determine if cores will be taken.

c. Cores (For mixes with a specified thickness of 1½ inches or greater.) Take 2 cores at random locations within each sublot. It may be necessary to chill the compacted mixture before coring so that the samples may be removed intact without distortion. Cut the samples using a 4-inch coring device, unless a 6-inch coring device is approved by the Engineer. Mark all samples with the lot number, sublot number and core number.

Transport the cores to the laboratory as soon as possible to prevent damage due to improper handling or exposure to heat. Cut all cores including the Engineer's verification cores. The Contractor will be paid only for cores cut to calibrate the nuclear gauge, when requested by the Engineer. Use KT-15 Procedure III to determine core density.

Do not take cores within 1 foot of a longitudinal joint or edge, nor within 20 feet of a transverse joint. For shoulders with a plan width of less than or equal to 3 feet, and placed at the same time as the traveled way, do not take cores on the shoulder nor within 1 foot of the shoulder unless the pavement section is uniform across the entire roadway.

Take 1 verification core per sublot (at locations selected by the Engineer) for testing at KDOT's laboratory. Density pay adjustment factors and control of shoulder density are based on the core results, provided those results are validated by the verification cores sent to KDOT's laboratory.

Dry the core holes, tack the sides and bottom, fill with the same type of material and properly compact it by the next working day.

602.7 WEATHER LIMITATIONS

Do not place HMA on any wet or frozen surface or when weather conditions otherwise prevent the proper handling and finishing of the mixture.

Only place HMA when either the minimum ambient air temperature or the road surface temperature shown in **TABLE 602-13** is met.

TABLE 602-13: MINIMUM HMA PLACEMENT TEMPERATURES							
Paving Course	**Thickness (inches)**	**Air Temperature (ºF)**			**Surface Temperature (ºF)**		
		HMA	**WMA Foam**	**WMA Chem**	**HMA**	**WMA Foam**	**WMA Chem**
Surface	All	50	45	40	55	50	45
Subsurface	<1.5	50	45	40	55	50	45
Subsurface	≥1.5 and < 3	40	35	30	45	40	35
Subsurface	≥ 3	30	30	30	35	32	32

602.8 MIXTURE ACCEPTANCE

a. General. Test each mix designation at each plant for compliance with **TABLE 602-1**. Acceptance will be made on a lot by lot basis contingent upon satisfactory test results. Obtain test samples of the mix designation from the roadway behind the paving operation before compaction. The sampling device and procedures used to obtain the samples must be approved by the Engineer. Use KT-25 for obtaining HMA from the roadway and splitting of the sample. The Contractor's quality control tests will be used for acceptance provided those results are verified by KDOT.

A load or loads of mixture which, in the opinion of the Engineer, are unacceptable for reasons such as being segregated, aggregate being improperly coated, foaming aggregate or being outside the mixing temperature range may be rejected. Verification samples will be taken by the Engineer at randomly selected locations from behind the paver. Fill all sample locations before compaction.

The V_a test values will also be used to determine V_a pay adjustments according to **subsection 602.9d**. V_a pay adjustments apply to the HMA placed on the traveled way and shoulders (including ramps and acceleration and deceleration lanes).

b. Lot Definition for Mix Production Sampling and Testing. A lot is defined as an isolated quantity of a specified material produced from a single source or operation. Each lot shall normally be represented by 4 contiguous test results. A lot may be represented by test results on samples taken from 1 or more day's production.

c. Lot Investigation. The Engineer may examine materials represented by individual test results which lie beyond the Contractor's normal quality control testing variation. The investigation may be based on either Contractor or KDOT test results. The information from additional testing (including testing of in-place HMA) may be used to define unacceptable work according to **SECTION 105**. The Engineer may apply appropriate price reductions or initiate corrective action.

For any test, if a dispute exists between the Engineer and Contractor about the validity of the other's test results, the KDOT District Materials Laboratory or the MRC will perform referee testing, except for nuclear density dispute resolution and V_a dispute resolution. If the disputed KDOT test results were generated at the District Laboratory, the MRC will perform the referee tests. If the disputed KDOT test result was generated at the MRC, an independent laboratory agreeable to both parties will be selected. The Laboratory shall be accredited by the AASHTO Accreditation Program in the appropriate testing category.

If referee testing indicates that KDOT test results are correct, the Contractor pays for the additional testing, including referee testing performed at the MRC. This will be paid using the bid item Contract Deduct which will be an item added to the contract.

If the referee testing indicates that Contractor test results are correct, KDOT pays for the additional testing. Pay the independent lab for the testing and submit the paid invoice to KDOT. The Engineer will reimburse the Contractor (based on the invoice price) as Extra Work, **SECTION 104**.

(1) For nuclear density dispute resolution (the statistical comparison fails and the Contractor questions KDOT's results), the following procedure applies:

- Discard pay factors previously established with the nuclear gauge, and use the core results to establish the pay factors.
- With the Engineer present, take 1 core from each of the locations previously tested with the Contractor's nuclear gauge and KDOT's nuclear gauge (normally 15 cores). Mark all cores with the lot number, sublot number and core number.

- Take the cores to the field laboratory and dry to a constant weight before testing. The Contractor and the Engineer, working together, will determine the core densities (KT-15, Procedure III).
- A statistical comparison will be made between Contractor and KDOT core results. If the t-test passes, KDOT will pay for all cores. The Contractor's test results will be used to calculate the density pay factors. If the t-test fails, KDOT will not pay for the cores. KDOT test results will be used to calculate the density pay factors.

(2) For V_a dispute resolution (the statistical comparison fails and the Contractor questions KDOT results), the following procedure applies for the lots in question:

- Determine which lots to dispute. Only dispute the lot produced immediately prior to the lot currently under production and being tested. Notify the Engineer, prior to the completion of all Contractor V_a testing for this lot. (When production is completed for any mix, the last lot may be challenged the day production is completed). When the hot mix plant shuts down for the winter, the Contractor has a maximum of 7 calendar days to dispute the last lot produced prior to winter shut down.
- Discard V_a and V_a pay adjustment factors previously determined within the lots being questioned.
- All saved gyratory compacted V_a quality control and verification samples and back half of samples within the lots in question will be taken by KDOT to the District Materials Laboratory. All back half of samples shall be a minimum of 35 pounds. Failing to obtain enough material removes the right to dispute resolution. Copies of all paperwork, including work sheets, associated with previous V_a calculations for the disputed lots will also be taken to the District Materials Laboratory.

The following retesting will be completed by KDOT:

- Check the samples to be sure they are dry before retesting. Reweigh the original gyratory compacted V_a quality control and verification samples. Determine the G_{mb} at N_{des} revolutions for all saved gyratory plugs. Compare retest results with original test results. Use this information to isolate potential testing errors, but continue with the remainder of the retesting steps.
- Determine the G_{mm} using the back half of all samples within each lot being questioned. Normally, there will be 5 back halves (4 Contractor's and 1 KDOT) to test within each lot.
- Compact the back halves to N_{max} revolutions and determine the G_{mb} at N_{des} revolutions.
- Use G_{mm} determined above and the G_{mb} determined from the recompacted samples to calculate V_a at N_{des} revolutions for the lots in question.
- Using the retest V_a results, a statistical comparison will be made. If the t-test passes, the Contractor's retest results will be used to calculate the pay factor and KDOT will pay for all retesting. Use the procedures shown in **subsection 602.9d**. If the t-test fails, KDOT's retest results will be used to calculate the pay factor, and the Contractor will pay for all retesting.

d. Resampling of Lots. Take no samples for retest for pay adjustment purposes except as noted in **subsections 602.6b.** and **602.8c**.

e. Multiple Projects. If multiple projects are supplied from 1 or more plants using the same mix, carry over the lots at each hot mix plant from project to project.

f. Lot Size. A standard size mix production lot (density test lots are defined in **subsection 602.6a.(5)**) consists of 4 equal sublots of 750 tons each of HMA (lot size is 3,000 tons).

It is anticipated that lot size shall be as specified. However, with the Engineer's approval, the Contractor may re-define lot size for reasons such as, but not limited to, change in contract quantities or interruption of the work. Take 1 sample during production of each sublot and utilize it to determine disposition of the lot in which it occurs.

g. Increased Lot Size. After 8 consecutive sublots have been produced within the tolerance shown for all mix characteristics listed in **TABLE 602-12** and without a V_a penalty, the sublot size may be increased to 1,000 tons (lot size of 4,000 tons), provided the normal production rate of the plant is greater than 250 tons per hour. Provide immediate notification of lot size changes to the Engineer any time a change is made.

After 8 additional consecutive sublots have been produced at the 1,000 ton sublot size, the sublot size may again be increased to 1,250 tons per sublot (lot size of 5,000 tons), provided all 8 consecutive 1,000 ton sublots have been produced within the tolerances shown for all mix characteristics listed in **TABLE 602-12**, without a V_a

penalty, production rates for the previous 2 days have been greater than 3,750 tons per day, and a minimum of 2 of the last 3 segregation profile checks comply with **TABLE 602-14**.

TABLE 602-14: SEGREGATION PROFILE CHECKS FOR INCREASED SUBLOT SIZE		
Mix Designation	**Maximum Density Range (highest minus lowest)**	**Maximum Density Drop (average minus lowest)**
All	3.1 lbs./cu. ft.	1.9 lbs./cu. ft.

If subsequent test results fall outside the tolerances shown for any mix characteristic listed in **TABLE 602-12** or a V_a penalty is incurred, decrease the sublot size to 750 tons. If the production rates fall below 3,750 tons per day for 2 consecutive days or a minimum of 2 of the last 3 segregation profile checks fail the above requirements, then reduce the 1,250 ton sublots size to 1,000 ton per sublot provided the **TABLE 602-12** criteria is met and no V_a penalty is incurred.

When the increased lot size criteria are again met for 4 consecutive sublots, the sublot may be increased as the limits given above.

h. Decreased Lot Size for Small Quantities. This is to be used when a small quantity (less than 3,000 tons) of a particular mix will be used. Use the plan quantity for the lot size. Reduce the sublot size below 750 tons by dividing the lot into 3 or 4 equal sublots. Before beginning production, provide the Engineer with the number and size of the sublots.

i. Pre-Production Mix. Test and evaluate a pre-production mix, limited to a maximum of 200 tons from each plant and type of mix before production of that mix. Evaluate the pre-production mix at initial start-up and after suspension of production resulting from failing test results. Do not adjust V_a payment for pre-production mixes. Provide a pre-production mix that complies with the gradation, D/B ratio, binder content, VMA, level of compaction for N_{ini}, N_{des}, N_{max} and laboratory V_a requirements prior to starting or resuming production. For binder content, V_a at N_{des} and VMA, use the "Single Test Value" listed in **TABLE 602-12** for comparison. For the other tests listed, use the values listed in **TABLE 602-1** for each mix. Except for initial start-up, normal delivery of material to the project before completion of certain test results on pre-production mixes may be authorized by the DME.

Place the material produced for the pre-production mix in locations approved by the DME. On projects where HMA is paid by the ton, consider placing the pre-production mix in non-critical areas such as side roads, entrances, shoulders or deep in the base. The Engineer will pay for material as the material produced, not in the location placed. However to prevent potential cost overruns, do not run an excessive number of “higher cost” pre-production mixes (as determined by the Engineer) on shoulders or entrances.

On projects in which the HMA is paid by the square yard, place pre-production mixes where required by the Contract Documents. A higher quality pre-production mix may be placed at no additional expense to KDOT. If HMA materials which are designated to be placed in the top 4 inches of the pavement structure are placed deeper than 4 inches as a pre-production mix, do not count the material toward the requirement to place the material in the top 4 inches of the pavement section.

At the direction of the Engineer, remove the pre-production mix if it is both out of specification and the material shortens the pavement life or changes the intended function. The Engineer will pay for the replacement of one pre-production mix at 100% of the contract unit price for each mix in the contract (not each mix design). If the HMA is paid by the square yard, then the removed material will be paid for at a rate of $40 per ton. The Engineer will create a change order (**SECTION 104**) adding the item of work with a unit price of $40/ton. The payment will be full compensation to the Contractor for the placement and removal of that pre-production mix. KDOT will not be financially responsible for any subsequent failed pre-production mixes (that require removal) for that mix. The removed material is the property of the Contractor.

The Engineer will not pay for pre-production mixes that are required to be replaced due to poor workmanship or equipment failure. The Engineer will make the final decision to remove a failed pre-production mix with input from the Contractor.

j. Suspension of Mix Production. Suspend production of the mix until appropriate corrections have been made, if 2 consecutive test results for any single mix characteristic fail to fall within the limits established by the tolerances shown in the single test value column of **TABLE 602-12**. Additionally, suspend production of the mix until appropriate corrections have been made, if any 4-point moving average value for any single mix characteristic fails to fall within the limits established by the tolerances shown in the 4-point moving average value column of **TABLE 602-12**. Production remains suspended pending the satisfactory results of a pre-production mix, unless waived by the DME.

The Engineer may stop production of HMA at any time the mix or process is determined to be unsatisfactory. Make the necessary corrections before production will be allowed to resume. Failure to stop production of HMA subjects all subsequent material to rejection by the Engineer, or acceptance at a reduced price, as determined by the Engineer.

602.9 BASIS OF ACCEPTANCE

a. General. Acceptance of the mixture will be contingent upon test results from both the Contractor and KDOT. The Engineer will routinely compare the variances (F-test) and the means (t-test) of the verification test results with the quality control test results for V_a, G_{mm} and density using a spreadsheet provided by KDOT. If KDOT verification test results do not show favorable comparison with the Contractor's quality control test results, then KDOT test results will be used for material acceptance, material rejection and the determination of any pay adjustment on the V_a and roadway density. Disputed test results will be handled according to **subsection 602.8c**.

KDOT will use a spreadsheet program to calculate pay adjustments for density and V_a, and to compare Contractor QC and KDOT QA test results (including G_{mm}). KDOT will provide a copy of this program to the Contractor, when requested. Microsoft Excel software is required to run this program; it is the Contractor's responsibility to obtain the correct software. Values computed using equations referenced in this specification may vary slightly from the spreadsheet values due to rounding of numbers. In such cases, the numbers computed by the spreadsheet will govern.

The comparison of quality control and verification tests will be completed using the t-tests to compare their population means and the F-test to compare their variances. The F & t tests, along with the Excel Spreadsheet used to compare the Contractor's QC results and KDOT's QA results, are described in Section 5.2.6 – Comparison of Quality Control and Verification Tests, Part V. (Examples of Air Voids F & t tests, along with Density F & t tests are shown in this section.) Additional information on the program may be obtained from the Bureau of Construction and Materials.

b. Asphalt Density Pay Adjustment for "HMA Overlay" Bid Items. Mixes with specified thickness of less than 1½ inches are not subject to the asphalt density pay adjustments.

For mixes with specified thickness of 1½ inches or greater: Asphalt density pay adjustment for compaction of the completed pavement shall be by lot, based on the percentage of G_{mm} obtained. Compute the asphalt density pay adjustment (incentive or disincentive) by multiplying the density pay adjustment factor (P_D) times the number of tons included in the lot times $40 per ton. (Air voids lots and density lots are normally of different sizes.) This adjustment will be paid for under the bid item Asphalt Density Pay Adjustment.

Density pay factors will be determined from **TABLE 602-15**. (For **TABLE 602-15**, average the percent of G_{mm} values to 0.01% and calculate the density pay adjustment factors rounded to the thousandths).

TABLE 602-15: DENSITY PAY FACTORS FOR SPECIFIED THICKNESS[4]			
Specified Thickness →	**≥ 2"**	**≥ 1½"**	
	All	**Continuous Action[5]**	**No Continuous Action[6]**
% of G_{mm} Average of 10 Density Tests[1]	**Pay Factor[2]**		**Pay Factor[2]**
93.0% or greater	1.040		1.040
92.0 to 92.9%	A1		A1
91.0 to 91.9%	1.000		1.000
90.0 to 90.9%	A2		1.000
89.0 to 89.9%	0.840 or Remove[3]		A3
less than 89.0%	0.840 or Remove[3]		0.840 or Remove[3]

[1]For low daily production rates less than 1000 tons, or when the Engineer's verification tests are to be used for asphalt density pay determination, the lot sample size is as determined in **TABLE 602-11**.

[2]Shoulders: For shoulders with a plan width greater than 3 feet and any shoulder not placed at the same time as the traveled way, compact the HMA in the lot to a minimum of 90.00% (if specified thickness is ≥2") or 89.00% (if the specified thickness is from 1½" to 1⅞") of the G_{mm}. Otherwise, the Engineer will determine whether the HMA in the lot may remain in place or be removed. Any such material left in place shall have a density pay factor of 0.950 or less.
[3]Low Density: The Engineer will determine if the traveled way, shoulders with a plan width of 3 feet or less and placed with the traveled way, ramps, acceleration and deceleration lanes may remain in place or be removed. The Engineer will notify the Contractor before 11:00 AM of the next working day if the area is to be removed. Any such material left in place shall have a density pay factor of 0.840.
[4]Specified thickness is the total thickness shown in the Contract Documents for the mix being placed.
[5]Use for ≥1½" when another continuous action, such as milling, surface recycling, cold recycling or overlay is completed ahead of this overlay.
[6]Use for ≥1½" when another continuous action is not completed before the overlay.

Calculations for Density Pay Factors A1, A2 and A3:

A1 = [100 + 4 (% of lot G_{mm} - 92.00)] ÷ 100
A2 = [84 + 16 (% of lot G_{mm} - 90.00)] ÷ 100
A3 = [84 + 16 (% of lot G_{mm} - 89.00)] ÷ 100

Density Pay Adjustment Factor Calculation:

Density Pay Adjustment Factor (P_D)* = Density Pay Factor - 1.000
*P_D rounded to the nearest thousandth

c. Asphalt Density Pay Adjustment for "HMA Surface", "HMA Base" and "HMA Pavement" Bid Items. Asphalt Density Pay Adjustment for compaction of the completed pavement shall be by lot, based on the percentage of G_{mm} obtained. This adjustment will be paid for under the bid item Asphalt Density Pay Adjustment. Compute the Asphalt Density Pay Adjustment (positive or negative) by multiplying the Density Pay Adjustment factor ($\boldsymbol{P_D}$) times the number of tons included in the lot times $40 per ton. The Asphalt Density Pay Adjustment will be added or subtracted on the pay estimate. For shoulders with a plan width of less than or equal to 3 feet, and placed at the same time as the traveled way, the $\boldsymbol{P_D}$ for the traveled way will apply. The $\boldsymbol{P_D}$ does not apply to sideroads, entrances, crossovers and other incidental surfacing. Use KDOT test results for the lot to determine the $\boldsymbol{P_D}$ when the statistical comparison between the quality control and the verification tests fail (see **subsection 602.9a.**).

Lot Size: A lot shall normally be comprised of the results of 10 tests performed on a day's placement of a given mix placed in a given lift. Lot size is defined in **subsection 602.6**. (Air void lots and density lots are normally of different sizes).

Shoulders: For all shoulders with a plan width greater than 3 feet and any shoulder not placed at the same time as the traveled way, the lower specification limit (LSL) is 90.00%. When the lower percent within limits ($\boldsymbol{PWL_{LD}}$) is 50.00% or more for the lot, $\boldsymbol{P_D}$ is zero. When the $\boldsymbol{PWL_{LD}}$ is less than 50.00% for the lot, the Engineer will determine whether the HMA in the lot may remain in place or be removed. Any such material left in place will have a $\boldsymbol{P_D}$ of -0.050, unless the Engineer establishes lower values for $\boldsymbol{P_D}$ (-0.100, -0.200, -0.300, etc.) as a condition of leaving the material in place.

Determination of $\boldsymbol{P_D}$ and $\boldsymbol{PWL_{LD}}$: Calculate the lower density quality index ($\boldsymbol{Q_{LD}}$) for each lot using Equation 1 and round to hundredths. Locate the $\boldsymbol{Q_{LD}}$ value in the left column of the Percent Within Limits (PWL) Table in Section 5.2.1 - Statistics, Part V. Select the appropriate $\boldsymbol{PWL_{LD}}$ value by moving across the selected quality index row to the column representing the number of samples in the lot.

If $\boldsymbol{Q_{LD}}$ is greater than the largest quality index value shown in the table, use 100.00 as the value for $\boldsymbol{PWL_{LD}}$.

If $\boldsymbol{PWL_{LD}}$ is less than 50.00% for the lot, the Engineer will determine if the material in the lot may remain in place. If the material is left in place, the value of $\boldsymbol{P_D}$ for the lot will be equal to -0.160, unless the Engineer establishes lower values for $\boldsymbol{P_D}$ (-0.200, -0.300, etc.) as a condition of leaving the material in place. Otherwise, calculate $\boldsymbol{P_D}$ using Equation 2 and round to thousandths.

Equation 1:

$$\boldsymbol{Q_{LD}} = \frac{\overline{X} - LSL}{S}$$

$\overline{X}$ is the average measured percent of G_{mm} of all samples within a lot rounded to hundredths.

LSL is the lower specification limit for density and is defined as 91.00% of G_{mm} for traveled way plan thickness 2 inches and less and 92.00% of G_{mm} for traveled way plan thickness greater than 2 inches.

S is the standard deviation of the measured density of all samples within a lot and is calculated using equation (4) in Section 5.17.09, Part V, rounded to hundredths.

Equation 2: $\boldsymbol{P_D} = (\boldsymbol{PWL_{LD}} * 0.004) - 0.360$

d. Asphalt Air Void Pay Adjustment. Asphalt Air Void (V_a) Pay Adjustment will be made on a lot basis and based on measured V_a from samples of plant produced material. This adjustment will be paid for under the bid item Asphalt Air Void Pay Adjustment. The V_a pay adjustment factor ($\boldsymbol{P_V}$) (positive or negative) will be determined and used to compute the V_a Pay Adjustment by multiplying $\boldsymbol{P_V}$ times the number of tons included in the lot times \$40 per ton. The V_a Pay Adjustment will be added or subtracted on the pay estimate. When the statistical comparison between the quality control and the verification tests pass, use the procedures in **subsection 602.9d.(1)** to compute $\boldsymbol{P_V}$. When the statistical comparison fails, calculate $\boldsymbol{P_V}$ using procedures in **subsection 602.9d.(2)**.

Lot Size: A lot shall normally be comprised of the results of 4 contiguous individual V_a tests performed on gyratory compacted samples of a given mix design. Lot size is defined in **subsections 602.8f.**, **602.8g.** and **602.8h**. When there are 1 or 2 tests remaining, such as at the end of a project or season, combine them with the previous 4 tests to create a 5 or 6 test lot, respectively. When there are 3 tests remaining, combine the 3 tests into a lot. (Air voids lots and density lots are normally of different sizes).

(1) Air Voids Pay Adjustment Factor (Passing t-test). Calculate the upper and lower V_a quality indices ($\boldsymbol{Q_{UV}}$ and $\boldsymbol{Q_{LV}}$) for each lot using Equations 3 and 4, respectively and round to hundredths. Locate the $\boldsymbol{Q_{UV}}$ value in the left column of the Percent Within Limits (PWL) Table in Section 5.2.1 – Statistics, Part V. Select the appropriate upper percent within limit value ($\boldsymbol{PWL_{UV}}$) by moving across the selected quality index row to the column representing the number of samples (N) in the lot. Repeat the process using the $\boldsymbol{Q_{LV}}$ value and select the appropriate value for the lower percent within limits ($\boldsymbol{PWL_{LV}}$). If the $\boldsymbol{Q_{UV}}$ or $\boldsymbol{Q_{LV}}$ value is greater than the largest quality index value shown in the table, then a value of 100.00 is assigned as the value for $\boldsymbol{PWL_{UV}}$ or $\boldsymbol{PWL_{LV}}$, respectively. If both $\boldsymbol{Q_{UV}}$ and $\boldsymbol{Q_{LV}}$ exceed the values shown in the table, a value of 100.00 is assigned as the value for both $\boldsymbol{PWL_{UV}}$ and $\boldsymbol{PWL_{LV}}$. If either $\boldsymbol{Q_{UV}}$ or $\boldsymbol{Q_{LV}}$ is a negative value or $\boldsymbol{PWL_{UV}} + \boldsymbol{PWL_{LV}}$ is less than 150.00, the Engineer will determine if the material in the lot may remain in place. If the Engineer determines that the material may remain in place then the maximum value of $\boldsymbol{P_V}$ for the lot will be equal to –0.120. The Engineer may establish lower values for $\boldsymbol{P_V}$ (-0.200, -0.300, etc.) in such instances. Otherwise, calculate $\boldsymbol{P_V}$ using Equation 5 and round to thousandths.

Equation 3: $\boldsymbol{Q_{UV}} = \dfrac{USL - \overline{X}}{S}$

Equation 4: $\boldsymbol{Q_{LV}} = \dfrac{\overline{X} - LSL}{S}$

$\overline{X}$ is the average measured V_a of all samples within a lot rounded to hundredths.
USL is the upper specification limit for V_a and is defined as 5.00%.
LSL is the lower specification limit for V_a and is defined as 3.00%.
S is the standard deviation of the measured V_a for all samples within a lot and is calculated using equation (4) in Section 5.2.1 - Statistics, Part V, rounded to hundredths.

Equation 5: $\boldsymbol{P_V} = ((\boldsymbol{PWL_{UV}} + \boldsymbol{PWL_{LV}} - 100.00)(0.003)) - 0.270$

$\boldsymbol{PWL_{UV}}$ is the upper percent within limits value for V_a.
$\boldsymbol{PWL_{LV}}$ is the lower percent within limits value for V_a.

(2) Air Voids Pay Adjustment (Failing t-Test). If the t-test fails, KDOT's test result will be used to calculate the $\boldsymbol{P_V}$ for the lot. Follow the procedures given in **subsection 602.9d.(1)** to determine the $\boldsymbol{P_V}$ or disposition of the lot. Use the values from **TABLE 602-16** to calculate $\boldsymbol{Q_{UV}}$, $\boldsymbol{Q_{LV}}$, $\boldsymbol{PWL_{UV}}$ and $\boldsymbol{PWL_{LV}}$ in Equations 3, 4 and 5 in **subsection 602.9d.(1)**.

TABLE 602-16: Statistical Values for Air Voids Pay Adjustment for Failing t-Test		
Term	**Definition**	**Value**
$\overline{X}$	Average or Mean	KDOT's test result for the lot
S	Standard Deviation	0.50
USL	Upper Specification Limit	5.50%
LSL	Lower Specification Limit	2.50%
N	Sample Size	3

602.10 DETERMINATION OF THICKNESS, THICKNESS PAY ADJUSTMENT AND AREA PAY ADJUSTMENTS FOR "HMA PAVEMENT" AND "HMA PAVEMENT SHOULDER" BID ITEMS

a. General. Construct the pavement to the dimensions shown in the Contract Documents. Inform the Engineer when a section is ready for coring and measurement of width and length. Complete all paving of the shoulder and driving lanes within this section, unless otherwise approved by the Engineer.

A driving lane is defined as mainline lanes, acceleration lanes (including tapers), deceleration lanes (including tapers), auxiliary lanes, ramp lanes or combination thereof.

When shoulders, medians and widenings are placed monolithically with the adjacent driving lane, and there is not a separate bid item for shoulders, then the shoulders are considered as part of the driving lane, and are subjected to the same unit price adjustment as the driving lane.

b. Measurements. The Engineer will divide the projects into lots. A lot is comprised of 5 sublots with the same plan thickness. A sublot is defined as a single driving lane or a single shoulder, with an accumulative length of 1000 feet. If the last lot has 1 or 2 sublots (such as at the end of a project or season), combine them with the previous lot to create a lot with 6 or 7 sublots, respectively. Consider as a single lot if there are 3 or 4 sublots in the final lot.

The Engineer will generate 1 random location for coring within each sublot. Do not take a core within 1 foot of a longitudinal joint or edge. Obtain the cores with the Engineer present.

Take a 4-inch diameter core from the selected sites. Mark each core with its lot and sublot number, and transport to the KDOT field lab.

For information only, the Engineer will determine the thickness of each HMA mixture and the total HMA base for each core.

The Engineer will determine the total core thickness for pay by taking 3 caliper measurements at approximately 120° apart and record each to the nearest 0.1 inch. The average of the 3 caliper measurements rounded to the nearest 0.1 inch shall represent the average measured thickness. The Engineer will use the total pavement thickness measurements to determine thickness pay adjustment factors.

The Engineer will provide a copy of the results to the Contractor before the end of the following working day.

Prior to coring, the Contractor may request that areas trimmed without automatically controlled equipment be handled separately. (This would require the Contractor to designate the area as a lot before knowing the actual core thickness.) When requested and approved by the Engineer, each area will be considered a lot. Divide the area into 5 sublots and obtain 1 core from each sublot.

For Percent Within Limits (PWL) thickness analysis, if any sublot thickness exceeds the design thickness by more than 1.0 inch, the Excel spreadsheet will automatically consider that sublot thickness to be 1.0 inch more than the design thickness. The spreadsheet will recalculate a new lot mean and sample standard deviation based on the adjusted value.

Dry the core holes, tack the sides and bottom, fill them with a HMA mixture (approved for the project) and properly compact it by the end of the next working day.

c. Deficient Measurements for Driving Lanes. When any full depth core for driving lanes is deficient by 1.0 inch or greater from the specified thickness, take exploratory cores at intervals a minimum of 50 feet in each direction (parallel to the centerline) from the deficient core.

Continue to take exploratory cores in each direction until a core is taken that is deficient a maximum of 0.5 inch. Exploratory cores are used only to determine the length of pavement in a lot that is to be overlaid, as approved by the Engineer.

The minimum overlay length (with surface mix) shall be equal to the distance between the cores that are deficient by a maximum of 0.5 inch, and the width to be paved shall be full width of the roadway (driving lanes and shoulders) when this occurs.

The minimum overlay thickness is 3 times the nominal maximum aggregate size.

Complete the overlay to the satisfaction of the Engineer. Mill butt joints on the ends of the overlay area. The Engineer will not pay for any milling costs.

The exploratory cores are not used to determine thickness pay adjustment factors. Randomly select another core (outside the overlay area) to represent the sublot.

d. Deficient Measurements for Shoulders. When any full depth core taken from the shoulders is deficient by greater than 1.5 inches, take exploratory cores at intervals a minimum of 50 feet in each direction (parallel to the centerline) from the deficient core.

Continue to take exploratory cores in each direction until a core is only deficient a maximum of 0.8 inches.

Exploratory cores are used only to determine the length of pavement in a lot that is to be removed and replaced, or accepted at a reduced price (in addition to any disincentive assessed on that lot), as approved by the Engineer.

The minimum repair length is equal to the distance between the cores that are deficient a maximum of 0.8 inches, and the full width of the shoulder.

Mill butt joints on the ends of the overlay area. The Engineer will not pay for any milling costs. Unless approved by the Engineer, replacing includes complete removal of all HMA within the area defined by the results of the exploratory cores. Rework, stabilize (if required) and regrade the subgrade. When required, reconstruct the base and replace all HMA mixes shown in the Contract Documents. Obtain 1 random core within this sublot and use its core length to determine the thickness pay adjustment factor.

e. Asphalt Pavement Area Pay Adjustment. Determine the areas for pay and pay adjustment as shown in **TABLE 602-18**. The KDOT spreadsheet program will calculate these areas. This adjustment will be paid for under the bid item Asphalt Pavement Area Pay Adjustment.

Irregularly shaped areas may have to be calculated outside the program and the area entered into the program. Compute pay per lot for areas placed and not placed (deducted) as shown in Equations 10, 11, 12 and 13.

Equation 10: Pay for Driving Lane = $(\sum PDLA)(BP)$

Equation 11: Pay Deduct for Driving Lanes = $2(\sum PDLDA)(BP)$

Equation 12: Pay for Shoulder = $(\sum PSA)(BP)$

Equation 13: Pay Deduct for Shoulder = $2(\sum PSDA)(BP)$

$\sum PDLA$ = Pay Driving Lane Area per Lot, Square Yard

$\sum PDLDA$ = Pay Driving Lane Deduct Area per Lot, Square Yard

$\sum PSA$ = Pay Shoulder Area per Lot, Square Yard

$\sum PSDA$ = Pay Shoulder Deduct Area per Lot, Square Yard

BP = Bid Price for either the driving lanes or the shoulder, as applicable

TABLE 602-17: HMA AREA ABBREVIATIONS

Abbreviation		Definition	Units
PDLA	=	Pay Driving Lane Area per Sublot	Sq Yd
PDLDA	=	Pay Driving Lane Deduct Area per Sublot,	Sq Yd
PSA	=	Pay Shoulder Area per Sublot	Sq Yd
PSDA	=	Pay Shoulder Deduct Area per Sublot	Sq Yd
MDLW	=	Measured Driving Lane Width	Ft
MSW	=	Measured Shoulder Width	Ft
MTLW	=	Measured Total Lane Width (includes shoulder, if any)	Ft
PDLW	=	Plan Driving Lane Width	Ft
PSW	=	Plan Shoulder Width	Ft
PTLW	=	Plan Total Lane Width (includes shoulder, if any)	Ft
EDLW	=	Excess Driving Lane Width	Ft
SL	=	Sublot Length	Ft

TABLE 602-18: HMA AREA SUBLOT CALCULATIONS[1]

Condition	PDLA[2]	PDLDA[2]	PSA[2]	PSDA[2]
	(Sq Yd)	(Sq Yd)	(Sq Yd)	(Sq Yd)
Projects with a Separate Bid Item for Shoulder				
Narrow Driving Lane				
MSW is less than PSW	(SL)(MDLW)	(SL)(PDLW–MDLW)	(SL)(MSW)	(SL)(PSW–MSW)
MSW is greater than PSW	(SL)(MDLW)	(SL)(PDLW–MDLW)	(SL)(MSW[3])	0
Wide Driving Lane				
MSW + EDLW is less than PSW	(SL)(PDLW)	0	(SL)(MSW+EDLW)	(SL)(PSW–MSW-EDLW)
MSW + EDLW is greater than PSW	(SL)(PDLW)	0	(SL)(MSW+EDLW[4])	0
Projects without a Separate Bid Item for Shoulder[5]				
Narrow Driving Lane and Shoulder	(SL)(MTLW)	(SL)(PTLW–MTLW)	N/A	N/A
Wide Driving Lane and Shoulder	(SL)(MTLW[6])	0	N/A	N/A

[1]Deductions will be made for unplaced areas.
[2]Calculate the areas to the nearest 0.01 square yards. Measure the lengths and widths to the nearest 0.01 feet. Divide the result of all equations in this table by 9 so that the resulting units are square yards.
[3]MSW shall be between PSW and PSW + 0.25 feet. Any excess width over 0.25 feet will not be included in PSW.
[4]MSW+ EDLW shall be between PSW and PSW + 0.25 feet. Any excess width over 0.25 feet will not be included in PSW.
[5]Shoulder is normally 0.00 feet to 3.00 feet wide and placed at the same time as the driving lane. PTLW = PDLW + PSW
[6]MSTLW shall be between PTLW and PTLW + 0.25 feet. Any excess width over 0.25 feet will not be included for pay.

f. Asphalt Pavement Thickness Pay Adjustment. Compute the Asphalt Thickness Pay Adjustment for the driving lanes (TPA_{DL}) and shoulders (TPA_{SH}) using Equation 6 or 7, respectively. Compute the Asphalt Thickness Pay Adjustment factor (P_T) as shown in Equation 9. Determine area calculations for the driving lanes and shoulders as shown in **TABLE 602-18**. **TABLE 602-17** provides the definition for the abbreviations used in **TABLE 602-18**. Enter the measured values into the spreadsheet program to determine PDLA and PSA.

This adjustment will be paid for under the bid item Asphalt Pavement Thickness Adjustment.

Equation 6: $TPA_{DL} = P_T\,(\sum PDLA)(\$1.90)(\text{Plan Thickness})$
Equation 7: $TPA_{SH} = P_T\,(\sum PSA)(\$1.70)(\text{Plan Thickness})$

TPA_{DL} = Thickness Pay Adjustment per Lot for Driving Lane
TPA_{SH} = Thickness Pay Adjustment per Lot for Shoulder
$\sum$PDLA = Pay Driving Lane Area per Lot, Square Yard
$\sum$PSA = Pay Shoulder Area per Lot, Square Yard
Plan Thickness = HMA Thickness shown on Plans, Inches

KDOT will use a spreadsheet program to calculate thickness pay adjustments. KDOT will provide a copy of this program to the Contractor, when requested. It is the Contractor's responsibility to obtain the Microsoft Excel software required to run this program. Values computed using equations referenced in this specification may vary slightly from the spreadsheet values due to rounding of numbers. In such cases the numbers computed by the spreadsheet take precedence.

Thickness Quality Index (Q_T) Computation. In each lot, calculate Q_T for the total pavement thickness using Equation 8 and round to hundredths.

Equation 8:

$$Q_T = \frac{\overline{X} - LSL}{S}$$

$\overline{X}$ = Average total core length of all samples representing a lot, rounded to the nearest 0.1 inch. (Adjust core length before averaging, as shown in **subsection 602.10b.**)
LSL = Lower specification limit for thickness. For driving lanes use 0.5 inch less than the total plan driving lane thickness shown on the typical section. For shoulders, use 0.8 inch less than the total plan shoulder thickness shown on the typical section.
S = Sample standard deviation of the measured core lengths of all samples representing a lot and is calculated using equation (4) in Section 5.2.1 – Statistics, Part V, rounded to hundredths.

Use the computed $\boldsymbol{Q_T}$ to determine the thickness Percent Within Limits value ($\boldsymbol{PWL_T}$) by locating the $\boldsymbol{Q_T}$ in the left column of the Percent Within Limits (PWL) Table in Section 5.2.1 - Statistics, Part V. Select the appropriate $\boldsymbol{PWL_T}$ by moving across the selected $\boldsymbol{Q_T}$ row to the column representing the number of samples in the lot.

If the computed $\boldsymbol{Q_T}$ is a negative value, then the lot and all adjacent areas (full width of roadway) shall be overlaid as determined by the Engineer. After the lot has been overlaid, randomly select another core for each sublot, and calculate a new pay factor. For lots that have been entirely overlaid, the maximum pay factor is zero.

If the computed $\boldsymbol{Q_T}$ is greater than the largest $\boldsymbol{Q_T}$ shown in the PWL Table, a value of 100.00 is assigned as the $\boldsymbol{PWL_T}$ for thickness.

For each lot and all lanes and shoulders, compute the thickness pay factor ($\boldsymbol{P_T}$) for the total pavement thickness using Equation 9 and round to nearest thousandth. No bonus will be paid for shoulders, thus use $\boldsymbol{P_T}$ = 0.000 whenever $\boldsymbol{P_T}$ calculates greater than 0.000 for shoulders.

Equation 9:

$$\boldsymbol{P_T} = \left(\frac{(\boldsymbol{PWL_T}) * 0.30}{100} \right) - 0.270$$

g. Minimum Quantity of HMA for Square Yard Projects with "HMA Pavement" and HMA Pavement Shoulder" Bid Items. For the total project, supply a minimum of 93% of G_{mm} required by the surface course of driving lanes and shoulders and the top base course of driving lanes and shoulder. Calculate the minimum quantity of those 2 mixes, individually as follows:

Equation 14:

$$\text{Minimum Quantity (Tons)} = \frac{0.93\,(A)\,(T)\,(G_{mm})}{42.7}$$

A = Area in square yards for each of the mixes.
T = Plan thickness in inches of surface course and the top base course of driving lanes and shoulders.
G_{mm} = Theoretical maximum specific gravity equals the average G_{mm} value used in the first 5 lots or the average G_{mm} for ½ of the project (whichever is less) for the 4 mixes listed in "T" in Equation 14. Determine the average G_{mm} from the Excel worksheet titled "Density F & T Test Worksheet".

If this minimum quantity of surface course or base course is not placed, a deduction of $40 per ton will apply to the quantity not placed for each mix. This will be paid using the bid item Contract Deduct which will be an item added to the contract.

602.11 MEASUREMENT AND PAYMENT

a. "HMA Base", "HMA Surface" and "HMA Overlay" Bid Items. The Engineer will measure HMA Base, HMA Surface and HMA Overlay by the ton of material at the time of delivery to the road. Batch weights will not be allowed as a method of measurement unless all the following conditions are met:

- the plant is equipped with an automatic printer system approved by the Engineer;
- the automatic printer system prints the weights of material delivered; and
- the automatic printer system is used in conjunction with an automatic batching and mixing control system approved by the Engineer.

Provide a weigh ticket for each load. Due to possible variations in the specific gravity or weight per cubic foot of the aggregates, the tonnage used may vary from the proposal quantities and no adjustment in contract unit price will be made because of such variances.

Payment for "HMA Base (*)(**)(***)", "HMA Surface (*)(**)(***)" and "HMA Overlay (*)(**)(***)" at the contract unit prices is full compensation for the specified work. Any pay adjustments will both be applied and the payment adjusted accordingly.

Sideroads, entrances and mailbox turnouts that are not shown in the Contract Documents that are to be surfaced shall be paid for at 1½ times the unit price for "HMA Surface (*)(**)(***)" or "HMA Base(*)(**)(***)".

b. "HMA Pavement" and "HMA Shoulder" Bid Items. The Engineer will measure HMA Pavement and HMA Pavement Shoulder by the square yard of the measured in-place material. All lifts, except the surface course, will be measured by the Contractor and verified by the Engineer. The Engineer will measure the surface course.

Measure each shoulder width, each driving lane width and sublot length separately. Measure the lengths (to the nearest 0.1 inch) a minimum of once per sublot. The location of the width measurements will be the same location as the mainline cores which were established using random numbers. Before the end of the next working day, type and submit to the Engineer, the Contractor's individual measurements and the sum of the 2 driving lanes. Likewise, when the surface course is completed the Engineer will provide a typed copy of the surface course measurements to the Contractor before the end of the next working day.

If the driving lane and shoulder (measured from centerline) is less than 0.25 feet (per side) deficient, a deduction will be assessed. If the roadway is greater than 0.25 feet (per side) deficient, correction will be required. The correction will be proposed by the Contractor and must be approved by the Engineer. After satisfactory correction by the Contractor, the deduction for the narrow roadway will be eliminated for the areas corrected.

The Engineer will measure the sublot length and width (to the nearest 0.01 feet). Measure the width from the construction joint to the top of the slope of HMA pavement. Calculate the pay area for each lot to the nearest square yard. Unless the Engineer authorizes in writing to increase the area of HMA pavement, the Engineer will use dimensions shown in the Contract Documents and as measured in the field to calculate the final pay quantity. If the Engineer authorizes in writing to increase the area of HMA pavement or shoulder, the additional area will be measured and paid for as "HMA Pavement (#) (##)" or "HMA Pavement (#) Shoulder", respectively. The length will be measured horizontally along the centerline of each roadway or ramp.

Payment for "HMA Pavement (#) (##)" and "HMA Pavement (#) Shoulder" at the contract unit prices is full compensation for the specified work.

The Asphalt Pavement Thickness Adjustment and Asphalt Pavement Area Pay Adjustment will be entered on the Contractor's Payment Vouchers (intermediates and final) after each lot of the surface course (driving lanes and shoulders) has been completed.

The Contractor will receive no additional compensation for overlaying or for removing and replacing areas of deficient thickness. Exploratory cores and cores taken to determine pavement thickness will not be measured for payment. The Engineer will apply a Contract Deduct for surface course (driving lanes and shoulders) and top base course (driving lanes and shoulders) mix not placed on the project as determined using Equation 14. The Contract Deduct will be computed by the spreadsheet and be an item added to the contract.

If the project has a large amount of grinding required for pavement smoothness, the Engineer may require the Contractor to cut cores after the grinding is complete. These cores will be used in the spreadsheet in place of the cores originally cut.

c. Emulsified Asphalt. The Engineer will measure emulsified asphalt used for tack by the ton. Payment for "Emulsified Asphalt" at the contract unit price is full compensation for the specified work.

d. Asphalt Core (Set Price). The Engineer will measure each asphalt core required by the Engineer to calibrate the nuclear density gauges (typically 3 cores for each calibration). No payment will be made for cores deemed unsuitable for calibrating the nuclear density gauges. No payment will be made for cores taken at the Contractor's option to determine density.

If during nuclear density dispute resolution, the Contractor's test results are used for payment, each core taken will be measured for payment at 1 ½ times the Asphalt Core (Set Price). If KDOT's test results are used for payment, then no payment for cores will be made for nuclear density dispute resolution.

Payment for "Asphalt Core (Set Price)" at the contract set unit price is full compensation for the specified work.

e. Material for HMA Patching (Set Price). When the Contractor is required to remove any existing base course, subgrade or surface course (unless damaged by the Contractor) and provisions are not made in the Contract

Documents, the Engineer will measure the material used for repair and patching (either HMA-Commercial Grade or a specified mix on the project) separately, by the ton at the time of delivery to the road. The Engineer will not measure the quantity of material used in the repair of damage due to the Contractor's negligence. The Engineer will measure HMA materials by the ton. For mixes containing Reclaimed HMA Pavement (RAP) or Recycled Asphalt Shingles (RAS), compute the HMA material contained in the RAP and RAS using the binder content determined from ignition oven testing. Maintain this information for materials tracking purposes. No separate payment for HMA material in RAP and RAS will be made. Combined gradation results will be used for acceptance in accordance with **TABLE 602-1**.

Payment for "Material for HMA Patching (Set Price)" at the contract set unit price includes all excavation, compaction of subgrade or subbase if required, disposal of waste material and all material (including emulsified asphalt for tack), all labor, equipment, tools, supplies, incidentals and mobilization necessary to complete the work. Pay adjustments will not be applied to this material.

f. Quality Control Testing (HMA). The Engineer will measure Quality Control Testing (HMA) performed by the Contractor on a per ton basis of HMA Surface, HMA Base, HMA Overlay and HMA Pavement placed on the project. No adjustment in the bid price will be made for overruns or underruns in the contract quantity. The bid price will constitute payment for all necessary mix design testing, field process control testing, the testing laboratory and all necessary test equipment.

The Engineer will not measure for payment Quality Control Testing (HMA) for the bid item Material for HMA Patching (Set Price).

Payment for "Quality Control Testing (HMA)" at the contract unit price is full compensation for the specified work.

SECTION 603

ASPHALT PAVEMENT SMOOTHNESS

603.1 DESCRIPTION

Determine the smoothness of the pavement surface and correct the deficiencies as specified in the Contract Documents.

For the purposes of this specification, define new construction to mean construction where pavement did not exist before, and where existing pavement is removed down to the base and subgrade.

All other conditions should be considered rehabilitation construction.

When projects contain both new and rehabilitation construction, follow appropriate guidelines for each type.

BID ITEM	UNITS
Asphalt Pavement Smoothness	Lump Sum

603.2 MATERIALS - None specified.

603.3 CONSTRUCTION REQUIREMENTS

a. Profilograph Testing. Determine the pavement smoothness by profiling the pavement surface of through traffic lanes and ramps. Excluded from profilograph testing, and not eligible for pay adjustments, on all projects are:

- bridge decks
- acceleration and deceleration lanes of at-grade intersections
- turning lanes
- shoulders
- pavement on horizontal curves with centerline radius of curvature of less than 1000 feet, and pavement within the superelevation transition of such curves
- individual sections of pavement less than 50 feet in length
- the first (or last) 15 feet of a pavement section where the Contractor is not responsible for the adjoining surface
- side roads less than 250 feet in length
- county secondary projects
- existing roadways that are surfaced with a plan thickness of less than 4 inches of either hot mix asphalt (HMA) or warm mix asphalt (WMA)
- chip seals
- microsurfacing

Profile and correct, if necessary, the following categories of asphalt surfacing. These are not eligible for pay adjustments:

- existing roadways that are milled, then surfaced with a plan thickness of less than 4 inches of either hot mix asphalt (HMA) or warm mix asphalt (WMA).
- existing roadways that are surfaced with a plan thickness of less than 4 inches of either HMA or WMA that is placed in 2 or more lifts.
- existing roadways that are cold in-place recycled (CIR) with a plan depth of 2 inches or more, then surfaced with either Ultrathin Bonded Asphalt Surface (UBAS) or a plan thickness of less than 4 inches of either HMA or WMA.
- existing roadways that are hot-in-place recycled (HIR) with a plan depth of 2 inches or more, then surfaced with either UBAS or a plan thickness of less than 4 inches of either HMA or WMA.

In addition to the asphalt surfacing above, profile and correct, if necessary, the following categories of asphalt base, prior to placement of the surface course. These are not eligible for pay adjustments:

- CIR pavement with a plan thickness of 2 inches or more.
- HIR pavement with a plan thickness of 2 inches or more.

b. Equipment. Use a California type profilograph, prequalified by the Bureau of Construction and Materials, to determine the pavement profile. If approved by the Bureau of Construction and Materials, other types of profilographs that produce results compatible to the California type profilograph may be used. If the profilograph has a mechanical recorder, provide a ProScan electronic scanner with motorized paper transport to reduce the trace. Use the motorized paper transport when scanning the profilograph traces. The Bureau of Construction and Materials can provide the information necessary for the Contractor to obtain a ProScan electronic scanner. If approved by the Bureau of Construction and Materials, other types of automated trace reduction equipment may be used. If the profilograph has a computerized recorder, the trace produced is evaluated without further reduction.

c. Profilograph Operation. Provide an operator for the profilograph certified according to KT-46, Part V.

Determine the pavement profiles for each lane according to the procedures for 1 lane shown in Kansas Test Method KT-46. Additional profiles may be taken only to define the limits of an out-of-tolerance surface variation. The Engineer may use a 10-foot straightedge (or other means) to detect irregularities outside the required trace paths. The Engineer may also use the straightedge to delineate the areas that require corrective action.

Determine a profile index (in./mi.) for each pavement section of finished pavement. A pavement section is a continuous area of pavement surface 0.1 mile long by 1 lane wide (12 feet nominal). A partial pavement section resulting from an interruption (such as a bridge) of the continuous pavement surface is subject to the same testing and evaluation as a whole section.

For projects with asphalt smoothness pay adjustments, profile the pavement after final rolling, and within 24 hours of placement of the pavement.

For projects with no asphalt smoothness pay adjustments, profile the pavement after final rolling, and within 72 hours of completing the asphalt paving on the project. At the engineer's discretion, the Contractor will profile the pavement after final rolling, and within 24 hours of placement of the pavement.

If the Contractor elects to test intermediate lifts with the profilograph, make the profilograms available to the Engineer to review for evaluating the paving methods and equipment.

On surfaces excluded from profilograph testing, the Engineer will determine the pavement smoothness using a 10-foot straightedge. The Engineer will select the locations to be tested. The variation of the surface from the testing edge of the straightedge shall not exceed ⅛ inch between any 2 contacts, longitudinal or transverse.

Correct all irregularities exceeding the specified tolerance using equipment and methods approved by the Engineer. After the irregularities are corrected, the Engineer will retest the area to verify compliance with the specified tolerance.

d. Profilograph Evaluation and Corrective Actions. Evaluate the profilograph results according to KT-46. For projects with asphalt smoothness pay adjustments, provide the Engineer with the profilograms and their evaluation the first working day after placement of the pavement. For projects with no asphalt smoothness pay adjustments, provide the Engineer with the profilograms and their evaluation the first working day after profiling the roadway.

Determine and evaluate the profile index (in./mi.) for each trace and the average profile index (in./mi.) for each section to identify where corrective action is needed.

Determine the daily average profile index (in./mi.) for each day's paving operation. A day's paving operation is the pavement placed in a day (a minimum of 1 pavement section).

- If less than 1 pavement section is placed in a day, the day's production is grouped with the next day's production.
- If the production of the last day of project paving is less than 1 pavement section, it is grouped with the previous day's production.
- The Contractor has the option of profiling the final portion of a day's production (not to exceed 5 sections) the first working day that paving is continued in the same lane. If the Contractor opts to profilograph the final portion of a day's paving the next working day that paving is continued in the same lane, those results (the final portion of the previous day's paving) are grouped with the day's paving as the lane is continued.

(1) For new construction bid items in **SECTION 602,** take the required corrective actions according to **TABLE 603-1**.

TABLE 603-1: ASPHALT PAVEMENT SURFACE TOLERANCES, NEW CONSTRUCTION SECTION 602 BID ITEMS		
Pavement Surface Tolerances (in./mi.)		Required Corrective Action
Through Lanes Speed Limit Greater than 45 mph	Acceleration Lanes* Deceleration Lanes* Ramps* Through Lanes Speed Limit 45 mph or Less	
Profile Index per Section of 30 or less for an individual trace	Profile Index per Section of 40 or less for an individual trace	Correct all bumps and dips**.
Profile Index per Section greater than 30 for an individual trace		Correct the Profile Index of each individual trace to 30 or less per section**.
	Profile Index per Section greater than 40 for an individual trace.	Correct the Profile Index of each individual trace to 40 or less per section**.
Daily Average Profile Index greater than 40	Daily Average Profile Index greater than 65	Suspend the paving operations until corrective actions are taken to improve the paving operations.

*Acceleration/deceleration lanes include the taper. Acceleration lanes that become through lanes are limited to 500 feet from the nose of the ramp. Ramps are from the nose to the intersection of the adjoining road.
**Correct all areas within each section having high or low points (bumps or dips) with deviations in excess of 0.3 inches in a length of 25 feet or less regardless of the profile index value.

(2) For all other rehabilitation construction bid items in **DIVISION 600**, take the required corrective actions according to **TABLE 603-2**.

TABLE 603-2: ASPHALT PAVEMENT SURFACE TOLERANCES, REHABILITATION DIVISION 600 BID ITEMS (EXCEPT SECTION 602, NEW CONSTRUCTION)		
Pavement Surface Tolerances (in./mi.)		Required Corrective Action
Through Lanes	Acceleration Lanes* Deceleration Lanes* Ramps* 2" Surface Recycled Asphalt/Hot In-place Recycled Asphalt Pavement Cold Recycle Asphalt Construction	
Profile Index per Section of 30 or less for an individual trace	Profile Index per Section of 40 or less for an individual trace	Correct all bumps and dips**.
Profile Index per Section greater than 30 for an individual trace		Correct the Profile Index of each individual trace to 30 or less per section**.
	Profile Index per Section greater than 40 for an individual trace.	Correct the Profile Index of each individual trace to 40 or less per section**.
Profile Index per Section greater than 40 for an individual trace	Profile Index per Section greater than 50 for an individual trace.	Suspend the paving operations until corrective actions are taken to improve the paving operations.

*Acceleration/deceleration lanes include the taper. Acceleration lanes that become through lanes are limited to 500 feet from the nose of the ramp. Ramps are from the nose to the intersection of the adjoining road.
**Correct all areas within each section having high or low points (bumps or dips) with deviations in excess of 0.4 inches in a length of 25 feet or less regardless of the profile index value.

f. Corrections. Make the required corrections for pavement smoothness before making the pavement thickness determinations. Use these methods for corrections:

- diamond grinding when the layer is the final riding surface
- when the layer will be covered with an asphalt seal or microsurfacing
    - micro-milling or fine-lace milling (minimum of 60 teeth per foot) may be done in a continuous 100-foot segment provided there is at least 400 feet of the surface adjacent to the segment that is not milled or diamond ground
    - diamond grind when more than 100 feet within a 400-foot segment requires correction. The Engineer may permit micro-milling if in the opinion of the Engineer the resulting surface is not detrimental to the functionality of the asphalt seal or the microsurfacing
- milling if the layer will be covered by another action
- remove and replace the entire pavement thickness
- remove the surface by milling, and replace the specified surface course
- overlay (not patch) with the specified surface course
- other methods that are approved by the Engineer

Apply the corrective measure to the full-lane width of the pavement. The corrected areas shall have uniform texture and appearance. The beginning and ending of the corrected areas shall be squared normal to centerline of the paved surface.

When grinding is performed, use vacuum equipment or other continuous methods to remove grinding slurry and residue. Remove from the project and properly dispose of the material. Do not allow the grinding slurry to flow across lanes being used by traffic, onto shoulder slopes, into streams, lakes, ponds or other bodies of water, or gutters or other drainage facilities. Do not place grinding slurry on foreslopes.

g. New Construction Bid Items in SECTION 602, and Eligible for Pay Adjustments. After the profilograph traces have been evaluated, make corrections according to **TABLE 603-3.**

TABLE 603-3: GRINDING REQUIREMENTS

Condition	Action*
Greater than 25% (132 feet) of the 0.1 mi. section requires correction	Continuously grind the entire 0.1 mi. section.**
Greater than 25% (1320 feet) of 1.0 mi. segment require correction	Continuously grind the entire 1.0 mi. segment, when the areas requiring correction are dispersed throughout the 1.0 mi. segment. If the areas requiring correction are isolated to 1/3 or ½ mi. within the 1.0 mi. segment, then only grind that 1/3 or ½ mi.

* Continuously grinding requires a minimum of 98% of the pavement be ground.

**If the skip length between areas to be ground (either within a 0.1 mi. section or between 0.1 mi. sections) is less than either grind length, combine the grinds so the area between is also ground. This additional ground area (area between) will apply to the computation of the 25% of the 0.1 mi. section.

If the Contractor elects or is required by **TABLE 603-3** to continuously grind the entire project, the following apply:

- the areas excluded in **subsection 603.3a.** are not required to be ground;
- at intersections constructed with multiple transitions for drainage (especially in urban areas), if smoothness meets **SECTION 603**, the intersection is not required to be ground; and
- when transitioning from a ground area to an unground area, feather the grinding a uniform distance throughout the project.

Grind and texture the entire surface of the pavement in the longitudinal direction. Provide positive lateral drainage by maintaining a constant cross slope between grinding passes in each lane.

Maintain a uniform transverse slope that matches the existing cross slope to the extent possible with no depressions or humps greater than 1/4 inch in 12 feet when tested with a string line or straightedge. Do not exceed by more than 1/16 inch the vertical alignment between adjacent passes of the cutting head. Begin and end grinding lines normal to the direction of vehicle travel. Grind the surface so corrugations are parallel to the pavement edge with ridges 1/16 inch, ±1/32 inch higher than the valleys of the corrugations.

g. Profilograms. After pavement sections are corrected, re-profile the pavement surface to verify compliance with the specified pavement smoothness. Provide the Engineer with the profilograms and their evaluation within 2 working days after correcting the pavement surface.

The Engineer may perform profilograph testing on the pavement surface for monitoring and comparison purposes. If the Engineer determines that the Contractor's certified test results are inaccurate, the Engineer may choose to test the entire project length. The Engineer will charge the Contractor for such testing at the rate of $500 per mile per profile track, with a minimum charge of $1000. Providing inaccurate test results may result in de-certification of the Contractor's certified operator.

603.4 MEASUREMENT AND PAYMENT

a. General. The Engineer will base the pay adjustment for pavement smoothness on the initial average profile index of the pavement section before any corrective work is performed. If the Contractor elects to remove and replace a pavement section, the Engineer will base the pay adjustment for pavement smoothness on the initial average profile index of the pavement section after the replacement.

For reconstruction projects, if the Contractor elects or is required by **TABLE 603-3** to continuously grind the entire project, pay adjustments will be based on the average profile index determined after all grinding is performed.

b. New Construction, Bid Items in SECTION 602, Eligible for Pay Adjustments. The Engineer will apply the contract price adjustment according to **TABLE 603-4**. Payments for "Asphalt Pavement Smoothness" are an added item to the contract.

TABLE 603-4: ASPHALT PAVEMENT SMOOTHNESS PAY ADJUSTMENT NEW CONSTRUCTION

Average Profile Index (in./mi. per lane per 0.1 mi. section)	Contract Price Adjustment (per 0.1 mi. section per lane)
6.0 or less	+$1000.00
6.0 to 10.0	+$835.00
10.1 to 15.0	+$625.00
15.1 to 18.0	+$310.00
18.1 to 30.0	0.00
30.1 to 40.0	0.00*
40.1 or more	-$615.00*

*Correct to 30.0 in./mi. (40.0 in./mi. as noted in **TABLE 603-1**).

The pay adjustments in **TABLE 603-4** are for 12" thick hot mix asphalt and 8" thick portland cement concrete pavements. Pay adjustments for pavements of different thicknesses will be reduced or increased proportionally, based on the typical section for the extent. (i.e. pay adjustment for a 9" hot mix asphalt pavement is equal to the adjustment from the **TABLE 603-4** multiplied by 0.75).

c. Rehabilitation Construction, for all Other Bid Items in DIVISION 600 and Eligible for Pay Adjustments, Take the Required Corrective Actions According to TABLE 603-5. The Engineer will apply the contract price adjustment according to **TABLE 603-5**. Payments for "Asphalt Pavement Smoothness" are an added item to the contract.

TABLE 603-5 ASPHALT PAVEMENT SMOOTHNESS PAY ADJUSTMENT REHABILITATION CONSTRUCTION

Average Profile Index (in./mi. per lane per 0.1 mi. section)	Contract Price Adjustment (per 0.1 mi. section per lane)
7.0 or less	+$152.00
7.1 to 10.0	+$76.00
10.1 to 30.0	0.00
30.1 to 40.0	0.00*
40.1 or more	-$203.00*

*Correct to 30.0 in./mi. (40.0 in./mi. as noted in **TABLE 603-1**).

SECTION 604

COLD RECYCLED ASPHALT CONSTRUCTION (CIR)

604.1 DESCRIPTION

Mill the asphalt pavement, mix the reclaimed asphalt pavement (RAP) material with hydrated lime slurry (use a minimum of 1% hydrated lime, based on the dry weight of the RAP) and emulsified asphalt, and spread and compact the mixture as specified in the Contract Documents.

BID ITEMS	UNITS
Cold Recycled Asphalt Material	Station
Lime (Hydrated) (Slurry)	Ton
Emulsified Asphalt (CSS) (Special)	Ton
Emulsified Asphalt (CSS-1H or SS-1H) Cure (Set Price)	Ton
Blotter Sand (Set Price)	Cubic Yard

604.2 MATERIALS

Provide materials that comply with the applicable requirements.

Emulsified Asphalt .... **DIVISION 1200**
Lime .... **DIVISION 2000**
Water .... **DIVISION 2400**

Blotter sand may be any fine sand approved by the Engineer.
Provide processed RAP material that complies with **TABLE 604-1**.

TABLE 604-1: RAP MATERIAL FOR CIR	
Sieve Size	**% Retained**
1 ¼"	0

Manufacture the hydrated lime slurry at the jobsite by slaking pebble quicklime. Accompany each load of quicklime with a certification stating the purity for that load.

604.3 CONSTRUCTION REQUIREMENTS

a. Mix Design. Submit to the Engineer for approval a mix design complying with 5.3.4-Mix Design Procedures for CIR Material, Part V.

Provide a technical representative from the asphalt emulsion supplier on the job site at the beginning of the CIR to obtain proper asphalt emulsion performance. When required, provide a technical representative to check on the project and make adjustments to the asphalt emulsion formulation as needed.

b. Milling Operation. Mill the required depth and width in 1 or more passes. Process the RAP material to the required gradation and thoroughly mix with the specified amount of binder. Water may be added to the RAP material to facilitate mixing, provided it does not adversely affect the binder. Deposit the recycled material in a windrow, a paver or load into trucks, without segregation.

When deposited in a windrow, have equipment available to equalize the windrow as directed by the Engineer.

If RAP is to become the property of the Owner, deliver and stockpile at locations shown in the Contract Documents.

c. Mixing Operations.

(1) Field Mixture Testing. Take all samples according to KT-1(3.1) or (3.2). Obtain a sample from each 0.6 mile before emulsion addition, and screened using a 1¼-inch sieve (or smaller sieve if required) to determine compliance with the maximum particle size requirement.

Additionally, obtain 2 gradations each day and compare to the mix design gradations using KT-4 to determine any necessary changes to the emulsion content.

(2) Asphalt Emulsion. Do not accept asphalt emulsion with a temperature greater than 120ºF, **TABLE 601-1**. Sample and accept or reject from the shipping trailers prior to unloading into the Contractor's storage units.

(3) Asphalt Emulsion Content. Check and record the emulsion content for each segment in which the percentage is changed. Make emulsion content changes based upon mix design recommendations, which are based upon different mix designs for road segments of varying construction. Determine asphalt emulsion content from the belt scale totalizer and asphalt pump totalizer.

(4) Lime Slurry Content. Add the amount of hydrated lime to the RAP determined by the mix design or directed by the Engineer, based on the weight of the dry RAP.

Add pebble quicklime by weight to the required quantity of water to provide a uniformly hydrated lime slurry having a minimum dry solids content of 30%. When requested by the Engineer, determine the solids content of the hydrated lime according to "Check Percent Solids of Lime Slurry Procedure" (KT-62). Check and record the lime slurry content for each segment in which the percentage is changed. Make the lime slurry changes based upon mix design recommendations or as approved by the Engineer.

(5) Water Content. Verify and record the water content at the milling head for each segment in which the percentage is changed. Determine water quantities from the water metering device, and compare with the belt scale totalizer to determine daily quantities used. Make the water content adjustments based on mixture consistency, coating and dispersion of the recycled materials.

d. Paving Operations. Deliver the RAP, lime and/or water and emulsion mixture to the paver immediately after mixing. The minimum temperature of the mixed material when placed is 50ºF. Pave in 1 continuous pass, utilizing an asphalt paver complying with **SECTION 155** or other equipment approved by the Engineer. Without tearing the surface, spread and finish the recycled material, to the lines and grades in the Contract Documents or established by the Engineer so it is smooth, free of segregation, uniform in density, texture and free from surface irregularities. Do not heat the paver screed. A pick-up machine may be used to transfer the windrowed material into the paver hopper. Maintain the asphalt paver within 150 feet of the mixing unit. If the process does not comply with these requirements, the Engineer will suspend paving until the deficiency is corrected.

e. Compaction and Density Requirements. Compaction and density requirements for each project shall be a minimum of 97% of the target density obtained on a test strip compacted under the following conditions:

- The minimum mix temperature of the test strip is 50ºF;
- Complete a minimum of 2 test strips to determine the target density and optimum sequence of rollers. These test strips shall remain in place as part of the completed work; and
- The depth of the lift shall be representative of the requirements of the Contract Documents.

Target density shall be the highest density achieved on the test strip using the rolling procedure approved by the Engineer. The rolling procedure used on the test strip shall have a minimum of 6 roller coverages. The Engineer will use a nuclear density gauge to establish a density growth curve for each procedure. Discontinue rolling when 4 consecutive coverages of the rollers fail to increase the density 1 pound per cubic foot.

As a minimum, provide the following self-propelled rollers for use on the test strips: a double drum vibratory steel roller and a pneumatic tired roller. Provide a vibratory roller complying with the requirements for hot asphalt pavement in **subsection 151.5** and having a minimum operating weight of 10 tons and a minimum drum width of 6½ feet. The vibratory roller may be used in the static mode. Use a pneumatic tired roller with a minimum weight of 30 tons and a minimum tire pressure of 90 psi. The air pressure in each of the pneumatic tires shall be within 5 psi of each other. Supply a suitable tire pressure gauge.

Change rolling or roller patterns when major displacement and/or cracking of the recycled material occur. Start rolling a maximum of 30 minutes after paving. Complete finish rolling a maximum of 1 hour after milling is completed. When possible, begin and end rolling sequences on previously compacted material or the existing pavement.

Before and after opening to traffic, maintain the surface of the recycled pavement in a condition suitable for the safe movement of the traffic. Remove all loose particles that develop on the pavement surface by power brooming.

When there is a significant change in mix proportions, weather conditions or other controlling factors, the Engineer may require construction of a new test strip to check target density.

f. Surface Treatment or Overlay. When required by the Engineer, apply a light application of asphalt material (smoke coat) on the recycled surface, and blot with fine sand, as necessary.

Before placing a HMA surface course, or other applicable surface treatment, allow the CIR asphalt material to cure until the moisture of the material is a maximum of 2.0%, or approved by the Engineer. Under dry conditions, the CIR should comply with the moisture requirements within 48 hours.

Cover each day's production of CIR material with any subsequent treatment or overlay, as designated in the Contract Documents, within 21 calendar days. If the CIR material requires patching before the 21 days have expired, and damage is not the result of the Contractor's operations, KDOT will pay for the patching. If the Contractor has not covered the CIR material by the end of the 21-day period and the material requires patching, the Contractor shall be responsible for the patching. Begin patching within 3 days of being notified by the Engineer of required patching.

g. Maintenance of Traffic. Perform traffic control according to **DIVISION 800**.

h. Weather and Seasonal Limitations. Complete milling, adding the liquid binder and laydown between May 1 and September 30, when the ambient air temperature is greater than 50°F and rising, the weather is not rainy or foggy and the weather forecast does not call for freezing temperature within 48 hours after placement. The above requirement may be waived, when approved in writing by the Engineer.

i. Pavement Smoothness. Evaluate pavement smoothness according to **SECTION 603**.

604.4 MEASUREMENT AND PAYMENT

The Engineer will measure cold recycled asphalt material by the Station, along the centerline. On divided highways, the Engineer will measure cold recycled asphalt material by the Station, along the centerline of each divided direction. This includes all widened and irregular areas and irregular variations in depth.

The Engineer will measure lime (hydrated) (slurry) and the various types of emulsified asphalt by the ton.

The Engineer will measure blotter sand by the cubic yard in the truck at the point of usage.

The Engineer will not measure water for separate payment.

Payment for "Cold Recycled Asphalt Material", "Lime (Hydrated) (Slurry)" and "Emulsified Asphalt (CSS) (Special)" at the contract unit prices and "Blotter Sand (Set Price)" and "Emulsified Asphalt (CSS-1H or SS-1H) Cure (Set Price)" at the contract set unit prices is full compensation for the specified work.

SECTION 605

SURFACE RECYCLED ASPHALT CONSTRUCTION

605.1 DESCRIPTION

Construct the hot-in-place recycling of the existing asphalt surface as specified in the Contract Documents. The activities associated with this work include heating the existing pavement, scarifying and/or hot milling the existing surface, adding a rejuvenating agent, mixing, spreading, leveling and compacting the recycled material. This process is referred to as Hot In-Place Recycled Asphalt Pavement (HIR). The term surface recycling and HIR are synonymous in the specification.

BID ITEMS	UNITS
Surface Recycling (*)	Station
Asphalt Rejuvenating Agent	Ton
*Thickness	

605.2 MATERIALS

a. Asphalt Rejuvenating Agent (ARA). Provide ARA that complies with **DIVISION 1200**.

b. Contractor Mix Design. When the specified thickness of the HIR is greater than or equal to 2 inches, submit a mix design complying with **TABLE 605-1**.

In the mix design, analyze the mixture at a minimum of 3 different ARA contents starting with 0.5% at the low end. Run the indirect tensile strength test (KT-60) at the lowest ARA content. Run the Asphalt Pavement Analyzer (AASHTO T 340) at the highest ARA content.

TABLE 605-1: SURFACE RECYCLE MIX DESIGN REQUIREMENTS

Property	Test Method	Limits
Air Voids at 30 gyrations, (%)	KT-58, KT-15, & KT-39	Report
Tensile Strength, (psi min)	KT-56	75
Retained Strength based on cured stability, (% min)	KT-56	80
Rut Resistance, (mm max)	AASHTO T 340	8
Thermal Cracking, (^{o}C max)	KT-60	-22

Testing procedures:

- Core the pavement to obtain Reclaimed Asphalt Pavement (RAP) for the mix design.
- Break down the RAP (representing the depth of the HIR) to a maximum particle size of 1 inch.
- The compaction temperature range for KT-58 is 200ºF to 250ºF.
- Perform all tests on plugs that are compacted to 30 gyrations, thus the air void criteria stated in KT-56, KT-60 and AASHTO T 340 are waived.
- Use procedure III when performing KT-15.

605.3 CONSTRUCTION REQUIREMENTS

a. Pavement Preparation. Before commencing surface recycling, remove all material from the surface of the pavement which would be detrimental to the HIR or would not comply with the design criteria of **subsection 605.2b**.

b. Heating and Scarifying Operations. Use a series of heaters, milling units and/or scarifiers to uniformly heat and recycle the existing pavement to the specified depth. Flames on the pavement can be prevented by heating the roadway more slowly using additional heaters. Intermittent or occasional flaming on the roadway or in the windrow that extinguishes on its own within 10 seconds is permissible, but if in the opinion of the Engineer it is detrimental to the final product, production will cease. In addition, production will cease when smoke is being produced continuously. (Smoke caused when the heaters pass over a maintenance patch is excluded from this clause.) The Contractor and Engineer will agree to a course of action to prevent this overheating before production is resumed. If flames or excessive smoke persists, then production is ceased until the Contractor modifies the operation and can demonstrate acceptable results without excessive smoke or flames on the pavement or in the windrows. When the depth of the HIR is more than 1 inch, heat the material in lifts not more than ¾ inches. When heating in multiple lifts, remove each lift at a uniform depth across the full width of the recycled pavement. This material may be windrowed when heating the next lift. Use equipment complying with **SECTION 155**. Provide adequate provisions for equipment calibration. Remove from the roadway milled or scarified material that can not be placed with a paving unit due to equipment breakdown or malfunction. Bring these removed areas to grade using a HMA approved by the Engineer.

c. Process Control.

(1) Depth Check. The Engineer will determine the depth per KT-47. The moving average of 3 consecutive tests shall equal or exceed the contract depth. If the 3-point moving average is less than the contract depth, KDOT will assess a Surface Recycling Pay Adjustment using Equation 1. The pay adjustment will correspond to those segments within the 3-point moving average that were deficient in depth.

Equation 1: $$P = 400\,(S)\left(1 - \frac{M}{T}\right)$$

Where: P is the Surface Recycling Pay Adjustment, ($0.00)
S is the number of stations (single lane) in penalty, (0.00)
M is the Measured Depth 3-point moving average, (0.000 feet or 0.00 inches)
T is the Plan Depth, (0.000 feet or 0.00 inches). T and M shall be the same unit of measure.

If 4 consecutive 3-point moving average values are less than the contract depth, stop production and evaluate the process with the Engineer. Change the process to the satisfaction of the Engineer before production is resumed. If the next 2 tests are deficient in thickness, Equation 2 will be used for the remainder of the project. The Engineer reserves the option to terminate production until a satisfactory agreement is reached anytime the 3-point moving average value is less than the contract depth for more than 2 consecutive tests.

Equation 2: $$P = 900\,(S)\left(1 - \frac{M}{T}\right)$$

If both KDOT and the Contractor agree that recycling to the contract depth would be detrimental to the project, the unit price will be negotiated for the reduced depth before proceeding with the project, and the Engineer would create a change order (**SECTION 104**) for the item at the new unit price.

(2) Temperature Requirements: Heat the HMA being scarified and/or hot milled to a minimum of 190ºF prior to scarifying and/or hot milling. Maintain the temperature of the HIR, directly behind the paver, between 190ºF and 300ºF. HIR temperatures taken within 2 feet of each other, transverse to the roadway, shall not vary by more than 30ºF. HIR temperatures taken within 10 feet of each other, transverse to the roadway, shall not vary by more than 50ºF. If these temperature requirements are not satisfied within 1 hour after a discrepancy is discovered, the HIR train will be stopped and the Engineer and Contractor will determine a course of action to correct the deficiency before the HIR train proceeds.

d. Rejuvenating and Mixing Operations. After heating and scarifying and/or hot milling, uniformly add the ARA and thoroughly mix the HIR. Include all of the previously scarified and/or hot milled material into the mixing operation.

e. Spreading and Compacting Operations. Immediately following heating, scarifying, adding ARA and mixing operations, begin work to fulfill the requirements of one of the following operations:

(1) Operation Number 1.

(a) Spread and finish the rejuvenated mixture with an acceptable paving unit.

(b) Provide density using an approved rolling procedure. Use a minimum of 2 Self-Propelled Smooth-Faced Steel Rollers complying with **SECTION 151**. The Engineer will determine the initial approved rolling procedure from densities obtained with various roller combinations.

Density will be determined by using a nuclear gauge. Use the approved rolling procedure. Achieve the maximum density before the temperature of the HIR falls below 160°F. Do not crush the aggregate. When the mat temperature falls below 160°F, roller marks may be removed from the mat with a self-propelled Smooth-Faced Steel Roller operated in the static mode. If there is a significant change in factors affecting density, such as weather or compaction equipment, the Engineer will reevaluate and modify the rolling procedure as required. Stop the HIR operation whenever rolling is not being performed according to the approved rolling procedure.

(c) Maintain the rejuvenated pavement surface until the surface treatment shown in the Contract Documents is completed. When required, apply a tack coat before placing the surface treatment. If a seal coat, asphalt seal, micro-surfacing or ultra-thin bonded asphalt surface is included in the Contract Documents, allow the HIR surface to cure 1 week before sealing.

(2) Operation Number 2. Use an asphalt paver equipped with automatic grade control to spread and finish the amount specified of the new asphalt surface material. **SECTIONS 601** and **602** apply. If a HMA overlay is included in the contract, place the HMA and surface recycle concurrently, or the 2 materials may be blended and laid as 1 lift.

f. Weather and Seasonal Limitations. Construct surface recycling when the surface is dry, and the weather is not foggy or rainy. Only construct surface recycling between May 1 and September 30, when either the minimum ambient air temperature or the road surface temperature shown in **TABLE 605-2** is met.

TABLE 605-2: MINIMUM HIR TEMPERATURE REQUIREMENTS		
Existing Surface Type	**Ambient Air Temperature (^oF)**	**Road Surface Temperature (^oF)**
On HMA Surface	50	55
On Asphalt Seal Surface	55	60

g. Pavement Smoothness. Evaluate pavement smoothness according to **SECTION 603**.

605.4 MEASUREMENT AND PAYMENT

The Engineer will measure surface recycling by the Station, along the centerline. On divided highways, the Engineer will measure surface recycling by the Station, along the centerline of each divided direction. This includes all widened and irregular areas and irregular variations in depth.

The Engineer will measure asphalt rejuvenating agent by the ton.

Payment for "Surface Recycling" and "Asphalt Rejuvenating Agent" at the contract unit prices is full compensation for the specified work.

The bid item Surface Recycling Pay Adjustment will be an item added to the contract.

SECTION 606

MICROSURFACING

606.1 DESCRIPTION

Spread a mixture of modified emulsified asphalt, mineral aggregate, water and additives on a prepared surface as specified in the Contract Documents.

BID ITEMS	UNITS
Aggregate for Microsurfacing	Ton
Emulsified Asphalt (*) (Modified)	Ton
Mineral Filler	Ton

*Designated Type and Grade

606.2 MATERIALS

Provide materials that comply with the applicable requirements.

Emulsified Asphalt .... **DIVISION 1200**
Aggregate for Microsurfacing .... **DIVISION 1100**
Water .... **DIVISION 2400**

Conduct aggregate acceptance tests at the point of usage.

Use a Cationic Type CSS-1HM emulsified asphalt complying with **SECTION 1202**.

For mineral filler, use any recognized brand of non-air-entrained portland cement that is free of lumps and acceptable to the Engineer.

Provide a Type "C" certification for any proposed additives.

The Engineer will test materials according to the Contract Documents and Appendix B-Sampling and Testing Frequency Chart-Quality Control/Quality Assurance Specifications.

606.3 CONSTRUCTION REQUIREMENTS

a. Mix Design.

(1) Job Mix Formula. Develop and submit the job mix formula and certified test results meeting the criteria in **TABLE 606-1** for the Engineer's approval. Include aggregate type and gradation, percentage of modified emulsion, water and cement by weight of dry aggregate in the mix.

TABLE 606-1: MICROSURFACING MIX DESIGN REQUIREMENTS

Property	Test	Requirements
Wear Loss (Wet Track Test)	ASTM D6372 (1 hr soak) (6 day soak)	 50 g/ft^2, maximum 75 g/ft^2, maximum
Wet Cohesion	ASTM D6372 @ 30 minutes @ 60 minutes	 10 in-lbs, minimum 17 in-lbs, minimum
Wet Stripping	ISSA TB-114	90%, minimum
Mix Time @ 77°F	ISSA TB-113	Controllable to 120 seconds, minimum

(2) Proportioning. Use the proportions in **TABLE 606-2** unless otherwise shown in the Contract Documents. Do not begin microsurfacing until the Engineer approves the mix design, materials, and construction.

TABLE 606-2: MICROSURFACING MIX PROPORTIONING		
Material	**Units**	**Value**
Mineral Aggregate	lbs/SY dry weight	15, minimum
Modified Emulsion	Percent residue by weight	6.5, minimum
Mineral Filler	Percent by weight of dry aggregate	1.0 to 3.0 *
Additive	Percent by weight of dry aggregate	As required

* Unless otherwise approved by the Engineer.

(3) Aggregate and Asphalt. Screen the aggregate for lumps, and weigh it before delivery to the lay down machine. Weigh the emulsified asphalt. The Engineer will approve the screens and scales.

Provide individual volume or weight controls for proportioning each item to be added to the mix. Calibrate and mark each material control device. Locate the devices to be accessible for ready calibration, and place so the Engineer can determine the amount of each material used at any time.

Mineral filler may be added at the loading facility, provided the Engineer approves accurate proportioning and metering devices, and there is no detrimental effect on the final product.

b. Surface Preparation. Immediately before applying the microsurfacing, thoroughly clean the surface of the roadway of all foreign material and pre-wet as required.

c. Ruts. When shown in the Contract Documents, fill ruts, utility cuts and depressions in the existing surface before placing the final surface. Cover ruts and irregularities of less than ½ inch in depth with a full width scratch coat. Accomplish the scratch coat by using a rigid rear seal in the spreading equipment.

Independently fill ruts greater than ½ inch in depth using a rut filling spreader box 5 to 6 feet in width. Crown ruts filled with a rut filling spreader box to compensate for compaction.

Ruts in excess of 1 ½ inches require multiple passes with the spreader box to restore the original cross section. When multiple passes are required, carry traffic overnight on each rut-filling pass before a subsequent filling pass is made.

d. Mixing and Spreading. Mix and spread the microsurfacing materials with a self-propelled machine capable of accurately delivering and proportioning all of the required components. Operate the machine continuously while loading, eliminating construction joints. Do not use lumping, balling or unmixed aggregate.

Place longitudinal joints on lane lines. Do not overlap or leave gaps in longitudinal joints. Construct a finished microsurface with a uniform texture and free of scratches, tears and other surface irregularities. Repair the surface if any of these conditions exist:

- more than 1 surface irregularity that is ¼ inch or wider and 10 feet or longer in any 100 foot section of the microsurface;
- more than 3 surface irregularities that are ½ inch or wider and more than 6 inches long in any 100 foot section of the microsurface; or
- any surface irregularity that is 1 inch or wider and more than 4 inches long.

Construct finished, uniform, longitudinal and transverse joints in the microsurface. Repair the joints if any of these conditions exist:

- build-up of microsurface material at the joints;
- uncovered areas at the joints;
- longitudinal joints with more than ½ inch vertical space between the surface and a 4 foot straightedge placed perpendicular to the joint; or
- transverse joints with more than ¼ inch vertical space between the surface and a 4 foot straightedge placed perpendicular to the joint.

Construct the edges of the microsurface to follow the centerline, lane lines, shoulder lines and curb lines. Repair edges that vary more than ± 3 inches from a 100 foot straight line (or a 100 foot arch on a curved section).

Use methods approved by the Engineer to correct deficiencies in the microsurface. Construct a dense, repaired surface with a uniform texture.

e. Curing. Provide adequate means to protect the microsurface from damage by traffic until the mixture has cured sufficiently. Allow the surface of microsurfacing to cure so as to not adhere to or be picked up by the tires of vehicles. Allow traffic to use the microsurfacing when cured.

Cure the material used for filling wheel ruts a minimum of 24 hours before the full width coverage is applied.

f. Maintenance of Traffic. Maintain traffic according to **DIVISION 800** and the following:

- Station 1 flagger immediately ahead of the application of the microsurfacing material and 1 flagger immediately behind the section being cured.
- Display suitable speed limit signs and “fresh oil” signs. Move the signs forward with the flaggers as the work progresses.
- Suspend application of the microsurface early enough each day to permit traffic to safely travel over the completed work before sunset.
- Repair any traffic damage to the microsurface at Contractor expense.

g. Seasonal and Weather Limitations. Construct the microsurfacing between May 1 and October 15. Do not place microsurfacing when the ambient air temperature is less than 50ºF, or the weather is foggy or raining, and the air temperature is forecasted to go below 32ºF within 24 hours following the placement.

h. Observation Period. The Engineer, along with the Contractor, will inspect the microsurfacing 30 days after work is completed on the microsurfacing. Repair areas where there is no cover material left in place (bare areas) as directed by the Engineer:

- In 5% the wheel paths; and
- Individual areas ≥ 10 square yards; and
- Where the total square yards of bare areas is greater than 5% of the total square yards of the seal.

g. Pavement Smoothness. Microsurfacing is excluded from profilograph testing, and not eligible for pay adjustments.

606.4 MEASUREMENT AND PAYMENT

The Engineer will measure aggregate for microsurfacing, emulsified asphalt (modified) and mineral filler by the ton. No deduction will be made for moisture in the aggregate. When sacked portland cement is used, 1 sack equals 94 pounds.

Water used for pre-wetting the pavement surface and mix water is subsidiary to other bid items and will not be measured for separate payment.

Material used to correct surface deficiencies in the microsurfacing will not be measured for payment.

Payment for "Aggregate for Microsurfacing", "Emulsified Asphalt (Modified)" and "Mineral Filler" at the contract unit prices is full compensation for the specified work.

SECTION 607

ASPHALT PRIME COAT

607.1 DESCRIPTION

Treat a previously prepared surface with asphalt material, and apply blotter material, when required, as specified in the Contract Documents.

BID ITEMS	UNITS
Emulsified Asphalt (*)	Ton
Cutback Asphalt (*)	Ton

*Designated Type and Grade.

607.2 MATERIALS

Provide asphalt materials that comply with **DIVISION 1200**.

607.3 CONSTRUCTION REQUIREMENTS

a. Preparation of Road Surfaces. Before distributing asphalt materials, blade the surface of the roadbed to a smooth, uniform cross-section. Broom off all loose materials, and clean the surface until it is free from dust. Shape, blade and broom side roads that receive asphalt treatment, at the same time as the roadbed surface. When required by the Engineer, give the broomed surface of an earth subgrade or a water-bound base course or subbase a light application of water (approximately 0.1 gallon per square yard) before the asphalt material is applied.

b. Protection of Adjacent Structures. Protect the surfaces of all structures and other roadway appurtenances from damage or splatter of asphalt material. Restore any damaged or splattered appurtenances to their original condition at own expense.

c. Temperature of Asphalt Materials at Time of Application. Apply asphalt material at the temperature specified in **TABLE 601-1**, or included on the producer's Bill of Lading.

d. Prime Coat. Apply the prime coat to earth subgrades, water-bound base courses and subbases as soon as practicable after they have been prepared and are sufficiently dry.

Apply the prime coat to asphalt surfaces immediately after final rolling, and before any traffic has been allowed upon or the surface has hardened and glazed hindering the penetration of asphalt material.

Using a distributor (see **subsection 155.2**), uniformly apply asphalt material at the rate shown in the Contract Documents. Frequently check and adjust the spray nozzles and spray bar to obtain uniform distribution. Should any nozzle malfunction, immediately stop distribution. Correct any deficiency before distribution is resumed.

Only use hand sprayers for areas that can not be primed by normal operation of the distributor.

e. Protection of Prime Coat After Application. Maintain the prime coat and the surface of the subgrade or base course until it has been covered by the surface course or until final acceptance of the work. Clean all damaged areas of loose material, repair them satisfactorily and reapply the prime coat. Such maintenance and repair is at the Contractor's expense.

After 48 hours, the Engineer may require a light application of blotting material on specified areas to prevent damage from traffic. Use a clean fine sand or other approved material.

f. Seasonal and Weather Limitations. Construct asphalt prime coats between May 1 and October 15 when the ambient air temperature is 60ºF and rising, and the weather is not rainy or foggy. These limitations may be modified with written approval from the Engineer.

g. Pavement Smoothness. Asphalt prime coat is excluded from profilograph testing, and <u>not</u> eligible for pay adjustments.

607.4 MEASUREMENT AND PAYMENT

The Engineer will measure emulsified asphalt and cutback asphalt by the ton.

The Engineer will measure blotter material by either the ton or the cubic yard in the vehicle at the time and place of unloading or at other points as designated by the Engineer. Blotting material will not be paid for as such, but will be included in the quantities of cover material or aggregate for base course, provided in the Contract Documents.

Manipulation for prime coat will not be measured directly, but will be subsidiary to the item of manipulation for other phases of work. Any water for the preparation of the prime coat is subsidiary.

Payment for "Emulsified Asphalt (*)" and "Cutback Asphalt (*)" at the contract unit prices is full compensation for the specified work.

SECTION 608

CHIP SEALS

608.1 DESCRIPTION

Apply asphalt material to the existing surface, followed by an application of cover material, as specified in the Contract Documents.

BID ITEMS	UNITS
Cover Material (*)	Cubic Yard
Cutback Asphalt (*)	Ton
Emulsified Asphalt (*)	Ton
Asphalt Cement (*)	Ton
Water (Flexible Pavement) (Set Price)	M Gallon
Manipulation (Chip Seals)	Station

*Type and Grade

608.2 MATERIALS

Provide materials that comply with the applicable requirements.

Aggregate for Cover Material .... **DIVISION 1100**
Asphalt Material .... **DIVISION 1200**
Water .... **DIVISION 2400**

608.3 CONSTRUCTION REQUIREMENTS

a. Preparation of Surfaces. Before applying asphalt material, clean all foreign material from the surface to be treated. Broom surface to remove dust.

b. Protection of Adjacent Structures. Protect the surfaces of all structures and other roadway appurtenances from damage or splatter of asphalt material. Restore any damaged or splattered appurtenances to their original condition at own expense.

c. Temperature of Asphalt Materials at Time of Application. Apply asphalt material at the temperature specified in **TABLE 601-1**, or as shown on the producer's Bill of Lading.

d. Application of Asphalt Material. Using a distributor (see **subsection 155.2**), uniformly apply asphalt material at the rate shown in the Contract Documents. Equip and operate the distributor to prevent asphalt material from dripping on the pavement.

At the beginning of each spread, start the application on a strip of building paper, approximately 3 feet in width and 1 foot longer than the spray bar. If the spray cut-off is not positive, use paper at the end of each spread. Remove and dispose of the paper in a satisfactory manner. Open the spray bar when the distributor is moving forward at proper speed, unless the distributor is equipped to apply the specified rate from a standing start. Correct any skipped areas or deficiencies. Construct junctions (joints) of spreads to obtain a smooth riding surface.

Do not spread more asphalt material than can be immediately covered.

Regulate the distribution of the asphalt material to obtain a uniform application. Do not allow the distributor to "blow".

Frequently check and adjust the angle of the spray nozzles and the height of the spray bar to obtain uniform distribution. If the spray bar rises as the load is removed, contributing to drilling and streaking, modify the distributor to maintain a constant spray bar height. Immediately stop distribution should any nozzle malfunction. Correct any deficiency before distribution is resumed.

e. Application of Aggregate. Immediately following the application of the asphalt material, spread cover material with a self-propelled aggregate spreader in quantities designated in the Contract Documents. The tires of the trucks or aggregate spreaders shall not come in contact with the fresh asphalt material at any time.

Do not allow the asphalt material to remain uncovered long enough to impair retention of the cover material. Do not apply the spread width of the cover material greater than 6 inches wider than the spread width of asphalt material.

Uniformly cover the asphalt before rolling. Equip and operate spreading equipment to provide complete coverage. Brooming, dragging or blading of the cover material is prohibited before initial rolling. Perform any rearrangement of the cover material by hand methods. Avoid overlapping applications of cover material and remove all spillage from the surface.

At the time of delivery to the roadway, the moisture content of the cover material shall not exceed 3% by weight plus ½ the water absorption of the aggregate. Do not let free moisture drain from the truck. The moisture limitations do not apply if lightweight aggregate is used.

When directed by the Engineer, moisten the cover material with water to eliminate or reduce the dust coating of the aggregate. Perform the moistening the day before the aggregate is used.

Any operation of equipment that results in displacement of the cover material or damage to the seal course is prohibited.

f. Rates of Application of Aggregate. When alternate types of cover material are shown in the Contract Documents, the quantities of aggregate and asphalt material are for the purpose of estimating and bidding only. Once the Contractor designates the alternate type of aggregate to be supplied, the total quantities to be used and paid for are determined by using the application rates in **TABLE 608-1**. No change in the contract unit price will be made.

The application rate shown in **TABLE 608-1** may be changed with written approval from the Engineer.

TABLE 608-1: RATES OF APPLICATION FOR CHIP SEAL				
Type	**Composition**	**Aggregate Cu. Yd./Mile 24 foot width***	**Asphalt Material Gal/Sq. Yd. Residue***	**Asphalt Type****
CM-A	Sand-Gravel	105	0.20	CRS-1H
CM-B	Sand-Gravel	135	0.23	CRS-1H
CM-D	Crushed Sandstone	145	0.27	CRS-1H or RS-1H
CM-K	Limestone	140	0.24	RS-1H
CM-L-1	Lightweight	85	0.17	CRS-1H
CM-L-2	Lightweight	115	0.26	CRS-1H
CM-L-3	Lightweight	150	0.30	CRS-1H

*Rates shown are estimated and will be adjusted to comply with actual field conditions.
** Asphalt type may be changed with approval of the DME.

If the quantity of cover material computed from **TABLE 608-1** exceeds the amount used on the roadway, the Engineer will designate a stockpile location for this excess quantity. Locate the stockpile along the project, or at locations requiring a haul distance no longer than the most distant end of the project.

The maximum quantity of cover material to be stockpiled is as follows:

- The amount shown on the Contract Documents minus the amount used on the road when one type of cover material is shown in the Contract Documents.
- The amount determined by using the application rates in **TABLE 608-1** minus the amount used on the road when alternate types of cover material are shown in the Contract Documents.
- The amount specified by the Engineer minus the amount used on the road when the Engineer changes the application rates in **TABLE 608-1**.

Payment for the stockpiled material will be at the contract unit price per cubic yard of cover material.

g. Manipulation. Immediately following the application of cover material, embed using pneumatic rolling. Provide a minimum of 3 self-propelled pneumatic rollers. Check the tire pressures of all tires on all rollers every morning. Inflate all tires on a roller to the same pressure. Provide this information to the Engineer before work begins. Complete the initial rolling within 5 minutes after application of cover material. If the air temperature is less than 70ºF, then complete the initial rolling within 2 minutes after applying the aggregate. Proceed at a speed less than or equal to 5 miles per hour to prevent turning over aggregate. Make a minimum of 3 complete passes over the aggregate. Roll the aggregate so the entire width of the treatment area is covered in one pass of all the rollers. The total compacting width of each pneumatic-tired roller shall exceed 5 feet. The number of rollers for shoulders may be reduced based on the width of the shoulders and the width of the rollers.

If emulsified asphalt is used, cure the asphalt material a minimum of 4 hours before opening the roadway to unrestricted traffic. If polymer modified emulsified asphalt is used, the cure time shall be a minimum of 1 ½ hours before the traveled way is opened to unrestricted traffic. If traffic causes excessive chip loss, increase the cure time until excessive chip loss is eliminated.

On seals using CM-A, or B, the Engineer may require the use of a steel roller for one of the coverages, provided excessive crushing of the cover material does not occur.

Do not turn rollers on the sealed surface.

When required, apply additional cover material and roll it with the pneumatic rollers as directed by the Engineer.

Broom the loose cover material from the surface of the traveled way as soon as the asphalt material has cured enough to prevent damage by brooming or vehicular traffic. Continue periodic brooming until all loose aggregate has been removed. Perform a minimum of 1 light brooming of the cover material, before opening to traffic. Additional broomings may be required before opening to traffic to prevent the cover material from being picked up by moving vehicles. Broom excess cover material from the shoulder.

The Contractor may seal in 1 lane for the entire day.

When CM-B and cutback asphalt are specified in the Contract Documents, begin a second period of manipulation on the day following the first rolling, or as soon thereafter as weather conditions permit. This manipulation consists of spreading the loose cover material uniformly over the surface and rolling with the type of rollers specified by the Engineer. The rolling operation consists of 2 complete coverages of the previous day's work. Following the second day's rolling, broom excess cover material off the traveled way and shoulders, as directed by the Engineer.

h. Maintenance of Completed Work. When directed by the Engineer, add asphalt material and aggregate to completed portions of the project. All additional asphalt material and aggregate so ordered will be included in the pay quantities. Spreading and rolling of additional aggregate will not be paid for separately, but is considered as subsidiary to the item of "Manipulation (Chip Seals)".

If the shoulder vegetation is not sufficient to define the edge of the traveled way, broom and blade the excess cover material off the shoulder to provide delineation.

i. Treatment of Adjacent Areas. When shown in the Contract Documents, seal the existing intersections and entrances, mailbox turnouts, etc. having asphalt surfaces. Seal all widened areas. Asphalt and cover material for this work is included in the contract quantities and will be paid for at the contract unit price.

j. Maintenance of Traffic. Maintain traffic according to **DIVISION 800** and the following.

Coordinate all construction operations to result in the least practicable delay of traffic. Maintain one-way traffic and restrict traffic speeds to 30 MPH on bare pavement and 20 MPH on freshly applied seal. Use pilot cars to lead one-way traffic through the areas of distribution and curing. Coordinate the work so the pilot car completes a round trip in 15 minutes or less. Do not delay traffic at more than 2 separate locations of work on a project.

Station one flagger immediately ahead of the application of the asphalt material and one flagger immediately behind the section being cured. Move the signs and flaggers forward as the work progresses.

Complete all brooming activities before opening the traveled way to unrestricted traffic.

On projects where asphalt sealing is constructed in connection with other work from which traffic is detoured, the provisions of this subsection do not apply. Restrict the speed of all equipment traveling on the freshly applied seal to 20 MPH for 24 hours.

k. Seasonal and Weather Limitations.

(1) Construct asphalt sealing using cutback asphalt between May 1 and October 15, when the ambient air temperature is 60ºF and rising.

(2) Construct asphalt sealing using emulsified asphalt between June 1 and September 15, when the ambient air temperature is 60ºF and rising, and the pavement temperature is a minimum of 70ºF.

(3) Construct asphalt sealing using asphalt cement between June 1 and September 1, when the ambient air temperature is 70ºF and rising, and the pavement temperature is a minimum of 80ºF.

When aggregate retention is unsatisfactory, suspend sealing. Do not seal when the surface is wet, or the weather is foggy or rainy. These limitations may be modified with written approval from the Engineer.

If the seal is damaged or lost, due to rain or wet pavement, repair or re-seal the damaged pavement.

l. Observation Period. If the chip seal is constructed in accordance with the seasonal limitations in **subsection 608.3k.**, the Engineer, along with the Contractor, will inspect the seal, 30 days after work is completed on the seal. If the seasonal limitations in **subsection 608.3k.** are modified, the Engineer, along with the Contractor, will inspect the seal between May 1 and April 1 the following year. Repair areas where there is no cover material left in place (bare areas) as directed by the Engineer:

- In 5% the wheel paths; and
- Individual areas ≥ 10 square yards; and
- Where the total square yards of bare areas is greater than 5% of the total square yards of the seal.

m. Pavement Smoothness. Chip seals are excluded from profilograph testing, and <u>not</u> eligible for pay adjustments.

608.4 MEASUREMENT AND PAYMENT

The Engineer will measure cover material by the cubic yard. The material will be measured in the vehicle at the time and place of unloading. No deductions will be made for moisture in the cover material.

The Engineer will measure asphalt material by the ton. Deductions will be made for the number of tons that are not placed on the road surface.

The Engineer will measure manipulation by the Station, along the centerline. On divided highways, the Engineer will measure manipulation by the Station, along the centerline of each divided direction. This includes all widened and irregular areas and irregular variations in depth.

The Engineer will measure ordered water by the M Gallon by means of calibrated tanks or water meters.

Payment for "Cover Material", "Cutback Asphalt", "Emulsified Asphalt", "Asphalt Cement" and "Manipulation (Chip Seals)" at the contract unit prices and "Water (Flexible Pavement) (Set Price)" at the contract set unit price is full compensation for the specified work.

When the Contract Documents call for asphalt cement for chip seals, the following provisions apply:

- If the work is not completed by September 1, and when ordered by the District Engineer in writing, change the type of asphalt material to cutback asphalt.
- If approved changes are made, the unit price for cutback asphalt will be the contract price for asphalt cement plus or minus the difference in the invoice price of the two materials at the refinery at the time of application.

Such measurement and payment is full compensation for the work specified.

SECTION 609

SINGLE ASPHALT SURFACE TREATMENT

609.1 DESCRIPTION

Construct a wearing surface composed of an asphalt prime coat followed by the application of an asphalt surfacing and cover material as specified in the Contract Documents.

BID ITEMS	UNITS
Cover Material (*)	Cubic Yard
Cutback Asphalt (*) (**)	Ton
Emulsified Asphalt (*) (**)	Ton
Asphalt Cement (*) (**)	Ton
Water (Flexible Pavement) (Set Price)	M Gallon
Manipulation (S.A.S.T.)	Station

*Type and Grade
**"Prime" denotes material to be used for prime.
"Seal" denotes material to be used for seal.

609.2 MATERIALS

Provide materials that comply with the applicable requirements.

Aggregates for Cover Material .... **DIVISION 1100**
Asphalt Material .... **DIVISION 1200**
Water .... **DIVISION 2400**

609.3 CONSTRUCTION REQUIREMENTS

a. Preparation of Road Surfaces.

(1) Earth subgrade, water-bound base courses and subbases. Before distributing asphalt materials, blade the surface of the roadbed to a smooth, uniform section. Remove all loose materials. Shape, blade and broom side roads that receive asphalt treatment, at the same time as the roadbed surface. When required by the Engineer, give the water-bound base course or subgrade a light application of water (approximately 0.1 gallon per square yard) before the asphalt material is applied.

(2) Asphalt surfaces. Before applying asphalt material, clean all foreign material from the surface to be treated. Broom surface to remove dust. When required by the Engineer, give the asphalt surface a light application of water (approximately 0.1 gallon per square yard) before the asphalt material is applied.

b. Protection of Adjacent Structures. Protect the surfaces of all structures and other roadway appurtenances from damage or splatter of asphalt material. Restore any damaged or splattered appurtenances to their original condition at own expense.

c. Temperature of Asphalt Materials at Time of Application. Apply asphalt material at the temperature specified in **TABLE 601-1**, or as shown on the producer's Bill of Lading.

d. Application of Prime Coat. Apply the prime coat to earth subgrades, water-bound base courses and subbases as soon as practicable after they have been prepared and are sufficiently dry.

Apply the prime coat to asphalt surfaces immediately after final rolling and before any traffic has been allowed, or when the surface has hardened and glazed so penetration of asphalt material is hindered.

Using a distributor (see **subsection 155.2**), uniformly apply asphalt material at the rate shown in the Contract Documents. Frequently check and adjust the spray nozzles and spray bar to obtain uniform distribution. Should any nozzle malfunction, immediately stop distribution. Correct any deficiency before distribution is resumed.

Only use hand sprayers for areas that can not be primed by normal operation of the distributor.

e. Preparation of Road Surfaces for Seal Coat. After the prime coat has thoroughly penetrated the subgrade, and before applying asphalt material, clean the surface to be treated of all foreign material and broom it as necessary to remove dust.

f. Application of Asphalt Material for Seal Coat. Using a distributor, uniformly apply asphalt material at the rate shown in the Contract Documents. Equip and operate the distributor to prevent asphalt material from dripping on the pavement.

At the beginning of each spread, use a strip of building paper, approximately 3 feet in width and 1 foot longer than the spray bar. If the spray cut-off is not positive, use paper at the end of each spread. Remove the paper and dispose of it in a satisfactory manner. Open the spray bar when the distributor is moving forward at proper speed, unless it is equipped to apply the specified rate from a standing start. Correct any skipped areas or deficiencies. Carefully make junctions of spreads to obtain a smooth riding surface.

Do not spread more asphalt material than can be immediately covered. Do not allow the asphalt material to remain uncovered long enough to impair retention of the cover material. Do not exceed the spread width of the cover material with the spread width of asphalt material by more than 6 inches.

Regulate the distribution of the asphalt material to obtain a uniform application. Do not allow the distributor to "blow".

Frequently check and adjust the angle of the spray nozzles and the height of the spray bar to obtain uniform distribution. If the rise of the spray bar as the load is removed is excessive and contributes to drilling and streaking, modify the distributor to maintain a constant spray bar height. Should any nozzle malfunction, immediately stop distribution. Correct any deficiency before distribution is resumed.

g. Application of Aggregate for Seal Coat. Immediately following the application of the asphalt material, spread cover material with a self-propelled aggregate spreader in quantities designated in the Contract Documents.

The tires of the trucks or aggregate spreaders shall not come in contact with the fresh asphalt material at any time.

Do not allow the asphalt material to remain uncovered long enough to impair retention of the cover material. Do not apply the spread width of the cover material greater than 6 inches wider than the spread width of asphalt material.

Uniformly cover the asphalt before rolling. Equip and operate spreading equipment to provide complete coverage. Brooming, dragging or blading of the cover material is prohibited before initial rolling. Perform any rearrangement of the cover material by hand methods. Avoid overlapping applications of cover material and remove all spillage from the surface.

At the time of delivery to the roadway, the moisture content of the cover material shall not exceed 3% by weight plus ½ the water absorption of the aggregate. Do not let free moisture drain from the truck. The moisture limitations do not apply if lightweight aggregate is used.

When directed by the Engineer, moisten the cover material with water to eliminate or reduce the dust coating of the aggregate. Perform the moistening the day before the aggregate is used.

Any operation of equipment that results in displacement of the cover material or damage to the seal course is prohibited.

h. Rates of Application of Cover Material for Seal Coat. When alternate types of cover material are shown in the Contract Documents, the quantities of aggregate and asphalt material are for the purpose of estimating and bidding only. Once the Contractor designates the alternate type of aggregate to be supplied, the total quantities to be used and paid for are determined by using the application rates in **TABLE 608-1**. No change in the contract unit price will be made.

The application rate shown in **TABLE 608-1** may be changed with written approval from the Engineer.

If the quantity of cover material computed from **TABLE 608-1** exceeds the amount used on the roadway, the Engineer will designate a stockpile location for this excess quantity. Locate the stockpile along the project, or at locations requiring a haul distance no longer than the most distant end of the project.

The maximum quantity of cover material to be stockpiled is as follows:

- The amount shown on the Contract Documents minus the amount used on the road when one type of cover material is shown in the Contract Documents.
- The amount determined by using the application rates in **TABLE 608-1** minus the amount used on the road when alternate types of cover material are shown in the Contract Documents.

- The amount specified by the Engineer minus the amount used on the road when the Engineer changes the application rates in **TABLE 608-1**.

Payment for the stockpiled material will be at the contract unit price per cubic yard of cover material.

i. Manipulation of Completed work. Immediately following the application of cover material, embed using pneumatic rolling. Provide a sufficient number of pneumatic rollers to complete the initial roller coverage within 15 minutes after the application of cover material. Continue pneumatic rolling until a total of 7 complete coverages are obtained. Keep the speed of rollers such that aggregate displacement is minimized. Vary the weight of the rollers to embed the cover material as shown in the Contract Documents.

If emulsified asphalt is used, cure the asphalt material a minimum of 4 hours before opening the roadway to unrestricted traffic. If polymer modified emulsified asphalt is used, the cure time shall be a minimum of 1 ½ hours before the traveled way is opened to unrestricted traffic. If traffic causes excessive chip loss, increase the cure time until excessive chip loss is eliminated.

On seals using CM-A, B or E, the Engineer may require the use of a steel roller for one of the coverages, provided excessive crushing of the cover material does not occur.

Control the rolling sequence so it shall be unnecessary for one roller to turn out to permit another roller to pass. Do not turn rollers on the sealed surface.

When required, apply additional cover material and roll it with the pneumatic rollers as directed by the Engineer.

Provide self-propelled rollers.

Broom the loose cover material from the surface of the traveled way as soon as the asphalt material has cured enough to prevent damage by brooming or vehicular traffic. Continue periodic brooming until all loose aggregate has been removed. Perform a minimum of 1 light brooming of the cover material before opening to traffic. Additional broomings may be required before opening to traffic to prevent the cover material from being picked up by moving vehicles. Broom excess cover material from the shoulder.

The Contractor may seal in 1 lane for the entire day.

When CM-B and cutback asphalt are specified in the Contract Documents, begin a second period of manipulation on the day following the first rolling, or as soon thereafter as weather conditions permit. This manipulation consists of spreading the loose cover material uniformly over the surface and rolling with the type of rollers specified by the Engineer. The rolling operation consists of 2 complete coverages of the previous day's work. Following the second day's rolling, broom excess cover material off the traveled way and shoulders, as directed by the Engineer.

j. Maintenance of Completed Work. When directed by the Engineer, add asphalt material and aggregate to completed portions of the project. All additional asphalt material and aggregate so ordered will be included in the pay quantities. Spreading and rolling of additional aggregate will not be paid for separately. It is considered as subsidiary to the item of "Manipulation (S.A.S.T.)".

If the shoulder vegetation is not sufficient to define the edge of the traveled way, broom and blade the excess cover material off the shoulder to provide delineation.

k. Treatment of Adjacent Areas. When shown in the Contract Documents, seal the existing intersections and entrances, mailbox turnouts, etc. having asphalt surfaces. Seal all widened areas. Asphalt and cover material for this work is included in the contract quantities and will be paid for at the contract unit price.

l. Seasonal and Weather Limitations.

(1) Construct asphalt sealing using cutback asphalt between May 1 and October 15, when the ambient air temperature is 60ºF and rising.

(2) Construct asphalt sealing using emulsified asphalt between June 1 and September 15, when the ambient air temperature is 60ºF and rising, and the pavement temperature is a minimum of 70ºF.

(3) Construct asphalt sealing using asphalt cement between June 1 and September 1, when the ambient air temperature is 70ºF and rising, and the pavement temperature is a minimum of 80ºF.

When aggregate retention is unsatisfactory, suspend sealing. Do not seal when the surface is wet, or the weather is foggy or rainy. These limitations may be modified with written approval from the Engineer.

If the seal is damaged or lost, due to rain or wet pavement, repair or re-seal the damaged pavement.

m. Pavement Smoothness. Single asphalt surface treatment is excluded from profilograph testing, and not eligible for pay adjustments.

609.4 MEASUREMENT AND PAYMENT

The Engineer will measure cover material by the cubic yard. The material will be measured in the vehicle at the time and place of unloading. No deductions will be made for moisture in the cover material.

The Engineer will measure asphalt material by the ton. Deductions will be made for the number of tons that are not placed on the road surface.

The Engineer will measure manipulation by the Station, along the centerline. On divided highways, the Engineer will measure manipulation by the Station, along the centerline of each divided direction. This includes all widened and irregular areas and irregular variations in depth.

The Engineer will measure ordered water by the M Gallon by means of calibrated tanks or water meters.

Payment for "Cover Material", "Cutback Asphalt", "Emulsified Asphalt", "Asphalt Cement" and "Manipulation (S.A.S.T.)" at the contract unit prices and "Water (Flexible Pavement) (Set Price)" at the contract set unit price is full compensation for the specified work.

When the Contract Documents call for asphalt cement for asphalt sealing, the following provisions apply:

- If the work is not completed by September 1, and when ordered by the District Engineer in writing, change the type of asphalt material to cutback asphalt.
- If approved changes are made, the unit price for cutback asphalt will be the contract price for asphalt cement plus or minus the difference in the invoice price of the two materials at the refinery at the time of application.

Such measurement and payment is full compensation for the work specified.

SECTION 610

DOUBLE ASPHALT SURFACE TREATMENT

610.1 DESCRIPTION

Construct a wearing surface composed of an asphalt prime coat followed by the applications of 2 asphalt seal coats and cover material as specified in the Contract Documents.

BID ITEMS	UNITS
Cover Material (*)	Cubic Yard
Cutback Asphalt (*) (**)	Ton
Emulsified Asphalt (*) (**)	Ton
Asphalt Cement (*) (**)	Ton
Water (Flexible Pavement) (Set Price)	M Gallon
Manipulation (D.A.S.T.)	Station

*Type and Grade
** "Prime" denotes material to be used for prime.
"Seal" denotes material to be used for seal.

610.2 MATERIALS

Provide materials that comply with the applicable requirements.

Aggregate for Cover Material .... **DIVISION 1100**
Asphalt Material .... **DIVISION 1200**
Water .... **DIVISION 2400**

610.3 CONSTRUCTION REQUIREMENTS

a. Preparation of Road Surfaces.

(1) Earth subgrade, water-bound base courses and subbases. Before distributing asphalt materials, blade the surface of the roadbed to a smooth, uniform section. Remove all loose materials. Shape, blade and broom side roads that receive asphalt treatment, at the same time as the roadbed surface. When required by the Engineer, give the water-bound base course or subgrade a light application of water (approximately 0.1 gallon per square yard) before the asphalt material is applied.

(2) Asphalt surfaces. Before applying asphalt material, clean all foreign material from the surface to be treated. Broom surface to remove dust. When required by the Engineer, give the asphalt surface a light application of water (approximately 0.1 gallon per square yard) before the asphalt material is applied.

b. Protection of Adjacent Structures. Protect the surfaces of all structures and other roadway appurtenances from damage or splatter of asphalt material. Restore any damaged or splattered appurtenances to their original condition at own expense.

c. Temperature of Asphalt Materials at Time of Application. Apply asphalt material at the temperature specified in **TABLE 601-1**, or as shown on the producer's Bill of Lading.

d. Application of Prime Coat. Apply the prime coat to earth subgrades, water-bound base courses and subbases as soon as practicable after they have been prepared and are sufficiently dry.

Apply the prime coat to asphalt surfaces immediately after final rolling and before any traffic has been allowed upon or when the surface has hardened and glazed so penetration of asphalt material is hindered.

Using a distributor (see **subsection 155.2**), uniformly apply asphalt material at the rate shown in the Contract Documents. Frequently check and adjust the spray nozzles and spray bar to obtain uniform distribution. Should any nozzle malfunction, immediately stop distribution. Correct any deficiency before distribution is resumed.

Only use hand sprayers for areas that can not be primed by normal operation of the distributor.

e. Preparation of Road Surfaces for First Seal Coat. After the prime coat has thoroughly penetrated the subgrade, and before applying asphalt material, clean the surface to be treated of all foreign material and broom it as necessary to remove dust.

f. Application of Asphalt Material for First Seal Coat. Using a distributor, uniformly apply asphalt material at the rate shown in the Contract Documents. Equip and operate the distributor to prevent asphalt material from dripping on the pavement.

At the beginning of each spread, use a strip of building paper, approximately 3 feet in width and 1 foot longer than the spray bar. If the spray cut-off is not positive, use paper at the end of each spread. Remove the paper and dispose of it in a satisfactory manner. Open the spray bar when the distributor is moving forward at proper speed, unless it is equipped to apply the specified rate from a standing start. Correct any skipped areas or deficiencies. Carefully make junctions of spreads to obtain a smooth riding surface.

Do not spread more asphalt material than can be immediately covered. Do not allow the asphalt material to remain uncovered long enough to impair retention of the cover material. Do not exceed the spread width of the cover material with the spread width of asphalt material by more than 6 inches.

Regulate the distribution of the asphalt material to obtain a uniform application. Do not allow the distributor to "blow".

Check and adjust the angle of the spray nozzles and the height of the spray bar frequently to obtain uniform distribution. If the rise of the spray bar as the load is removed is excessive and contributes to drilling and streaking, modify the distributor to maintain a constant spray bar height. Should any nozzle malfunction, immediately stop distribution. Correct any deficiency before distribution is resumed.

g. Application of Aggregate for First Seal Coat. Immediately following the application of the asphalt material, spread cover material with a self-propelled aggregate spreader in quantities designated in the Contract Documents. The tires of the trucks or aggregate spreaders shall not come in contact with the fresh asphalt material at any time.

Do not allow the asphalt material to remain uncovered long enough to impair retention of the cover material. Do not apply the spread width of the cover material greater than 6 inches wider than the spread width of asphalt material.

Uniformly cover the asphalt before rolling. Equip and operate spreading equipment to provide complete coverage. Brooming, dragging or blading of the cover material is prohibited before initial rolling. Perform any rearrangement of the cover material by hand methods. Avoid overlapping applications of cover material and remove all spillage from the surface.

At the time of delivery to the roadway, the moisture content of the cover material shall not exceed 3% by weight plus ½ the water absorption of the aggregate. Do not let free moisture drain from the truck. The moisture limitations do not apply if lightweight aggregate is used.

When directed by the Engineer, moisten the cover material with water to eliminate or reduce the dust coating of the aggregate. Perform the moistening the day before the aggregate is used.

Any operation of equipment that results in displacement of the cover material or damage to the seal course is prohibited.

h. Rates of Application of Cover Material for First Seal Coat. When alternate types of cover material are shown in the Contract Documents, the quantities of aggregate and asphalt material are for the purpose of estimating and bidding only. Once the Contractor designates the alternate type of aggregate to be supplied, the total quantities to be used and paid for are determined by using the application rates in **TABLE 608-1**. No change in the contract unit price will be made.

The application rate shown in **TABLE 608-1** may be changed with written approval from the Engineer.

If the quantity of cover material computed from **TABLE 608-1** exceeds the amount used on the roadway, the Engineer will designate a stockpile location for this excess quantity. Locate the stockpile along the project, or at locations requiring a haul distance no longer than the most distant end of the project.

The maximum quantity of cover material to be stockpiled is as follows:

- The amount shown on the Contract Documents minus the amount used on the road when one type of cover material is shown in the Contract Documents.
- The amount determined by using the application rates in **TABLE 608-1** minus the amount used on the road when alternate types of cover material are shown in the Contract Documents.

- The amount specified by the Engineer minus the amount used on the road when the Engineer changes the application rates in **TABLE 608-1**.

Payment for the stockpiled material will be at the contract unit price per cubic yard of cover material.

i. Manipulation. Immediately following the application of cover material, embed using pneumatic rolling. Provide a sufficient number of pneumatic rollers to complete the initial roller coverage within 15 minutes after the application of cover material. Continue pneumatic rolling until a total of 7 complete coverages are obtained. Keep the speed of rollers such that aggregate displacement is minimized. Vary the weight of the rollers to embed the cover material as shown in the Contract Documents.

If emulsified asphalt is used, cure the asphalt material a minimum of 4 hours before opening the roadway to unrestricted traffic. If polymer modified emulsified asphalt is used, the cure time shall be a minimum of 1 ½ hours before the traveled way is opened to unrestricted traffic. If traffic causes excessive chip loss, increase the cure time until excessive chip loss is eliminated.

On seals using CM-A, B or E, the Engineer may require the use of a steel roller for one of the coverages, provided excessive crushing of the cover material does not occur.

Control the rolling sequence so it shall be unnecessary for one roller to turn out to permit another roller to pass. Do not turn rollers on the sealed surface.

When required, apply additional cover material and roll it with the pneumatic rollers as directed by the Engineer.

Provide self-propelled rollers.

Broom the loose cover material from the surface of the traveled way as soon as the asphalt material has cured enough to prevent damage by brooming or vehicular traffic. Continue periodic brooming until all loose aggregate has been removed. Perform a minimum of 1 light brooming of the cover material before opening to traffic. Additional broomings may be required before opening to traffic to prevent the cover material from being picked up by moving vehicles. Broom excess cover material from the shoulder.

The Contractor may seal in 1 lane for the entire day.

When CM-B and cutback asphalt are specified in the Contract Documents, begin a second period of manipulation on the day following the first rolling, or as soon thereafter as weather conditions permit. This manipulation consists of spreading the loose cover material uniformly over the surface and rolling with the type of rollers specified by the Engineer. The rolling operation consists of 2 complete coverages of the previous day's work. Following the second day's rolling, broom excess cover material off the traveled way and shoulders, as directed by the Engineer.

j. Maintenance of First Seal Coat. When directed by the Engineer, add asphalt material and aggregate to completed portions of the project. All additional asphalt material and aggregate so ordered will be included in the pay quantities. Spreading and rolling of additional aggregate will not be paid for separately but is considered as subsidiary to the item of "Manipulation (D.A.S.T.)".

If the shoulder vegetation is not sufficient to define the edge of the traveled way, broom and blade the excess cover material off the shoulder to provide delineation.

k. Treatment of Adjacent Areas. When shown in the Contract Documents, seal the existing intersections and entrances, mailbox turnouts, etc. having asphalt surfaces. Seal all widened areas. Asphalt and cover material for this work is included in the contract quantities and will be paid for at the contract unit price.

l. Second Seal Coat. If the asphalt material consists of cutback asphalt, do not apply the second seal coat until 60 days after the application of the first seal coat, unless shown otherwise in the Contract Documents.

Immediately prior to the second seal coat application, clean the surface of all foreign material, and broom to remove dust and excess cover material. Exercise care not to dislodge any cover material which is embedded in the asphalt material. Apply the second seal coat according to the provisions for the First Seal Coat in **subsections 610.3f.** thru **i**. Do not use brooms to shift the cover material until the initial rolling is complete, and until the asphalt material has sufficiently cured to hold the cover material. Perform any rearrangement of the cover material during the initial rolling by hand methods.

Continue rolling until the entire surface has been covered a minimum of 7 times with a pneumatic roller. Operate rollers at speeds which shall not displace the aggregate.

m. Maintenance of Completed Work. Maintain the completed surface for a period of 5 days after the project or portions of the project are open to traffic. If for reasons beyond the Contractor's control, traffic can not be routed over the work upon completion of the project, maintain the surface for a period of 5 days after completion of the second seal coat. Maintenance consists of the following:

(1) Make one, complete coverage each day of the 5 days after the project or portions of the project are open to traffic with a light blade equipped with broom drag followed by a pneumatic roller. If weather and roadbed conditions are such that the dragging and rolling would not be beneficial to the surface the daily dragging and rolling may be omitted with approval of the Engineer.

(2) The application of additional asphalt material, aggregate, dragging and rolling or all of these operations may be required.

Asphalt material and aggregate ordered by the Engineer used in the maintenance work will be included in the quantities of these materials for which payment is to be made. Additional manipulation required for the maintenance work will not be paid for separately, but will be considered as subsidiary work to the item of "Manipulation (D.A.S.T.)" included in the Contract Documents.

n. Treatment of Adjacent Areas. When shown in the Contract Documents, perform the second seal on the same areas as the first seal, including existing intersections and entrances, mailbox turnouts, all widened areas etc. Asphalt and cover material for this work is included in the contract quantities and will be paid for at the contract unit.

o. Maintenance of Traffic. Maintain traffic according to **DIVISION 800** and the following.

Coordinate all construction operations to result in the least practicable delay of traffic. Maintain one-way traffic and restrict traffic speeds to 30 MPH on bare pavement and 20 MPH on freshly applied seal. Use pilot cars to lead one-way traffic through the areas of distribution and curing. Coordinate the work so the pilot car completes a round trip in 15 minutes or less. Do not delay traffic at more than 2 separate locations of work on a project.

Station one flagger immediately ahead of the application of the asphalt material and one flagger immediately behind the section being cured. Move the signs and flaggers forward as the work progresses.

Complete all brooming activities before opening the traveled way to unrestricted traffic.

On projects where asphalt sealing is constructed in connection with other work from which traffic is detoured, the provisions of this subsection do not apply. Restrict the speed of all equipment traveling on the freshly applied seal to 20 MPH for 24 hours.

p. Seasonal and Weather Limitations.

(1) Construct asphalt sealing using cutback asphalt between May 1 and October 15, when the ambient air temperature is 60ºF and rising.

(2) Construct asphalt sealing using emulsified asphalt between June 1 and September 15, when the ambient air temperature is 60ºF and rising, and the pavement temperature is a minimum of 70ºF.

(3) Construct asphalt sealing using asphalt cement between June 1 and September 1, when the ambient air temperature is 70ºF and rising, and the pavement temperature is a minimum of 80ºF.

When aggregate retention is unsatisfactory, suspend sealing. Do not seal when the surface is wet, or the weather is foggy or rainy. These limitations may be modified with written approval from the Engineer.

If the seal is damaged or lost, due to rain or wet pavement, repair or re-seal the damaged pavement.

q. Pavement Smoothness. Double asphalt surface treatment is excluded from profilograph testing, and not eligible for pay adjustments.

610.4 MEASUREMENT AND PAYMENT

The Engineer will measure cover material by the cubic yard. The material will be measured in the vehicle at the time and place of unloading. No deductions will be made for moisture in the cover material.

The Engineer will measure asphalt material by the ton. Deductions will be made for the number of tons that are not placed on the road surface.

The Engineer will measure manipulation by the Station, along the centerline. On divided highways, the Engineer will measure manipulation by the Station, along the centerline of each divided direction. This includes all widened and irregular areas and irregular variations in depth.

The Engineer will measure ordered water by the M Gallon by means of calibrated tanks or water meters.

Payment for "Cover Material", "Cutback Asphalt", "Emulsified Asphalt", "Asphalt Cement" and "Manipulation (D.A.S.T.)" at the contract unit prices and "Water (Flexible Pavement) (Set Price)" at the contract set unit price is full compensation for the specified work.

When the Contract Documents call for asphalt cement for asphalt sealing, the following provisions apply:

- If the work is not completed by September 1, and when ordered by the District Engineer in writing, change the type of asphalt material to cutback asphalt.
- If approved changes are made, the unit price for cutback asphalt will be the contract price for asphalt cement plus or minus the difference in the invoice price of the two materials at the refinery at the time of application.

Such measurement and payment is full compensation for the work specified.

SECTION 611

HOT MIX ASPHALT (HMA)-COMMERCIAL GRADE

611.1 DESCRIPTION

Construct the designated class of HMA-Commercial Grade asphalt pavement, as shown in the Contract Documents.

Class A HMA-Commercial Grade is intended for all areas that are not Class B locations. Class A includes permanent traffic areas and temporary traffic areas with moderate to high volumes of vehicular traffic such as driving lanes, auxiliary lanes and shoulders.

Class B HMA-Commercial Grade is intended for non-traffic areas and short-term temporary traffic areas with a low volume of vehicular traffic.

BID ITEMS	UNITS
HMA–Commercial Grade (Class *)	Ton
HMA–Commercial Grade (Class *) (Patching)	Ton
*A or B	

611.2 MATERIALS

a. Aggregates. Provide individual aggregates that comply with **DIVISION 1100**.

b. Asphalt. Provide performance graded asphalt binder that complies with **DIVISION 1200**.
Provide asphalt for tack coat suitable for the intended use and approved by the Engineer.

c. Mix Design. Using forms provided by KDOT, submit a mix design for the designated class of HMA-Commercial Grade to the DME for review and approval. When requested by the Engineer, submit a sufficient quantity of materials to verify the mix design.

Submit a mix design that complies with these requirements:

(1) **TABLE 611-1**, Class A and Class B HMA-Commercial Grade Mix Criteria: Unless the Engineer approves otherwise or shown elsewhere in the Contract Documents, use a SM-12.5A or SR-12.5A (**TABLE 611-2**) for Class A. Use any mix designation listed in **TABLE 611-2** for Class B.

TABLE 611-1: HMA-COMMERCIAL GRADE CLASS A and CLASS B MIX CRITERIA			
	CLASS A	CLASS B	
AGGREGATE:			
Coarse Angularity (min.%)	75	50	
Uncompacted Voids-Fine (min. %)	42	40	
Sand Equivalent (min. %)	40	40	
Natural sand (max. %)	35	-	
Reclaimed Asphalt Pavement (RAP) (max. %)	25	50	
Binder:	PG64-22 or PG58-28[1]	PG58-28 or PG64-22	
COMPACTION REVOLUTIONS:		(A)[3]	(B)[3]
N_{ini}	7	6	7
N_{des}	75	50	75
N_{max}	115	75	115
Level of Compaction at N_{ini}	≤90.5	≤91.5	≤91.5
MIX:			
VFA	65 – 78	66-80	65 – 78
Tensile Strength Ratio (TSR) (min. %)	80[2]	-	-

[1]In permanent locations with an asphalt mixture containing Recycled Asphalt Shingles (RAS) or 16% to 25% RAP, use PG58-28. In all other locations, the Contractor may use either grade of binder.
[2]Meet the minimum TSR requirement for design only. Depending on the anticipated exposure to the environment, the DME may waive the TSR requirement.
[3]Use either column A or B, Contractor's option.

If RAP or RAS is used, inform the Engineer as to the source and type of RAP and RAS. Provide RAP that is reasonably free of contamination, uniform in composition (similar to RAP gradation shown on mix design) and has passed through a 2 ¼" screen or grizzly. The Engineer will accept the RAP and RAS based on a visual inspection.

The Engineer may approve the use of an asphalt mixture (listed in **TABLE 611-2**) that is produced, tested and complies with **SECTION 602**. If used, QC/QA testing is required.

(2) **TABLE 611-2**, Mix Design Requirements.

TABLE 611-2: MIX DESIGN REQUIREMENTS (Master Grading Limits and VMA)								
Nominal Maximum Size & Mix Designation	**Percent Retained - Square Mesh Sieves**							**Min. VMA (%)**
	1"	**3/4"**	**1/2"**	**3/8"**	**No. 4**	**No. 8**	**No. 200**	
SM-9.5A			0	0-10	10 min.	33-53	90.0-98.0	14.5
SR-9.5A			0-2	0-10	10 min.	33-53	90.0-98.0	14.5
SM-9.5T			0	0-10	10 min.	53-68	90.0-98.0	14.5
SR-9.5T			0-2	0-10	10 min.	53-68	90.0-98.0	14.5
SM-12.5A		0	0-10	10 min.		42-61	90.0-98.0	13.5
SR-12.5A		0-2	0-10	10 min.		42-61	90.0-98.0	13.5
SM-19A	0	0-10	10 min.			51-65	92.0-98.0	13.0
SR-19A	0-2	0-10	10 min.			51-65	92.0-98.0	13.0

- Meet the minimum VMA requirements with design only.
- Use an air void target of 4% (at N_{des}) to establish binder content.
- Using the combined gradation (RAP and RAS, if any, and virgin aggregate), select a single point for each sieve within the master grading limits and the No. 16, No. 30, No. 50 and No. 100 sieves. Also, provide the combined virgin aggregate gradation.
- When controlling a virgin mix by cold feed gradation testing, apply single point tolerances in **TABLE 611-3** to the design single points for the virgin aggregate. Do not exceed the tolerances for the Master Grading Limits.
- When controlling a mix that contains RAP or RAS by cold feed virgin gradation testing, apply single point tolerances in **TABLE 611-3** to the design single points for the virgin aggregate. The tolerances may exceed the Master Grading Limits.
- If RAP is used, calculate the Effective Specific Gravity (G_{se}) of the RAP as shown in subsection 5.10.4 – Calculations for the Marshall Mix Design of Bituminous Mixtures, Part V and used as the G_{sb} of the RAP. If RAS is used, calculate the Effective Specific Gravity (G_{se}) of the RAS as shown in subsection 5.10.4, Part V and use as the G_{sb} of the RAS.

TABLE 611-3: SINGLE POINT TOLERANCES								
Nominal Maximum Size & Mix Designation	**Percent Retained - Square Mesh Sieves**							
	3/8"	**No. 4**	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 100**	**No. 200**
SM-9.5A or SR-9.5A		±5	±5	±5	±4	±4	±3	±2
SM-9.5T or SR-9.5T		±6	±5	±5	±4	±3	±3	±2
SM-12.5A or SR-12.5A	±6	±6	±5	±5	±4	±4	±3	±2
SM-19A or SR-19A	±6	±6	±5	±5	±4	±4	±4	±2

Comply with the certification requirements for the appropriate categories listed in the Policy and Procedure Manual for the Certified Inspection and Testing Training (CIT^2) Program. Use calibrated testing equipment with prescribed procedures in the KDOT Construction Manual, Part V, Section 5.2.7.

d. Process Control. Prior to making a single point or proportion change, receive approval from the Engineer. Depending upon the change, the Engineer may require another mix design before granting approval. On the first Lot only of production of any mix designation, any gradation penalty for the entire Lot will be assessed on the basis of the revised design job-mix (if any), provided no change in asphalt content is required as a result of the revision. For changes made in the design job-mix on subsequent Lots, computation of adjusted payment will not be retroactive within the Lots. Make any gradation change for the Lot before starting the gradation testing for that Lot.

During mix production on non-QC/QA projects, the Engineer may conduct tests (randomly located) to verify compliance with the approved mix design, and make adjustments to the binder content (Note: Plant produced mix may have a lower VMA and require a reduction in binder content.).

On projects with less than 500 tons of commercial grade asphalt mixture, testing (QC/QA or cold-feed gradations) is at the Engineer's discretion. On projects with 500 tons or more, testing of the asphalt mixture is required:

- The Engineer will test the combined virgin gradation at a frequency of 1 test for each 500 ton Lot or fraction thereof.
- On projects with more than 2000 tons of HMA–Commercial Grade mixture the Contractor may request the lot be increased to 750 ton provided the following criteria are met:
  - The plant is producing more than 500 tons of HMA–Commercial Grade mixture per day;
  - Previous 3 consecutive lots were produced without penalty; and
  - Provide immediate notification of lot size change to the Engineer any time a change is made.

- If any lot fails to meet all of the above criteria, the lot size shall resort to 500 tons until such time that the aforementioned criteria are met.
- Or, the Contractor and Engineer will test (QC/QA respectively) the asphalt mixture according to the testing requirements and frequencies in Part V, Appendix B.

KDOT will perform tests at the Contractor's lab or at a location agreed to by the Engineer and Contractor. Testing will be completed and the results reported to the Contractor within 24 hours. If the test results indicate there is non-compliant material, make the appropriate adjustments to the mix proportions to comply with the approved mix design.

e. Suspension of Mixture Production. If the results of 2 consecutive cold-feed gradation tests fail to meet the single point tolerances, or QC/QA test results fail to comply with **SECTION 602**, suspend the production of that mix pending satisfactory results of a pre-production sample. Such suspension will constitute Lot termination.

f. Additives. Provide a method for the Engineer to continually monitor the percent of each additive being added.

When more than 25% of the mix is comprised of siliceous virgin aggregates and/or RAP, add anti-strip to the mix. The minimum amount of anti-strip required in the mix is 0.01% for every percent of natural sand and RAP in the mix. Thus, if 25% natural sand and 10% RAP is in a mix, then 0.35% anti-strip by weight of virgin asphalt binder is required in the mix.

If during production, the TSR values (both KDOT and Contractor) exceed 85%, then the Contractor and the DME, working together, may decide on a lower amount of anti-strip.

Provide Warm Mix Asphalt (WMA) additives or processes that comply with **DIVISION 1200**. The Contractor is permitted to use WMA unless otherwise shown on the plans.

For mixes containing Warm Mix Asphalt (WMA) additives, submit for the Engineer's review and approval, the additive or process used, the recommended rate of application, and the temperature ranges for mixing and compaction.

Mixing temperature range is provided by the Asphalt Binder Supplier. When using WMA, the mixing temperature may be reduced no more than 30°F for WMA water foaming processes, and no more than 70°F for WMA chemical and organic additives. The minimum mixing temperature for WMA is 220°F.

611.3 CONSTRUCTION REQUIREMENTS

a. General. Prepare the road surface according to **subsection 602.4b**.

Use equipment that complies with **DIVISION 150** to produce, haul, spread and compact the HMA-Commercial Grade mixture.

Lift Thickness. Except for leveling courses or when shown otherwise in the Contract Documents, **TABLE 602-9** applies. The Engineer may adjust lift thickness to utilize the most efficient method of acquiring specified density and surface quality. The minimum lift thickness for any HMA mixture is 3 times the nominal maximum aggregate size, unless otherwise designated in the Contract Documents or approved by the Engineer.

TABLE 602-9: NOMINAL COMPACTED THICKNESS	
Lift	**Maximum Nominal Compacted Thickness**
Surface	2 inches
Base	4 inches

Use a minimum of 2 rollers to compact the mixture to the maximum density before the mixture temperature falls below 175°F. When using WMA, achieve the maximum density before the temperature of the WMA falls below 165°F. Do not crush the aggregate. On incidental or miscellaneous work, the Engineer may waive the minimum roller requirement if conditions warrant. Roller marks may be removed with a self-propelled static roller when the pavement surface temperature falls below 175°F or 165°F for WMA, roller marks may be removed from the mat with a self-propelled static steel roller.

b. Weather Limitations. Do not place asphalt mixtures on any wet or frozen surface or when weather conditions otherwise prevent the proper handling and finishing of the mixture.

Only place asphalt mixtures when either the ambient air temperature or the road surface temperature is equal to or greater than that shown in **TABLE 611-4**.

TABLE 611-4: ASPHALT PLACEMENT TEMPERATURE LIMITATIONS							
Paving Course	**Thickness (inches)**	**Air Temperature (ºF)**			**Surface Temperature (ºF)**		
		HMA	**WMA Foam**	**WMA Chem**	**HMA**	**WMA Foam**	**WMA Chem**
Surface	All	50	45	40	55	50	45
Subsurface	<1.5	50	45	40	55	50	45
Subsurface	≥1.5 and < 3	40	35	30	45	40	35
Subsurface	≥ 3	30	30	30	35	32	32

c. Pavement Smoothness. Evaluate pavement smoothness according to **SECTION 603** and the following:

Excluding side roads, entrances and non-traffic areas, the Engineer may test the completed surface with a 10 foot straightedge, and the maximum allowable surface variation is 3/16 inch in 10 feet. Correct areas that exceed the allowable variation as directed by the Engineer.

HMA Commercial Grade is not eligible for pay adjustments.

611.4 MEASUREMENT AND PAYMENT

The Engineer will measure HMA-Commercial Grade and HMA-Commercial Grade (Patching) by the ton.

Payment for "HMA-Commercial Grade (Class*)" at the contract unit prices is full compensation for the specified work (including emulsified asphalt for tack). Payment for and "HMA-Commercial Grade (Class *) (Patching)" includes all excavation, compaction of subgrade or subbase if required, disposal of waste material and all material (including emulsified asphalt for tack), all labor, equipment, tools, supplies, incidentals and mobilization necessary to complete the work.

If the gradation test results or air void test results indicate there is non-compliant material, the Engineer will compute and assess either an Aggregate Price Adjustment or an Air Void Price Adjustment that will be an item added to the contract.

(1) Aggregate Price Adjustment. Use **TABLE 611-5**, on each Lot of asphalt mixture represented by non-compliant cold-feed gradation (acceptance) tests:

- Determine the absolute value of the deviation between the acceptance test results (rounded to the nearest 0.01%) and the design virgin aggregate single point for the No. 4, No. 8, No. 30 and the No 200 pay sieves.
- Use the 1 Test Column in **TABLE 611-5** to determine payment for the Lot.
- Use the deviation from the sieve that produces the greatest price adjustment.

TABLE 611-5: SCHEDULE OF ADJUSTED PAYMENT FOR ASPHALT MIXES					
		Accumulated Deviation of the Acceptance Tests from the Design Job-Mix Single Point			
Tolerance	Pay Factor	1 Test	2 Tests	3 Tests	4 Tests
± 7	1.00	0.00 - 7.00	0.00 - 9.00	0.00 - 12.12	0.00 - 14.00
	0.98	7.01 -7.50	9.91 - 10.60	12.13 - 12.99	14.01 - 15.00
	0.95	7.51 - 8.00	10.61 - 11.32	13.00 - 13.86	15.01 - 16.00
	0.92*	8.01 - 8.50	11.33 - 12.02	13.87 - 14.73	16.01 - 17.00
	0.88*	over 8.50	over 12.02	over 14.73	over 17.00
± 6	1.00	0.00 - 6.00	0.00 - 8.48	0.00 - 10.38	0.00 - 12.00
	0.98	6.01 - 6.50	8.49 - 9.20	10.39 - 11.25	12.01 - 13.00
	0.95	6.51 - 7.00	9.21 - 9.90	11.26 - 12.12	13.01 - 14.00
	0.92*	7.01 - 7.50	9.91 - 10.60	12.13 - 12.99	14.01 - 15.00
	0.88*	over 7.50	over 10.60	over 12.99	over 15.00
± 5	1.00	0.00 - 5.00	0.00 - 7.08	0.00 - 8.61	0.00 - 10.00
	0.98	5.01 - 5.50	7.09 - 7.78	8.62 - 9.54	10.01 - 11.00
	0.95	5.51 - 6.00	7.79 - 8.48	9.55 - 10.38	11.01 - 12.00
	0.92*	6.01 - 6.50	8.49 - 9.20	10.39 - 11.25	12.01 - 13.00
	0.88*	over 6.50	over 9.20	over 11.25	over 13.00
± 4	1.00	0.00 - 4.00	0.00 - 5.66	0.00 - 6.93	0.00 – 8.00
	0.98	4.01 - 4.50	5.67 - 6.36	6.94 - 7.80	8.01 – 9.00
	0.95	4.51 - 5.00	6.37 - 7.08	7.81 - 8.67	9.01 - 10.00
	0.92*	5.01 - 5.50	7.09 - 7.78	8.68 - 9.54	10.01 - 11.00
	0.88*	over 5.50	over 7.78	over 9.54	over 11.00
± 3	1.00	0.00 - 3.00	0.00 - 4.24	0.00 - 5.19	0.00 – 6.00
	0.98	3.01 - 3.20	4.25 - 4.52	5.20 - 5.55	6.01 – 6.40
	0.95	3.21 - 3.40	4.53 - 4.80	5.56 - 5.97	6.41 – 6.80
	0.92*	3.41 - 3.80	4.81 - 5.38	5.98 - 6.57	6.81 – 7.60
	0.88*	over 3.80	over 5.38	over 6.57	over 7.60
± 2.5	1.00	0.00 - 2.50	0.00 - 3.54	0.00 - 4.32	0.00 – 5.00
	0.98	2.51 - 2.70	3.55 - 3.82	4.33 - 4.68	5.01 – 5.40
	0.95	2.71 - 2.90	3.83 - 4.10	4.69 - 5.01	5.41 – 5.80
	0.92*	2.91 - 3.30	4.11 - 4.66	5.02 - 5.73	5.81 – 6.60
	0.88*	over 3.30	over 4.66	over 5.73	over 6.60
± 2	1.00	0.00 - 2.20	0.00 - 3.12	0.00 - 3.81	0.00 – 4.40
	0.95	2.21 - 2.40	3.13 - 3.40	3.82 - 4.17	4.41 – 4.80
	0.92*	2.41 - 2.75	3.41 - 3.88	4.18 - 4.77	4.81 – 5.56
	0.88*	over 2.75	over 3.88	over 4.77	over 5.56

*If approved by the Engineer, the Contractor may accept the indicated partial pay. KDOT may require removal and replacement at no additional cost. At any time, the Contractor may remove and replace at no cost to KDOT.

(2) Air Void Price Adjustment. The Engineer will assess an Air Void Price Adjustment (negative price adjustment only), as outlined in **SECTION 602**, on the asphalt material (taken from each QC/QA Lot) represented by non-compliant QC/QA (acceptance) tests.

SECTION 612

MILLING

612.1 DESCRIPTION

Remove the existing surface to the depth and limits shown in the Contract Documents or established by the Engineer. Load and stockpile the milled material, when required.

Provide transitions at transverse joints and raised structures to create a smooth longitudinal riding surface before opening the milled surface to traffic.

Remove transitions prior to resurfacing.

BID ITEM	**UNITS**
Milling	*

* Unit of Measurement Shown in the Contract Documents

612.2 MATERIALS – None specified.

612.3 CONSTRUCTION REQUIREMENTS

Remove the existing surface to the required grade line as established by the Engineer. Use equipment that is automatically controlled with regard to grade and slope. Operate the automatic grade and slope control from a traveling stringline, a minimum of 30 feet long, attached to the milling machine and operating parallel to the line of travel.

Extend the cross slope of the pavement by milling across the shoulder to the point where this line intersects the existing shoulder surface or to the edge of the shoulder, whichever is less, unless shown otherwise in the Contract Documents or directed by the Engineer. When shoulders are to be milled (daylighted out), mill them the same day as the adjacent traveled way pavement is milled.

When milling multiple passes, mill so the longitudinal joint between passes is flush.

When milling asphalt down to an existing concrete pavement, keep the final milling operation a maximum of 2 miles ahead of the laydown operation, unless approved otherwise by the Engineer.

Do not track the milling machine across span bridges if the operating weight of the machine exceeds 80,000 pounds.

Limit the operating weight of the milling machine to 80,000 pounds when removing existing asphalt material from, or performing machine preparation on a bridge deck.

If the milled area will be opened to traffic prior to resurfacing, perform the following:

- At transverse joints, either feather transitions between milled and unmilled surfaces by milling or placing a wedge of hot mix asphalt (no steeper than 1 vertical, 24 horizontal), for the entire width of the transverse joint.
- After removal of existing material around manholes, utility valves inlets and other appurtenances, place a temporary wedge around the appurtenance (no steeper than 1 vertical, 12 horizontal).
- Use hot mix asphalt or other approved material of a thickness and design that the material remains intact while under traffic.
- Remove transitions prior to resurfacing.

Do not open the milled area to traffic unless all transverse joints, manholes, utility valves, inlets and other appurtenances have wedges in place to provide for a smooth longitudinal riding surface.

612.4 MEASUREMENT AND PAYMENT

When milling is a bid item in the contract, the Engineer will measure milling as shown in the Contract Documents. This shall include the removal, hauling, if required, and stockpiling of existing surface.

When shown by the Station, the Engineer will measure the Station along the centerline of the lanes, regardless of the pavement width.

When shown by the square yard, the Engineer will measure the square yards of surface milled.

When shown by the ton, the Engineer will measure the tons of material milled.

Payment for "Milling" at the contract unit price is full compensation for the specified work.

SECTION 613

ULTRATHIN BONDED ASPHALT SURFACE

613.1 DESCRIPTION

Construct the ultrathin bonded asphalt surface (UBAS) as designated in the Contract Documents.

BID ITEMS	UNITS
HMA Surface (Ultrathin Bonded) (*) (**)	Ton
Emulsified Asphalt (Emulsion Bonding Liquid)	Ton
Quality Control Testing (HMA)	Ton

* Type of mix gradation
** Grade of Asphalt Binder

613.2 CONTRACTOR QUALITY CONTROL REQUIREMENTS

a. General. Provide qualified personnel and sufficient equipment complying with the requirements listed in Part V to conduct quality control testing that complies with Appendix B - Sampling and Testing Frequency Chart for Asphalt Construction Items for Quality Control/Quality Assurance Projects.

Allow the Engineer access to the Contractor's laboratory to observe testing procedures, calculations, test documentation and plotting of test results.

Calibrate and correlate the testing equipment with prescribed procedures, and conduct tests in compliance with specified testing procedures as listed in Section 5.2.7- Contractor's Quality Control Plan, Part V.

Store and retain the most recent 2 lots per mix designation of quality control samples for KDOT. KDOT will retain the most recent 2 lots per mix designation gyratory compacted samples and the remaining material not previously used for testing (back half of sample). Do not retain more than the previous 3 lots per mix designation of quality control or verification samples. When the hot mix plant shuts down for the winter, discard the samples after 7 days.

Maintain control charts on an ongoing basis.

At the completion of the project, all documentation becomes the property of KDOT.

Provide the following test data to the KDOT Project Representative:

- Copies of all test results and control charts on a weekly basis, representing the prior week's production;
- Copies of the quality control summary sheet on a daily basis. Include, as a minimum, mix gradation, binder content, theoretical maximum specific gravity (G_{mm}) and film thickness; and
- Copies of all failing test results (based on a moving average of 3 tests, when appropriate).

b. Quality Control Plan (QCP). At the pre-construction conference, submit to the Engineer for approval, a QCP as outlined in Section 5.2.7 – Contractor's Quality Control Plan, Part V. Follow Appendix A of the Contractor's Quality Control Plan in Part V as a general guideline. The Contractor's laboratory and equipment will be inspected and approved as outlined in Section 5.2.7 - Contractor's Quality Control Plan, Part V.

Include a listing of the names and phone numbers of individuals and alternates responsible for quality control administration and inspection. On the Contractor's organizational chart, show the specified lines of authority relating both to mix design and quality control operations during production. Post the organizational chart in the Contractor's test facility.

Provide a quality control organization or private testing firm having personnel certified according to the Policy and Procedure Manual for the Certified Inspection and Testing (CIT) Training Program. The testing for this type of construction will require personnel certified in Aggregate Field Tester (AGF), Aggregate Lab Technician, Profilograph (PO), and Superpave Field (SF) classifications.

Only persons certified in the appropriate classifications covering the specific tests required shall perform such testing. At the beginning of the project, provide the Engineer with the list of certified technicians and alternates, phone numbers and tests/inspection they will be performing. As personnel changes and certifications may expire, continue to provide the Engineer with an accurate list.

Provide an organizational chart showing the specified lines of authority relating to both mix design and quality control operations during production. Identify the company official acting as liaison with KDOT, and the Certified Technician who will direct inspection and testing. Post the chart in the test facility.

c. Required Duties of Certified Technicians. Be available on the project site whenever UBAS is being produced and being placed on the project site. Perform and utilize quality control tests and other quality control practices to assure that delivered materials and proportioning meet the requirements of the mix designs.

Periodically inspect all equipment utilized in transporting, proportioning, mixing, placing, and compacting to assure it is operating properly and that placement and compaction comply with the contract requirements.

d. Contractor's Testing Facilities. Describe the testing facility and its accreditation in the QCP.

Locate the testing facility either at the plant site or at the project. Obtain approval of the testing facilities and location from the DME before the commencement of mixture production.

Provide suitable space for the required testing equipment. Also, equip the testing facility with these items for the exclusive use of the testing facility's quality control personnel and the Engineer:

A telephone with a private line for the exclusive use of the testing facility's quality control personnel; and

A copying machine for use by the Contractor's personnel and the Engineer.

Provide Broadband internet connection (for 1 computer). If the Engineer determines that broadband internet service is not available, provide a fax machine, at no additional cost.

An air conditioner capable of maintaining a temperature below 77°F in the main part of the Field Office and Laboratory.

Locate the KDOT field laboratory near the Contractor's testing facility and have it fully functional 2 working days before placement of the pre-production mix.

e. Documentation. Include in the QCP procedures, charts and forms to be used to provide the required documentation.

Record all original documentation in a bound field book or other KDOT approved bound record and turn over to KDOT at the end of the project.

At all times, have complete records of all inspections and tests available on site for the Engineer. All records documenting the Contractor's quality control inspections and tests become the property of KDOT upon completion of the work.

Indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and the corrective action taken in the records. Examples of quality control forms and charts are available in Part V, or Contractors may design their own. Documentation procedures are subject to approval by the Engineer before the start of the work and to compliance checks during the progress of the work.

Maintain control charts on an ongoing basis.

Provide the following test data to the KDOT Project Representative:

- Copies of all test results and control charts on a weekly basis, representing the prior week's production;
- Copies of the quality control summary sheet on a daily basis. Include, as a minimum, mix gradation, binder content, theoretical maximum specific gravity (G_{mm}) and film thickness; and
- Copies of all failing test results (based on a moving average of 3 tests, when appropriate). Include all applicable sieves, binder content and film thickness.

f. Testing Requirements. In the QCP, identify test methods, procedures and equipment proposed for use. Use standard KDOT test methods and properly calibrated measuring and testing equipment as outlined in Part V. Detail any alternative sampling method, procedure or inspection equipment proposed to be used. Such alternatives are subject to review and approval by the DME.

Take all samples for tests and perform in-place tests at random locations, selected according to the Contractor's QCP and at the rates specified in the Sampling and Testing Frequency Chart for UBAS for Quality Control/Quality Assurance Projects in Appendix B, Part V.

g. Pre-Production Testing Requirements.

(1) The Engineer will observe the Contractor obtaining and splitting the pre-production test section samples into 3 representative portions. Each sample set shall consist of enough material for G_{mm} and ignition burnoff testing.

(2) Determine G_{mm}, perform ignition burnoff, evaluate the mix gradation and complete calculations.

(3) Provide the KDOT Field Representative with the 2nd sample set. The KDOT Field Representative will determine G_{mm}, perform ignition burnoff, evaluate the mix gradation and complete calculations.

(4) Retain or provide the 3rd sample set to the KDOT Field or District Materials Representative.

(5) The results of the testing will be compared. If Contractor and KDOT field laboratory test results do not compare favorably, the District Materials Laboratory will test their ⅓ of the sample. KDOT personnel will determine G_{mm}, perform ignition burnoff and complete calculations.

If results are not acceptable to either party, repeat the above steps in **subsections 613.2g.(1)** through **(4)** for the Contractor's Field Laboratory, KDOT's Field Laboratory, and KDOT's District Laboratory until the issues may be resolved satisfactorily by all parties.

h. Lot 1 Testing Requirements.

(1) Sequence of Sampling. KDOT field personnel will determine the random truckload for the Contractor for sublots A, B, C and D, and the KDOT verification test.

The verification sample will be sampled and tested by KDOT field personnel. The verification sample shall be randomly taken within the lot and shall not be from the same truckload as selected for the Contractor's sublot samples A, B, C or D.

Obtain sampling using KT-25 procedure C.1 Plant Discharge or C.2 Truck Bed.

KDOT field personnel will:

- not supply the Contractor the identity of the truckload to be sampled ahead of time;
- notify the Contractor's laboratory of which truck to sample after the aggregate has left the cold feeds, and before the truck is finished loading; and
- determine whether the split sample will be taken from sublot A or B and notify the Contractor.

(2) Split Samples. The Contractor shall:

- obtain a sample large enough to split 3 ways for testing;
- retain and test ⅓ of the sample;
- supply ⅓ of the sample to the KDOT field laboratory for testing; and
- retain or supply ⅓ of the sample for the KDOT District Materials Laboratory.

(3) Results. At a minimum, compare the KDOT Field Laboratory's and the Contractor's G_{mm}, binder content, and film thickness results. The acceptable difference for the G_{mm} results is 0.019. If the results exceed this difference, take an additional split sample in Lot 1 from sublot C or D, as time permits.

If Contractor and KDOT field laboratory test results do not compare favorably, KDOT and the Contractor will investigate the differences in test results together and take appropriate action. The Contractor's test results will be used for quality control. KDOT Field Laboratory test results and District Materials Laboratory test results will be reported as "information only" samples.

i. Testing Requirements for Lots 2 and Greater.

(1) Take all samples for tests randomly as designated in the approved QCP at the rates specified in Appendix B - Sampling and Testing Frequency Chart, Part V.

Provide the Engineer with the random locations before obtaining the sample. The Engineer reserves the right to generate the random locations. If the Engineer generates the random locations, the Contractor will be notified of which truck to sample after the aggregate has left the cold feeds, and before the truck is finished loading.

(2) Conduct the tests for mixture properties, aggregate gradation and binder content on representative portions of the HMA, quartered from the larger sample of HMA. Take a random sample weighing a minimum of 55 pounds using a method to retain heat to facilitate sample quartering procedures.

(3) Record and document all test results and calculations on data sheets provided by KDOT. Record specific test results on a daily summary sheet provided by KDOT to facilitate the computation of moving test averages. Base moving averages on 3 consecutive test results. Calculations are to be based on the precision displayed on the data sheets. Use "precision displayed" when calculating within Excel. Appendix B - Sampling and Testing Frequency Chart, Part V shows the accuracy to "record to" for the tests listed. Include a description of quality control actions taken (adjustment of cold feed percentages, changes in Job Mix Formulas (JMF), etc.) in the Daily Quality Control Summary Sheet. In addition, post and keep current quality control charts, showing both individual test results and moving average values. As a minimum, plot the single test values on KDOT approved control charts for the mix characteristics shown in **TABLE 613-5**.

(4) If the Contractor and Engineer agree, the procedures shown for sampling, testing and evaluation of Lot

1 in **subsection 613.2h.** may be used for any other Lot produced on the project.

j. Corrective Action. In the QCP, identify procedures for notifying the Engineer when corrective measures must be implemented, and for halting production.

k. Non-Conforming Materials. In the QCP, specifically address how non-conforming materials will be controlled and identified. Establish and maintain an effective and positive system for controlling non-complying material, including procedures for its identification, isolation and disposition. Reclaim or rework non-complying materials according to procedures acceptable to the Engineer. This could include removal and replacement of in-place pavement.

Positively identify all non-conforming materials and products to prevent use, shipment and intermingling with complying materials and products. Provide holding areas, mutually agreeable to the Engineer and Contractor.

613.3 MATERIALS

a. Asphalt Binder. Provide Asphalt Binder that complies with **DIVISION 1200**. Post a legible copy of the latest bill of lading for the Asphalt Binder in the Contractor's Field Lab. Use the mixing and compaction temperatures shown on the bill of lading; however, the maximum mixing or compaction temperature is 340ºF, unless otherwise approved by the Field Materials Engineer. Notify the Engineer if the mixing or compaction temperature changes.

Provide Emulsion Bonding Liquid (EBL) that complies with **DIVISION 1200**.

b. Reclaimed Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS). Do not use RAP or RAS in the UBAS.

c. Aggregates. Provide aggregates that comply with **SECTION 1103**.

d. Combined Aggregates. Provide combined aggregates for the mixes required in the Contract Documents as shown in **TABLE 613-1**.

Mixes may use any combination (except as noted below) of aggregate and mineral filler supplements complying with the applicable requirements in **TABLES 1103-1** and **1103-2**. When coarse aggregates are blended from 1 or more sources, or if more than 1 type, each source or type shall meet the coarse aggregate properties (CAA, LA Abrasion, and micro-deval) in **TABLE 1103-3**.

The minimum Uncompacted Void Content of the Fine Aggregate "U" Value, of the combined aggregate is 45%.

The minimum sand equivalency (SE) of the combined aggregates is 45%.

Provide materials with less than 0.5% moisture in the final mixture.

The maximum quantity of crushed steel slag used in the mix is 50% of the total aggregate weight.

No natural sand will be used in the UBAS.

Traveled way mixes shall include:

- a minimum of 40% primary aggregate based on total aggregate weight;
- a minimum of 50% of the plus No. 4 mesh sieve material in the mixture shall be from the primary aggregate;
- a minimum of 45% of the plus No. 8 mesh sieve material in the mixture shall be from the primary aggregate; and
- Primary aggregates are designated as CS-1 (excluding limestone), CS-2 (excluding limestone), CG, CH-1 and CSSL as described in **subsection 1103.2a.(1)**. Primary aggregate requirements do not apply to the mixture on the shoulder.

e. Contractor Trial Mix Design. A minimum of 10 working days before the start of UBAS production, submit in writing to the DME for review and approval, a proposed JMF for each combination of aggregates. For each JMF submitted, include test data to demonstrate that mixtures complying with each proposed JMF shall have properties specified in **TABLE 613-1** for the designated mix type at the Recommended Percent Asphalt (P_{br}). Submit the proposed JMF on forms provided by KDOT. Submit the worksheets used in the design process to include at a minimum the individual coarse aggregate properties listed in **TABLE 1103-3**, the fine aggregate properties listed in **TABLE 1103-4**, and the mix properties listed in **TABLE 613-2**. Contact the DME to determine if additional material is needed for additional design checks.

For each aggregate used in the mix design, determine the specific gravity using KT-6. This may be accomplished while the project is being constructed or anytime during the 12 months preceding the start of construction on a project. If construction has not yet begun, notify the DME 5 working days prior to obtaining the material for the specific gravity test so that companion samples may be obtained at the same time. If construction has already begun on the project, then determine the specific gravity values of the individual aggregates before 10,000 tons of HMA is produced. Provide the test results to the DME within 14 days of sampling the material. If the producer of the aggregate has been required to submit material to KDOT for a new Official Quality test report since the time the Contractor ran the specific gravity tests, then perform KT-6 on the aggregate currently produced. Do not use the specific gravity values obtained from these tests in the mix design calculations for current projects unless mutually agreeable to both parties. Use the information, as soon as it becomes available, as part of the process to verify and update the "Monthly Hot Mix Aggregate Specific Gravity Values" posted on KDOT's Internet site.

TABLE 613-1: COMBINE AGGREGATE REQUIREMENTS FOR ULTRATHIN BONDED ASPHALT SURFACE*

Mix Designation / Nom Thickness	**Percent Retained – Square Mesh Sieves**										**Asphalt Content (%)**
	¾"	**½"**	**⅜"**	**No. 4**	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 100**	**No. 200**	
Type A - ⅝"		0	0-7	45-60	68-78	75-85	82-90	87-92	90-94	94.0-96.0	5.0 to 6.2
Type B - ⅝"	0	0-7	0-25	62-75	73-83	77-85	82-90	87-92	90-94	94.0-96.0	4.8 to 6.2
Type C - ⅝"	0	0-25	20-50	62-75	73-83	77-85	82-90	87-92	90-94	94.0-96.0	4.6 to 6.2

*For flat and elongated particles in the combined coarse aggregate, use the ratio of 3:1 in lieu of 5:1 shown in KT-59. Do not exceed 25% for the total sample.

TABLE 613-2: MIX PROPERTIES

Property	**Test Method**	**Limits**
Total Amine Value of Antistrip Agent, (mg/g of KOH, min) [a]	ASTM D2074	500
Design Film Thickness (µm, min.)	KDOT Construction Manual	9.0 [b]
Drain Down (% max.)	KT-63	0.10
Gyratory Compacted Revolutions, Ndes	KT-58	100 [c]
Emulsion Bonding Liquid (EBL),(gal/sy)	Equation 1	(0.20 ± 0.07) [d]

a – The asphalt binder used in the mix will contain a minimum of 0.25% of an amine based antistripping agent by weight of the asphalt binder.
b – Calculate using the film thickness equation in Section 5.10.4-Calcs for Marshall Mix Design of Bituminous Mixtures, Part V.
c – Compact gyratory specimen to 100 gyrations. Calculate the percent air voids using KT-15, Procedure IV.
d – Calculate the target EBL Shot Rate (S_{ebl} (gal.sy)), using Equation 1; however, the value must be within the limits in this table.

Equation 1: $$S_{ebl} = 3.93 * P_s * \frac{(V_a + MF)}{100}$$

The particle size (P_s), and the mix factor (MF) are based on the mix designation as shown in the **TABLE 613-3**.

TABLE 613-3: VARIABLES IN EBL SHOT RATE EQUATION

Mix Designation	**Particle Size (Ps)**	**Mix Factor (MF)**
Type A	0.250	3.2
Type B	0.375	3.2
Type C	0.500	3.2

Consider adjusting the EBL spray rate based on the condition of the existing surface as listed in the **TABLE 613-4**. Consult the supplier of the EBL to obtain the recommended adjustment to the spray rate.

TABLE 613-4: EBL ADJUSTMENT CONSIDERATIONS		
Existing Pavement Type	**Condition**	**Adjustment Rate (gal/sy)**
PCCP	Smooth	0.00
	Textured	+0.02 to +0.04
HMA	Flushed	-0.02 to -0.04
	New	0.00
	Matte and OGFC	+0.02
	Dry	+0.03
	Milled	+0.02 to +0.04
Surface Recycle & Cold Recycle	Flushed	-0.02 to -0.04
	Black	+0.02
	Dry	+0.03
Chip Seal	Flushed	-0.02 to -0.04
	Black	+0.02
	Dry	+0.03

613.4 CONSTRUCTION REQUIREMENTS

a. Plant Operation. Adjust all plant operations to operate continuously.

(1) Preparation of the Asphalt Binder. Heat the asphalt binder to within a range as specified in **SECTION 601**. When heating the asphalt binder to the specified temperature, avoid local overheating. At all times, provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. Asphalt binder received from the refinery at temperatures less than 375°F may be used as received, if the requirements regarding the reheating of asphalt binder in **SECTION 601** are met.

(a) Commingling of Asphalt Binders. Do not add or commingle asphalt binders from 2 or more sources into a storage tank. If this occurs, the contents of the storage tank are considered contaminated. Do not use the contents of the storage tank on the project, except as follows: It is permissible, at the Contractor's option, to thoroughly mix the contents of the tank and request sampling of the mixture. Submit the sample to the MRC for testing. Do not use the asphalt binder until approved, and when needed, a new mix design evaluation is completed.

(b) Asphalt Binder Sources. Before changing asphalt binder sources on a project, obtain approval from the DME. A new JMF may be required.

(c) Anti-Strip Additives. If liquid anti-strip additives are added at the Contractor's plant, install a "totalizer" to monitor the quantity of anti-strip additive being added. The Engineer may approve alternative methods for including anti-strip additives in a batch plant. If added at the plant, the anti-strip will be added in line with the asphalt binder as it is being transferred from the transit unit to the asphalt binder storage tank. Provide a method for the Engineer to monitor the percent of additive being added.

(2) Preparation of Mineral Aggregate. When the mineral aggregate is composed of 2 or more ingredients, combine as shown in the approved JMF.

Temperature Requirements. Dry the aggregate for the mixture and heat to a temperature to obtain an asphalt-aggregate mixture temperature immediately after mixing within the 75 to 150 second Saybolt viscosity range of the asphalt binder used. Obtain the temperature for this viscosity range from the MRC or the Asphalt Binder Producer. No mixing or compaction temperatures are to exceed 340ºF without approval from the Field Materials Engineer. The minimum temperature may be revised by the DME provided it is demonstrated that satisfactory results may be obtained at a lower temperature. In such event, deliver the HMA to the paver at a temperature sufficient to allow the material to be satisfactorily placed and compacted to the specified density and surface tolerance requirements.

(3) Preparation of HMA. Introduce asphalt binder into the prepared aggregate in the proportionate amount determined by the P_{br} in the JMF.

(a) Basis of Rejection. HMA will be rejected if the aggregate, as it is discharged from the drum or the pugmill, contains sufficient moisture to cause foaming of the mixture, or if the temperature of the aggregate is such that the asphalt-aggregate mixture temperature is outside the range specified in **SECTION 601**.

(b) Mixing Time. Operate drum mixers at a rate to provide uniform aggregate coating in a continuous operation. For batch and continuous type plants, the minimum wet mixing time is 40 seconds. In all cases, mix a sufficient time to produce a uniform mixture in which all the aggregate particles are thoroughly coated. On batch plants, begin the timing at the start of the asphalt binder introduction into the pugmill, and end upon the opening of the discharge gate. For continuous flow plants, mixing time in seconds shall equal:

[pugmill dead capacity in pounds] divided by [pugmill output in pounds per second].

(c) Manufacturer's Specifications. Operate all drying, pumping and mixing equipment within the limits specified by the manufacturer, unless it can be demonstrated to the satisfaction of the Engineer that such limits may be exceeded without detriment to the HMA.

(d) Batcher Operation. Coordinate HMA batchers (Gob Hoppers) with the plant production rate at all times so the hopper is more than ¾ full before the gates open, and the gates close before material can drop through the gob hopper directly into the surge bin, weigh hopper or truck.

(e) Wasted Material. Wasted material is not measured for pay.

If after an interruption of production, the drum-mixer contains cold, uncoated or otherwise unsuitable material, waste material through a diversion chute. In a continuous or batch plant drier, waste unsuitable material through the pugmill.

At the end of a production run, waste any segregated material in the cone of the storage bin.

(4) End of Day Quantities. At the end of each day of production, provide the Engineer with a document signed by the Plant Foreman or the Project Manager listing the dry weight of each aggregate and mineral filler; the tons of asphalt binder, and the tons of anti-strip agent used for the project during the day. The dry weight is the tons of the material less the water content.

b. Road Surface Preparation.

(1) Preparation of an Existing Asphalt Pavement. Clean the surface to remove all foreign material and broom to remove dust. Excavate areas shown in the Contract Documents to be patched to a depth directed by the Engineer. Fill with HMA and compact.

(2) Preparation of an Existing Concrete or Brick Pavement. Clean all foreign material and broom to remove dust. Clean and fill cracks and joints, and construct surface leveling as shown in the Contract Documents.

c. Weighing Operations. See **subsection 109.1** for details regarding weighing operations.

d. Hauling Operations. Schedule operations to minimize hauling over a surface course.

Deliver HMA to the paver at a temperature sufficient to allow the material to be placed and compacted to the specified density and surface tolerance.

e. Paving Operations.

(1) Equipment Use a transfer device between the haul units and the paver to assist in maintaining continuous placement. Use equipment such as a shuttle buggy, material transfer vehicle or mobile conveyor. (The material will not be deposited on the roadway and a pick-up device used to transfer the material to the paver.)

Use a self-priming paver, designed and built for applying the UBAS and approved by the Engineer.

Use a paver with the following requirements:

- with a receiving hopper, feed conveyor, asphalt emulsion storage tank, a system for measuring the EBL volume applied, a spray bar, and a heated, variable width, vibratory screed;
- capable of spraying the EBL, applying the hot mix surface course and leveling the surface of the mat in one pass;
- capable of placing the hot mix surface course within 5 seconds after the application of the EBL;
- capable of paving at a controlled speed from 30-100 feet/minute;
- equipped so no wheel or other part of the paving machine is in contact with the EBL before the hot mix surface course is applied; and

- equip the screed with the ability to crown the pavement at the center and have vertically adjusted extensions to accommodate the desired pavement profile.

The Engineer will check the pavement for longitudinal streaks and other irregularities. Make every effort to prevent or correct any irregularities in the pavement, such as changing pavers or using different and additional equipment.

Do not raise (dump) the wings of the paver receiving hopper at any time during the paving operation.

(2) Application: Spray the EBL by a metered mechanical pressure spray bar at the temperature specified in **TABLE 601-1**, or as recommended by the EBL supplier. Use a sprayer that accurately and continuously monitors the rate of spray and provides a uniform application across the entire width to be overlaid. The Engineer may make adjustments to the spray rate based upon the existing pavement surface conditions and the recommendations of the EBL supplier.

Apply the UBAS at a temperature of 290-330ºF and spread over the EBL immediately after the application of the EBL. Place the UBAS over the full width of the EBL with a heated vibratory screed. Adjust the screed and its extensions to eliminate variances in surface texture caused by density segregation. Operate the paver as continuous as possible to reduce the possibility of screed indentations in the finished mat.

The target application rate of the UBAS will be stated in the Contract Documents. Use a field application rate as necessary to minimize fracturing of the top size aggregate by the screed. The Engineer will determine the acceptable extent of fracturing at the edge of the paving for tapering purposes.

The finished asphalt surface shall be free of oversized material. The Engineer will determine the extent of the oversized material in the UBAS. Take immediate corrective action to eliminate the source. If the source of the oversized material is determined to be a stockpile or a process of plant operations, cease production until corrective actions are complete.

Spread the UBAS without tearing the surface. Strike a finish that is smooth, free of segregation, true to cross section, uniform in density and texture and free from surface irregularities. If the pavement does not comply with all of these requirements, plant production and paving will be suspended until the deficiency is corrected.

(3) Compaction: Roll the UBAS with a minimum of 1 pass and a maximum of 3 passes with 2-axle tandem steel rollers having a minimum weight of 10 tons, before the material temperature has fallen below 195ºF. The Engineer will determine the number of passes necessary based on appearance of the rolled material. Do not allow the roller or rollers to remain stationary on the freshly placed UBAS. Perform rolling immediately following the placement of the UBAS with approved asphalt rollers. Supply adequate roller units so the rolling will be accomplished promptly following the placement of the material. A release agent (added to the water system) may be required to prevent adhesion of the fresh mix to the roller drum and wheels. Normally, perform rolling in the static mode. Do not excessively roll the driving lanes, to the extent of aggregate degradation. The Engineer will determine the acceptable extent of fracturing at the edge of the pavement from the rolling operation. Do not open the new pavement to traffic or allow any roller to sit idle on the pavement until the rolling operation is complete and the material has cooled below 160°F.

Damaged Areas: Replace any defective areas, as determined by the Engineer, at no additional cost to KDOT.

(4) Construction Joints.

- Transverse Construction Joints. Use a method of making transverse construction joints which provide a thorough and continuous bond and provide an acceptable surface texture. Do not vary the surface elevation more than 3/16 inch in 10 feet, when tested longitudinally across the joint. When required, repair the joints or paving operations will be suspended.
- Longitudinal Joints. Construct well bonded and sealed longitudinal joints to obtain maximum compaction at the joint.

(5) Adjustment of Manholes (Set Price). When required, this work will be performed and paid for under **SECTION 816**.

f. Maintenance of Traffic. Maintain traffic according to **DIVISION 800** and the following:

Maintain one-way traffic, and restrict traffic speeds to 20 miles per hour in the vicinity of workers, unless otherwise designated. Use pilot cars to lead traffic through the area of paving and rolling operations, and if directed, through a curing area. The use of flaggers is allowed through patching operations, unless the patching area or distance between flaggers exceeds ½ mile, in which case the use of a pilot car shall be required. On overlay projects with 2 lanes or more in each direction for traffic use, the Engineer may waive the pilot car requirements.

Station one flagger ahead of the application of the tack coat and one flagger ahead of the area being protected from traffic. Take adequate protection for traffic on side roads approaching the tack area.

g. Treatment of Adjacent Areas. Pave sideroads, entrances and turnouts for mailboxes as shown in the Contract Documents. Overlay all widening areas designated in the Contract Documents or ordered by the Engineer.

h. Pavement Smoothness. Evaluate pavement smoothness according to **SECTION 603**.

613.5 PROCESS CONTROL

a. General. Establish gradation limits and proportions for each individual aggregate and mineral filler. Specify the limits and proportions such that the material produced complies with the applicable requirements of the designated mix type. The Contractor is responsible for all process control operations including testing. At no time will KDOT's representative issue instructions to the Contractor or producer as to setting of dials, gauges, scales and meters. KDOT will collect and test verification samples and assurance samples and inspect the Contractor's quality control operations.

b. JMF Adjustments. Produce a mixture of uniform composition closely complying with approved design JMF to obtain the specified properties when compacted. If, during production, results from quality control tests demonstrate a need to make adjustments to the mix design, then make adjustments to the design JMF single point gradation and binder content to achieve the specified properties. The JMF adjustments shall produce a mix that complies with **TABLE 613-1** for the specified mix designation. When necessary, adjust on a sublot basis. Report the new JMF to KDOT's field representative and the DME before making such changes, and submit a new mix design for review and approval if required by the DME.

c. Specification Working Ranges. Establish acceptable limits for field test results by applying the tolerances shown in **TABLE 613-5** to the JMF or adjusted JMF for binder content. Establish acceptable limits for the other listed mix characteristics by applying the tolerances shown in **TABLE 613-5** to the requirements of **TABLE 613-1**.

TABLE 613-5: SPECIFICATION WORKING RANGES (QC/QA)

Mix Characteristic	Tolerance from JMF and Specification Limits		
	Single Test Value	Plot	3 Point Moving Average Value
Binder Content (Maximum deviation from JMF)	±0.3%	*	±0.3%
Film Thickness	n/a	*	zero tolerance
Gradation**	n/a	*	zero tolerance
Course Aggregate Angularity (CAA)	zero tolerance		n/a
Fine Aggregate Uncompacted Voids (FAA)	zero tolerance		n/a
Sand Equivalent	zero tolerance		n/a

*Values to plot. In addition, plot the Gmm values. For gradations, as a minimum, plot the No. 4, 8, 30 and 200 sieves.

The maximum deviation for UBAS from the JMF for the sieves with a ± tolerance shall be as listed in **TABLE 613-6. Only the No. 16, 30, 50 and 100 sieves may exceed the limits listed in **TABLE 613-1** provided the minimum retained percentage shown in **TABLE 613-6** is met.

TABLE 613-6: SPECIFICATION WORKING RANGES FROM THE JMF

Mix Designation	Percent Retained – Square Mesh Sieves									
	¾"	½"	⅜"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
Type A				±5	68 - 78	75 min	82 min.	87 min.	90 min.	94.0 – 96.0
Type B			±5	±4	73 - 83	77 min.	82 min	87 min.	90 min.	94.0 – 96.0
Type C		±5	±5	±4	73 - 83	77 min.	82 min	87 min.	90 min.	94.0 – 96.0

d. EBL Shot Rate Specification. Periodically determine the application rate of the EBL. The Engineer will verify the application rate. Acceptable tolerance of the application rate is the target rate ±0.02 gal/sq yd. Check for proper coverage at least twice per day by applying the EBL to the road surface for a minimum distance of 20 feet. When the Engineer verifies the coverage meets specification, back up the paver and shoot not more than 1/4 of the EBL shot rate over the previously tacked segment.

613.6 WEATHER LIMITATIONS

Do not place UBAS on any wet or frozen surface or when weather conditions otherwise prevent the proper handling and finishing of the mixture.

Only place UBAS when either the minimum ambient air temperature is 50^{o}F or the minimum road surface temperature is 55^{o}F.

613.7 MIXTURE ACCEPTANCE

a. General. Test the UBAS at each plant for compliance with **TABLE 613-1**. Acceptance will be made on a lot by lot basis contingent upon satisfactory test results. Obtain quality control and verification samples of the UBAS using KT-25 sampling procedure C.1 Plant Discharge or C.2 Truck Bed.

A load or loads of mixture which, in the opinion of the Engineer, are unacceptable for reasons such as being segregated, aggregate being improperly coated, foaming aggregate or being outside the mixing temperature range may be rejected.

b. Lot Definition for Mix Production Sampling and Testing. A lot is defined as an isolated quantity of a specified material produced from a single source or operation. Each lot shall normally be represented by 4 contiguous test results. A lot may be represented by test results on samples taken from 1 or more day's production.

c. Lot Investigation. The Engineer may examine materials represented by individual test results which lie beyond the Contractor's normal quality control testing variation. The investigation may be based on either Contractor or KDOT test results. The information from additional testing (including testing of in-place HMA) may be used to define unacceptable work according to **SECTION 105**. The Engineer may apply appropriate price reductions or initiate corrective action.

For any test, if a dispute exists between the Engineer and Contractor about the validity of the other's test results, the KDOT District Materials Laboratory or the MRC will perform referee testing. If the disputed KDOT test results were generated at the District Laboratory, the MRC will perform the referee tests. If the disputed KDOT test result was generated at the MRC, an independent laboratory agreeable to both parties will be selected. The Laboratory shall be accredited by the AASHTO Accreditation Program in the appropriate testing category.

If referee testing indicates that KDOT test results are correct, the Contractor pays for the additional testing, including referee testing performed at the MRC. This will be paid using the bid item Contract Deduct which will be an item added to the contract.

If the referee testing indicates that Contractor test results are correct, KDOT pays for the additional testing. Pay the independent lab for the testing and submit the paid invoice to KDOT. The Engineer will reimburse the Contractor (based on the invoice price) as Extra Work, **SECTION 104**.

d. Multiple Projects. If multiple projects are supplied from 1 or more plants using the same mix, carry over the lots at each hot mix plant from project to project.

e. Lot Size. A standard size mix production lot consists of 4 equal sublots of 400 tons each of asphalt mixture (lot size 1,600 tons). If the last sublot contains less than 200 tons, combine it with the previous sublot.

It is anticipated that lot size shall be as specified. However, with the Engineer's approval, the Contractor may re-define lot size for reasons such as, but not limited to, change in contract quantities or interruption of the work. Take 1 sample during production of each sublot and utilize it to determine disposition of the lot in which it occurs.

f. Increased Lot Size. After 8 consecutive sublots have been produced with the tolerances shown for all mix characteristics listed in **TABLES 613-5** and **613-6**, the sublot size may be increased by the Contractor to 500 tons each of asphalt mixture (lot size 2,000 tons), provided normal production rate of the plant is over 200 tons per hour. Immediately notify the Engineer of lot size change. If subsequent test results fall outside the tolerances shown for any mix characteristics listed in **TABLES 613-5** and **613-6**, the sublot size will be decreased to 400 tons. When the increased lot size criteria are again met, the sublot size maybe increased to 500 tons.

g. Pre-Production Mix. Test and evaluate a pre-production mix, limited to a maximum of 200 tons from each plant before production of that mix. Evaluate the pre-production mix at initial start-up and after suspension of production resulting from failing test results. Limit pre-production quantities to 100 tons following a suspension of production. Provide a pre-production mix that complies with the "Single Test Value" in **TABLES 613-5** and **613-6**. Except for initial start-up, normal delivery of material to the project before completion of certain test results on pre-production mixes may be authorized by the DME.

At the direction of the Engineer, remove the pre-production mix if it is both out of specification and the material shortens the pavement life or changes the intended function. The Engineer will pay for the replacement of one pre-production mix at 100% of the contract unit price. The payment will be full compensation to the Contractor for the placement and removal of that pre-production mix. KDOT will not be financially responsible for any subsequent failed pre-production mixes (that require removal) for that mix. The removed material is the property of the Contractor.

The Engineer will not pay for pre-production mixes that are required to be replaced due to poor workmanship or equipment failure. The Engineer will make the final decision to remove a failed pre-production mix with input from the Contractor.

h. Suspension of Mix Production. Suspend production of the mix until appropriate corrections have been made, if 2 consecutive test results for any single mix characteristic fail to fall within the limits established by the tolerances shown in the single test value column of **TABLE 613-5**. Additionally, suspend production of the mix until appropriate corrections have been made, if any 3-point moving average value for any single mix characteristic fails to fall within the limits established by the tolerances shown in the 3-point moving average value column of **TABLE 613-5**. Production remains suspended pending the satisfactory results of a pre-production mix, unless waived by the DME.

When the mix fails to meet the criteria listed in **TABLE 613-5**, identify the cause and document, in detail, what corrective action was taken. The JMF may only be adjusted, when requested by the Contractor, and when approved by the Engineer. For significant changes in the JMF, as determined by the Engineer, a new mix design may be required by the Engineer before the JMF is approved.

The Engineer may stop production of HMA at any time the mix or process is determined to be unsatisfactory. Make the necessary corrections before production will be allowed to resume. Failure to stop production of HMA subjects all subsequent material to rejection by the Engineer or acceptance at a reduced price, as determined by the Engineer.

613.8 MEASUREMENT AND PAYMENT

a. Ultrathin Bonded Asphalt Surface. The Engineer will measure UBAS by the ton of material at the time of delivery to the road. Batch weights will not be allowed as a method of measurement, unless all the following conditions are met:

- the plant is equipped with an automatic printer system approved by the Engineer;
- the automatic printer system prints the weights of material delivered; and
- the automatic printer system is used in conjunction with an automatic batching and mixing control system approved by the Engineer.

Provide a weigh ticket for each load. Due to possible variations in the specific gravity or weight per cubic foot of the aggregates, the tonnage used may vary from the proposal quantities and no adjustment in contract unit price will be made because of such variances.

Payment for "HMA Surface (Ultrathin Bonded)" at the contract unit prices is full compensation for the specified work including quality control testing.

Sideroads, entrances and mailbox turnouts that are not shown in the Contract Documents that are to be surfaced shall be paid for at 1½ times the unit price for "HMA Surface (Ultrathin Bonded)".

b. Emulsified Asphalt. The Engineer will measure emulsified asphalt used for tack by the ton. Payment for "Emulsified Asphalt (Emulsion Bonding Liquid)" at the contract unit price is full compensation for the specified work.

c. Quality Control Testing (HMA). The Engineer will measure Quality Control Testing (HMA) performed by the Contractor on a per ton basis of UBAS placed on the project. No adjustment in the bid price will be made for overruns or underruns in the contract quantity. The bid price will constitute payment for all necessary mix design testing, field process control testing, the testing laboratory and all necessary test equipment.

Payment for "Quality Control Testing (HMA)" at the contract unit price is full compensation for the specified work.

SECTION 614

HMA BASE (REFLECTIVE CRACK INTERLAYER (RCI))

614.1 DESCRIPTION

Construct the HMA-reflective crack interlayer (RCI) as designated in the Contract Documents.

BID ITEMS	**UNITS**
HMA-RCI (PG 70-28 RCI)	Ton
Quality Control Testing (HMA)	Ton

614.2 CONTRACTOR QUALITY CONTROL REQUIREMENTS

Perform quality control testing according to **subsection 602.2**. Develop control charts for the mix characteristics listed in **Table 614-7**.

614.3 MATERIALS

a. Asphalt Binder. Provide PG 70-28 RCI binder that complies with **SECTION 1202**, with this exception:

Post a legible copy of the latest bill of lading for the Asphalt Binder on or near the gyratory compactor. Use the mixing and compaction temperatures shown on the bill of lading; however, the maximum mixing or compaction temperature is 340ºF, unless otherwise approved by the Field Materials Engineer. Notify the Engineer if the mixing or compaction temperature changes.

Exception: The mixing temperature may be increased no more than 10ºF above the maximum mixing temperature shown on the bill of lading provided all the following are met:

1. The air temperature is below 70ºF
2. The plant has not produced mix earlier in the day.
3. Do not exceed a mix temperature of 350ºF.
4. No truck has returned for its second load of the day.

Once a previously loaded truck returns for its next load, reduce the temperature to not higher than the maximum mix temperature shown on the bill of lading, not to exceed 340ºF.

b. Reclaimed Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS). Do not use RAP or RAS in the RCI.

c. Aggregates. Provide aggregates that comply with **SECTION 1103**.

d. Combined Aggregates. Provide combined aggregates for the mixes required in the Contract Documents as shown in **TABLE 614-1**.

Mixes may use any combination of aggregate and mineral filler supplements complying with the applicable requirements in **TABLES 1103-1** and **1103-2**.

Provide materials with less than 0.5% moisture in the final mixture.

The maximum quantity of crushed steel slag used in the mix is 50% of the total aggregate weight.

Natural sand shall be called SSG-1, SSG-2, etc. in the mix design.

e. Contractor Trial Mix Design. A minimum of 10 working days before the start of HMA production, submit in writing to the DME for review and approval, a proposed JMF for each combination of aggregates. For each JMF submitted, include test data to demonstrate that mixtures complying with each proposed JMF shall have properties specified in **TABLE 614-1** for the designated mix type at the Recommended Percent Asphalt (P_{br}). Submit the proposed JMF on forms provided by KDOT. Submit the worksheets used in the design process to include at a minimum the mix properties listed in **TABLE 614-2**. Contact the DME to determine if additional information should be submitted. Provide sufficient material as identified in **TABLE 614-3**. Submit for the Engineer's review and approval, the test data listed in **TABLE 614-4** for each blend and the proposed JMF. Provide a mix that meets the requirements in **TABLE 614-5**.

For each aggregate used in the mix design, determine the specific gravity using KT-6. This may be accomplished while the project is being constructed or anytime during the 12 months preceding the start of construction on a project. If construction has not yet begun, notify the DME 5 working days prior to obtaining the material for the specific gravity test so that companion samples may be obtained at the same time. If construction has already begun on the project, then determine the specific gravity values of the individual aggregates before 10,000 tons of HMA is produced. Provide the test results to the DME within 14 days of sampling the material. If the producer of the aggregate has been required to submit material to KDOT for a new Official Quality test, since the time the Contractor ran the specific gravity tests, then perform KT-6 on the aggregate currently produced. Do not use the specific gravity values obtained from these tests in the mix design calculations for current projects, unless mutually agreeable to both parties. Use the information, as soon as it becomes available, as part of the process to verify and update the "Monthly Hot Mix Aggregate Specific Gravity Values" posted on KDOT's Internet site.

For RCI mixes, the optimum percentage of asphalt material is the percentage that yields the design air voids at N_{des} (50 gyrations) and complies with the other requirements of the specifications. Submit test results for all design criteria. The values from the approved mix design become the values in the initial job mix formula (JMF) for the RCI. These values remain in effect for the JMF until a written request by the Contractor for a change is approved by the Engineer. Provide a new mix design when any change in materials occurs from those used in the mix design, unless waived by the DME.

TABLE 614-1: COMBINED AGGREGATE REQUIREMENTS

Mix Designation	**Percent Retained - Square Mesh Sieves**							
	⅜"	**No. 4**	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 100**	**No. 200**
RCI	0	0-15	1-25	13-47	41-68	74-91	88-99	94.0-99.0

1. Aggregate Adjustment Limit: Do not exceed a 7% adjustment on any single sieve from the approved mix design to the Job Mix Formula (JMF). Submit a new mix design when requesting a change beyond this limit.
2. Do not use RAP in the RCI design.
3. The flat and elongated particles in the combined coarse aggregate shall not exceed 10% for the total sample.
4. The maximum percent moisture in the final mixture shall not exceed 0.5.
5. There are no criteria for CAA, FAA, or D/B ratio.

TABLE 614-2: MIX PROPERTIES

Property	**Abbreviation**	**Test Method**	**Additional Information**
Air Voids	V_a	KT-15 & KT-58	Calculated from G_{mm} and G_{mb}. Run at the P_{br}.
Recommended Percent Asphalt	P_{br}		Produce a mix with a V_a of 4.5%.
Theoretical Maximum Specific Gravity	G_{mm}	KT-39	Rice Test.
Sand Equivalent	SE	KT-55	
Bulk Specific Gravity of HMA	G_{mb}	KT-15	Compacted Mix Property.
Percent G_{mm} at N_{des}	$\%G_{mm}$ @ N_{des} %	KT-15	Use G_{mm} value from KT-39. Calculated from Gyratory Compaction height data, G_{mm}, and G_{mb}.
Voids in Mineral Aggregate	VMA	KT-15 & KT-6	Calculated from G_{mb}, G_{sb}, P_b.
Voids Filled with Asphalt	VFA		Calculated from VMA and V_a @ N_{des}.

Formulas for calculations are in the Superpave Volumetric Mixture Design and Analysis Handbook.

TABLE 614-3: MATERIAL SUBMITTALS			
Submittal	**Quantity**	**Description**	**Additional Information**
Aggregate for KT-15	3 Samples	Sized for 6 inch Plugs	Comply with Job Mix Gradation.
Aggregate for KT-39	2 Samples	Sized for G_{mm} Testing	Comply with Job Mix Gradation.
Binder for KT-15	As Needed	Sized for 3 Plugs at P_{br}	
Binder for KT-39	As Needed	Sized for 2 G_{mm} Tests	
Each Aggregate for KT-6	As Needed	Specific Gravity Test	
Uncompacted HMA Sample	35 lbs	Cool sample to room temperature	If transported hot and compacted within 2 hours, then requirement to cool sample may be waived by the DME.
Gyratory Plugs at N_{des}	2 Plugs	Compacted at P_{br}	Compacted to N_{des}

TABLE 614-4: TEST DATA SUBMITTALS	
Submittal	**Information**
Asphalt Binder	Source, Grade, Specific Gravity, Mixing and Compaction Temperature from the Producer of the asphalt binder.
Each Aggregate	Source and Producer, including Legal Description.
Gradation of Each Aggregate	Percentage Retained to nearest 1% (except nearest 0.1% for No. 200 sieve)
Material Proportioning	Proportion of each material is shown in percentage of aggregate.
Composite Gradation	Based on Gradation of Each Aggregate and Material Proportioning.
Composite Gradation Plot	Plotted on KDOT Form 712 (0.45 power graph paper).
Asphalt Binder Added	Percentage to nearest 0.01% based on total weight of the mixture.
Aggregate	Percentage of flat and elongated particles in the coarse aggregate
Sand Equivalent	SE for the combined virgin aggregates.

TABLE 614-5: RCI MIX REQUIREMENTS FOR DESIGN SUBMITTAL	
MIX CHARACTERISTIC	**CRITERIA**
Sand Equivalent (SE), minimum, %	45
Gyratory Compaction Revolutions, N_{des}	50
Air Voids (V_a) target, %(1)	4.5(2)
VMA, minimum, %(1)	18.0
VFA, minimum, %(1)	70
Hveem Stability (AASHTO T-246) @ 140°F), 4" (100 mm) molds, minimum(1)	18.0
Flexural Beam Fatigue (AASHTO T-321) (3), 2000 microstrain, 10 Hz., 98% ± 1.0 of Gmb @ N_{des}, 59°F (Age samples for 4 hours at 275°F before compaction, reference AASHTO R30 Section 7.2)	200,000 cycles

1. Criteria based on 50 gyrations (N_{des}).
2. Complete all tests on the mix producing 4.5% air voids at 50 gyrations. If the mix does not meet the requirements for all tests, then change the target air voids to correlate to the mix that does meet all the test requirements. Use this for all target air voids during production. The target asphalt binder content during production (JMF) will be the asphalt binder content from the approved mix design that yields the target air voids. Submit a new mix design to include the Hveem Stability and Flexural Beam Fatigue Testing when a new target asphalt binder content or target air voids is requested.
3. AASHTO T-321 will be used for analysis with the following exceptions:

Section 8.7 Replace the last sentence with the following:

This stiffness is the Initial Beam Modulus, which is used as a reference for determining the specimen failure.

Section 8.8: Delete the second sentence.

Section 8.9: Delete the last sentence.

Section 9.1.3: Change “Flexural Stiffness” to “Beam Modulus”

Section 9.1.6: Replace this section with the following:

Normalized Modulus = (Beam Modulus x Cycle Number) / (Initial Beam Modulus x 50)

Figure 6 - Plot the Normalized Modulus x Cycles versus Load Cycles (Repetitions)

Section 9.1.7 and Section 9.1.8: Delete

Section 9.1.9: Replace with the following:

Failure Point – Failure is defined at the maximum or peak Normalized Modulus when Normalized Modulus x Cycles is plotted versus Load Cycles.
Section 9.1.10: Delete
Section 10.4, Table 2: Change the last two headings to "Normalized Modulus" and "Normalized Modulus x Cycles", respectively
Section 10.7: Delete
Section 10.8: Replace with the following:
Prepare a plot of Normalized Modulus x Cycles versus load cycles

TABLE 614-6: MIX DESIGN TEST DATA SUBMITTALS	
Submittal	**Information**
Minimum of 1 Mix Design	As a minimum, 1 mix design at the P_{br}
G_{mm}	Determined at each binder content.
Individual and Bulk Specific Gravity Tests	Provide results for a minimum of 2 specimens at each binder content.
Percent Air Voids	Provide % V_a in the mixture for each binder content when compacted to N_{des} gyratory revolutions along with copies of the Gyratory graphs.
Percent VMA	Provide %VMA at each binder content.

614.4 CONSTRUCTION REQUIREMENTS

a. Plant Operation. Adjust all plant operations to operate continuously.

(1) Preparation of the Asphalt Binder. Heat the asphalt binder to within a range as specified in **SECTION 601**. When heating the asphalt binder to the specified temperature, avoid local overheating. At all times, provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. Asphalt binder received from the refinery at temperatures less than 375°F may be used as received, if the requirements regarding the reheating of asphalt binder in **SECTION 601** are met.

(a) Commingling of Asphalt Binders. Do not add or commingle asphalt binders from 2 or more sources into a storage tank. If this occurs, the contents of the storage tank are considered contaminated. Do not use the contents of the storage tank on the project, except as follows: It is permissible, at the Contractor's option, to thoroughly mix the contents of the tank and request sampling of the mixture. Submit the sample to the MRC for testing. Do not use the asphalt binder until approved, and when needed, a new mix design evaluation is completed.

(b) Asphalt Binder Sources. Before changing asphalt binder sources on a project, obtain approval from the DME. A new JMF may be required.

(2) Preparation of Mineral Aggregate. When the mineral aggregate is composed of 2 or more ingredients, combine as shown in the approved JMF.

(a) Temperature Requirements. Dry the aggregate for the mixture and heat to a temperature to obtain an asphalt-aggregate mixture temperature immediately after mixing within the 75 to 150 second Saybolt viscosity range of the asphalt binder used. Obtain the temperature for this viscosity range from the MRC or the Asphalt Binder Producer. No mixing or compaction temperatures are to exceed 340ºF without approval from the Field Materials Engineer. The minimum temperature may be revised by the DME provided it is demonstrated that satisfactory results may be obtained at a lower temperature. In such event, deliver the HMA to the paver at a temperature sufficient to allow the material to be satisfactorily placed and compacted to the specified density and surface tolerance requirements.

(3) Preparation of HMA. Introduce asphalt binder into the prepared aggregate in the proportionate amount determined by the P_{br} in the JMF.

(a) Basis of Rejection. HMA will be rejected if the aggregate, as it is discharged from the drum or the pugmill, contains sufficient moisture to cause foaming of the mixture, or if the temperature of the aggregate is such that the asphalt-aggregate mixture temperature is outside the range specified in **SECTION 601**.

(b) Mixing Time. Operate drum mixers at a rate to provide uniform aggregate coating in a continuous operation. For batch and continuous type plants, the minimum wet mixing time is 40 seconds. In all cases, mix a sufficient time to produce a uniform mixture in which all the aggregate particles are thoroughly coated. On batch plants, begin the timing at the start of the asphalt binder introduction into the pugmill, and end upon the opening of the discharge gate. For continuous flow plants, mixing time in seconds shall equal:

[pugmill dead capacity in pounds] divided by [pugmill output in pounds per second].

(c) Manufacturer's Specifications. Operate all drying, pumping and mixing equipment within the limits specified by the manufacturer, unless it can be demonstrated to the satisfaction of the Engineer that such limits may be exceeded without detriment to the HMA.

(d) Batcher Operation. Coordinate HMA batchers (Gob Hoppers) with the plant production rate at all times so the hopper is more than ¾ full before the gates open, and the gates close before material can drop through the gob hopper directly into the surge bin, weigh hopper or truck.

(e) Wasted Material. Wasted material is not measured for pay.

If after an interruption of production, the drum-mixer contains cold, uncoated or otherwise unsuitable material, waste material through a diversion chute. In a continuous or batch plant drier, waste unsuitable material through the pugmill.

At the end of a production run, waste any segregated material in the cone of the storage bin.

(4) End of Day Quantities. At the end of each day of production, provide the Engineer with a document signed by the Plant Foreman or the Project Manager listing the dry weight of each aggregate, mineral filler and the tons of asphalt binder. The dry weight is the tons of the material less the water content.

b. Road Surface Preparation. Clean all foreign material and broom to remove dust from existing concrete pavement. Clean and fill cracks and joints, and construct surface leveling as shown in the Contract Documents.

Prior to placing the HMA, apply a tack coat to the existing surface, as shown in the Contract Documents. When warranted by weather conditions, the Engineer may authorize a change in the asphalt for tack coat. When such changes are made, the price per ton of material being used will be the unit price bid for the material designated in the contract plus or minus the difference in the invoice price per ton of the 2 materials at the refinery as determined at the time of application.

c. Weighing Operations. See **SECTION 109** for details regarding weighing operations.

d. Hauling Operations. Schedule operations to minimize hauling over a surface course for the RCI.

Deliver HMA to the paver at a temperature sufficient to allow the material to be placed and compacted to the specified density and surface tolerance.

e. Paving Operations. The Engineer will check the pavement for longitudinal streaks and other irregularities. Make every effort to prevent or correct any irregularities in the pavement, such as changing pavers or using different and additional equipment.

Do not raise (dump) the wings of the paver receiving hopper at any time during the paving operation. The Engineer may waive this requirement if it is determined that raising (dumping) the wings will not produce detrimental segregation. If segregation or irregularities in the pavement surface or density are noted, review the plant, hauling and paving operations and take corrective action. The recommendations made in KDOT's "Segregation Check Points" should reduce the segregation and irregularities to an acceptable level. Copies of KDOT's "Segregation Check Points" may be obtained from the KDOT District Office or Field Engineer.

Spread the HMA and finish to the specified crown and grade using an automatically controlled HMA paver. Operate the paver at a speed to provide a uniform rate of placement without undue interruption. At all times, keep the paver hopper sufficiently full to prevent non-uniform flow of the HMA to the augers and screed.

If the automatic grade control devices break down, the Engineer may allow the paver to operate to the close of the working day, provided the surface is satisfactory.

(1) Surface Quality. Spread the HMA without tearing the surface. Strike a finish that is smooth, free of segregation, true to cross section, uniform in density and texture and free from surface irregularities. If the pavement does not comply with all of these requirements, plant production and paving will be suspended until the deficiency is corrected. The Engineer may verify segregation and uniformity of density requirements in **TABLE 602-7** are met by using methods outlined in Section 5.8.3 – Segregation Check Using the Nuclear Density Gauge, Part V.

(2) Grade Control. Achieve grade control by use of 1 or more of the following grade reference devices. Approval of any of these devices will be based upon satisfactory performance.

(a) Traveling Stringline. Attach a traveling stringline or ski type attachment, a minimum length of 30 feet, to the paver and operate parallel with its line of travel.

(b) Reference Shoe. Attach a short reference shoe or joint matching device to the paver for control in matching surface grades along longitudinal joints.
(c) Erect Stringline. Use an erected stringline consisting of a tightly stretched wire or string offset from and parallel to the pavement edge on 1 or both sides. Erect the stringline parallel to the established pavement surface grade and support at intervals as necessary to maintain the established grade and alignment.
(d) Stringless Paving. Control line, grade and pavement cross-section as shown in the Contract Documents. Use electronic guidance systems that meet the requirements and tolerances listed in **SECTION 802**. Horizontal control is guided by GPS. Vertical control is guided by Total Stations. GPS will not be allowed for Vertical control.

(3) Compaction of Mixtures. Uniformly compact the HMA as soon after spreading and strike-off as possible without shoving or tearing. Use self-propelled rollers operated at speeds slow enough to avoid displacement of the HMA. Equipment and rolling procedures which result in excessive crushing of the aggregate are prohibited. Use a sufficient number and weight of rollers to compact the HMA to the required density. Perform final rolling with a steel roller unless otherwise specified. On the final pass, operate finishing, vibratory rollers in the static mode.

Coordinate the frequency, amplitude and forward speed of the vibratory roller to achieve satisfactory compaction without objectionable undulations. For HMA lifts with a compacted thickness less than 1¼ inch, operate vibratory rollers in the static mode.

Keep rollers in operation as necessary so all parts of the pavement receive substantially equal compaction at the proper time. The Engineer will suspend HMA delivery to the project at any time proper compaction is not being performed.

Remove, replace with suitable material and finish according to these specifications any mixture that becomes loose, broken, mixed with foreign material or which does not comply in all respects with the specifications.

(4) Density Requirements. RCI mixes will not have a density pay adjustment. Control density using an approved rolling procedure with random nuclear gauge density determinations. Include a method for controlling density in the QCP.

Designate a "Compaction Foreman". This person shall control compaction procedures, review nuclear gauge results as they are obtained, adjust compaction procedures as needed to optimize compaction and report any changes in the compaction process and results of nuclear gauge testing to the Engineer. The compaction foreman may also be the nuclear gauge operator. The nuclear gauge operator shall continuously monitor compaction procedures. As a minimum, take 10 random nuclear gauge density determinations per day and report results to the Engineer. Throughout the day, nuclear gauge results shall be available for review by the Engineer. The compaction foreman shall document at a minimum of once every 2 hours that the approved rolling sequence is being followed. Documentation shall include roller passes, the mat temperature at each pass, amplitude setting of rollers and roller speed. Provide the documentation to the Engineer.

Determine and periodically update an approved rolling procedure as outlined in this section. As a minimum, evaluate the initial rolling procedure using 3 rollers. If the hot mix plant is operating at over 275 tons per hour, use a minimum of 4 rollers in the initial evaluation. The number of rollers may be reduced to 2 (or 3 if the plant is operating at over 275 tons per hour) provided cores (minimum of 3 sets of 3) are taken from both a segment (single truck load) using 3 rollers and a segment (single truck load) using 2 rollers (4 and 3 rollers, respectively if plant is running over 275 tons per hour). Determine the G_{mb} of the cores using KT-15. If the G_{mb} of the segment with less rollers is equal to or greater than the G_{mb} of the segment with more rollers, then the minimum number of rollers may be reduced by 1. Operate vibratory rollers in the static mode only. Evaluate RCI paver screed operation with the nuclear gauge at various vibration settings. For screed evaluation, take the nuclear gauge readings directly behind the screed and before rolling. The Compaction Foreman and Engineer will evaluate the densities obtained with the various roller combinations and screed settings to determine the initial approved rolling procedure.

Together, the Compaction Foreman and Engineer will determine when new rolling procedures are required. RCI production may be stopped by the Compaction Foreman or Engineer whenever rolling is not being performed according to the approved rolling procedure.

For all lots, achieve the maximum density before the temperature of the HMA falls below 175°F. Do not crush the aggregate. When the mat temperature falls below 175°F, roller marks may be removed from the mat with a self-propelled static steel roller.

(5) Contact Surfaces. Coat contact surfaces of curbing, gutters, manholes and similar structures with a thin uniform coating of asphalt material. Place the HMA uniformly high near the contact surfaces so that after compaction it shall be approximately ¼ inch above the edge of such structures.

(6) Adjustment of Manholes (Set Price). When required, this work will be performed and paid for under **SECTION 816**.

(7) Construction Joints.

(a) Transverse Construction Joints. Use a method of making transverse construction joints to provide a thorough and continuous bond, provide an acceptable surface texture and meet density requirements. Do not vary the surface elevation more than 3/16 inch in 10 feet, when tested longitudinally across the joint. When required, repair the joints or paving operations will be suspended.

(b) Longitudinal Joints. Construct well bonded and sealed longitudinal joints to obtain maximum compaction at the joint. If deemed necessary by the Engineer to properly seal the joint, apply a light coat of asphalt emulsion or asphalt binder to the exposed edge before the joint is made.

Before placing the fresh HMA against a cut joint or against old pavement, spray or paint the contact surface with a thin uniform coat of asphalt emulsion or asphalt binder. Where a finishing machine is used, make the longitudinal joint by depositing a sufficient amount of HMA to form a smooth and tight joint.

Offset the longitudinal joint in successive courses by 6 to 12 inches. Comply with traffic lane edges for the width of the surface of top course placement.

f. Maintenance of Traffic. Maintain traffic according to **DIVISION 800** and the following:

Maintain one-way traffic, and restrict traffic speeds to 20 miles per hour in the vicinity of workers, unless otherwise designated. Use pilot cars to lead traffic through the area of paving and rolling operations, and if directed, through a curing area. The use of flaggers is allowed through patching operations, unless the patching area or distance between flaggers exceeds ½ mile, in which case the use of a pilot car shall be required. On overlay projects with 2 lanes or more in each direction for traffic use, the Engineer may waive the pilot car requirements.

Station one flagger ahead of the application of the tack coat and one flagger ahead of the area being protected from traffic. Take adequate protection for traffic on side roads approaching the tack area.

g. Treatment of Adjacent Areas. Pave sideroads, entrances and turnouts for mailboxes as shown in the Contract Documents. Overlay all widening areas designated in the Contract Documents or ordered by the Engineer.

h. Special RCI Requirements.

Technical Support: Personnel familiar with the process will provide technical support for production and placement of the RCI.

Tack Coat: Place a tack coat prior to the placement of the RCI.

Thickness: Compact the RCI, as a minimum, to the depth shown in the Contract Documents. Thicknesses less than the plan thickness are not acceptable and may result in removal and replacement at no additional cost to KDOT.

Longitudinal Joint: Overlap the PCCP or HMA longitudinal joint with the RCI by at least 6 inches.

Compaction and Density: Control the in-place density of all lots of the RCI using an approved rolling procedure as outlined in **subsection 614.4e**. If cores are taken use extreme care when handling the cores. Use a solid flat and un-textured surface to transport and store the cores prior to testing.

Release to Traffic and Overlay Placement: Cover the RCI with a hot mixture overlay within 10 days after placement. The RCI may be opened to traffic or covered with the hot mix overlay after cooling to less than 140°F or as determined by the Engineer.

Unacceptable work: Remove and replace areas determined unacceptable by the Engineer, in accordance with this specification, at no additional cost to KDOT.

Damaged Areas: Replace any traffic-damaged or marred areas at no additional cost to KDOT.

Blisters: Perforate blisters that are a minimum of 8" in diameter or a minimum of 1" high that have not disappeared by the time of the overlay using a method approved by the Engineer.

i. Pavement Smoothness. Evaluate pavement smoothness according to **SECTION 603**.

614.5 PROCESS CONTROL

a. General. Establish gradation limits and proportions for each individual aggregate and mineral filler. Specify the limits and proportions such that the material produced complies with the applicable requirements of the designated mix type. The Contractor is responsible for all process control operations including testing. At no time will KDOT's representative issue instructions to the Contractor or producer as to setting of dials, gauges, scales and meters. KDOT will collect and test verification samples and assurance samples and inspect the Contractor's quality control operations.

b. JMF Adjustments. Produce a mixture of uniform composition closely complying with approved design JMF to obtain the specified properties when compacted. If, during production, results from quality control tests demonstrate a need to make adjustments to the mix design, then make adjustments to the design JMF single point gradation and binder content to achieve the specified properties. The JMF adjustments shall produce a mix that complies with **TABLE 614-1** for the specified mix designation. When necessary, adjust on a sublot basis. Report the new JMF to KDOT's field representative and the DME before making such changes, and submit a new mix design for review and approval if required by the DME.

c. Specification Working Ranges. Establish acceptable limits for field test results by applying the tolerances shown in **TABLE 614-7** to the JMF or adjusted JMF for binder content and air voids. Establish acceptable limits for the other listed mix characteristics by applying the tolerances shown in **TABLE 614-7** to the requirements of **TABLE 614-1**.

TABLE 614-7: SPECIFICATION WORKING RANGES (QC/QA)

Mix Characteristics	Tolerance from JMF			
	Single Test Value	**Plot**	**4 Point Moving Average Value**	**Plot**
Binder Content	±0.5%	*	±0.3%	*
Air Voids @ N_{des} gyrations	±1.0%	*	±1.0%	*
Mix Characteristics	**Tolerance for Specification Limits**			
	Single Test Value	**Plot**	**4 Point Moving Average Value**	**Plot**
Gradation (applicable sieves shown in **TABLE 614-1**)	**	*	zero tolerance	*
Voids in Mineral Aggregate	1.0% below min.	*	zero tolerance	*
Voids Filled with Asphalt	zero tolerance		n/a	
Sand Equivalent	zero tolerance		n/a	

*Values to plot. For gradations, as a minimum, plot the No. 8, No. 16, No. 50, and No. 200 sieves.
** The maximum deviation from the JMF shall be ±4% for No. 16 sieve and ±1.0% for No. 200 sieve.

614.6 WEATHER LIMITATIONS

Do not place HMA on any wet or frozen surface or when weather conditions otherwise prevent the proper handling and finishing of the mixture.

Only place HMA when either the minimum ambient air temperature or the road surface temperature shown in **TABLE 614-8** is met.

TABLE 614-8: MINIMUM RCI PLACEMENT TEMPERATURES

Paving Course	Thickness (inches)	Air Temperature (ºF)	Road Surface Temperature (ºF)
RCI	All	50	55

614.7 MIXTURE ACCEPTANCE

a. General. Test the RCI at each plant for compliance with **TABLE 614-1**. Acceptance will be made on a lot by lot basis contingent upon satisfactory test results. Obtain quality control and verification samples of the RCI using KT-25 sampling procedure D.2 Truck Bed. The sampling device and procedures used to obtain and split the samples must be approved by the Engineer. The Contractor's quality control tests will be used for acceptance provided those results are verified by KDOT.

A load or loads of mixture which, in the opinion of the Engineer, are unacceptable for reasons such as being segregated, aggregate being improperly coated, foaming aggregate or being outside the mixing temperature range may be rejected. The Engineer will take verification samples using the same sampling and splitting procedure as approved for the Contractor's quality control tests.

The P_b test values will also be used to determine P_b pay adjustments according to **subsection 614.8b**. P_b pay adjustments apply to the RCI placed on the traveled way and shoulders (including ramps and acceleration and deceleration lanes).

b. Lot Definition for Mix Production Sampling and Testing. A lot is defined as an isolated quantity of a specified material produced from a single source or operation. Each lot shall normally be represented by 4 contiguous test results. A lot may be represented by test results on samples taken from 1 or more day's production.

c. Lot Investigation. The Engineer may examine materials represented by individual test results which lie beyond the Contractor's normal quality control testing variation. The investigation may be based on either Contractor or KDOT test results. The information from additional testing (including testing of in-place RCI) may be used to define unacceptable work according to **subsection 105.5**. The Engineer may apply appropriate price reductions or initiate corrective action.

For any test, if a dispute exists between the Engineer and Contractor about the validity of the other's test results, the KDOT District Materials Laboratory or the MRC will perform referee testing, except for P_b dispute resolution. If the disputed KDOT test results were generated at the District Laboratory, the MRC will perform the referee tests. If the disputed KDOT test result was generated at the MRC, an independent laboratory agreeable to both parties will be selected. The Laboratory shall be accredited by the AASHTO Accreditation Program in the appropriate testing category.

If referee testing indicates that KDOT test results are correct, the Contractor pays for the additional testing, including referee testing performed at the MRC. This will be paid using the bid item Contract Deduct which will be an item added to the contract.

If the referee testing indicates that Contractor test results are correct, KDOT pays for the additional testing. Pay the independent lab for the testing and submit the paid invoice to KDOT. The Engineer will reimburse the Contractor (based on the invoice price) as Extra Work, **SECTION 104.**

For P_b dispute resolution (the statistical comparison fails and the Contractor questions KDOT results), the following procedure applies for the lots in question:

- Determine which lots to dispute. Only dispute the lot produced immediately prior to the lot currently under production and being tested. Notify the Engineer, prior to the completion of all Contractor P_b testing for this lot. (When production is completed for any mix, the last lot may be challenged the day production is completed).
- Discard P_b and P_b pay adjustment factors previously determined within the lots being questioned.
- All back halves of samples within the lot in question will be taken by KDOT to the District Materials Laboratory. All back halves of samples shall be a minimum of 35 pounds. Failing to obtain enough material removes the right to dispute resolution. Copies of all paperwork, including work sheets, associated with previous P_b calculations for the disputed lots will also be taken to the District Materials Laboratory.

The following retesting will be completed by KDOT:

- Determine the P_b using the back half of all samples within the lot being questioned using KT-57. Normally, there will be 5 back halves (4 Contractor's and 1 KDOT) to test within each lot.
- Using the retest P_b results, a statistical comparison will be made. If the t-test passes, the Contractor's retest results will be used to calculate the pay factor and KDOT will pay for all retesting. Use the procedures shown in **subsection 614.8b.** If the t-test fails, KDOT's retest results will be used to calculate the pay factor, and the Contractor will pay for all retesting.

When a deficiency within a lot is determined to exist for properties other than P_b (P_b deficiencies are addressed elsewhere in the specification), the Engineer will decide on the disposition of each lot as to the acceptance, rejection or acceptance at an adjusted payment. The Engineer's decision is final.

d. Resampling of Lots. Take no samples for retest for pay adjustment purposes except as noted in **subsection 614.7c**.

e. Multiple Projects. If multiple projects are supplied from 1 or more plants using the same mix, carry over the lots at each hot mix plant from project to project.

f. Lot Size. A standard size mix production lot consists of 4 equal sublots of 750 tons of RCI (lot size is 3,000 tons).

It is anticipated that lot size shall be as specified. However, with the Engineer's approval, the Contractor may re-define lot size for reasons such as, but not limited to, change in contract quantities or interruption of the work. Take 1 sample during production of each sublot and utilize it to determine disposition of the lot in which it occurs.

g. Increased Lot Size. After 8 consecutive sublots have been produced within the tolerances shown for all mix characteristics listed in **TABLE 614-7** and without a P_b penalty, the sublot size may be increased to 1,000 tons (lot size of 4,000 tons), provided the normal production rate of the plant is greater than 250 tons per hour. Provide immediate notification of lot size changes to the Engineer any time a change is made.

If subsequent test results fall outside the tolerances shown for any mix characteristic listed in **TABLE 614-7** or a P_b penalty is incurred, the sublot size shall be decreased to 750 tons. When the increased lot size criteria are again met, the sublot size may be increased to the limits given above.

h. Decreased Lot Size for Small Quantities. This is to be used when a small quantity (less than 3,000 tons) of RCI will be used. Use the plan quantity for the lot size. Reduce the sublot size below 750 tons by dividing the lot into 3 or 4 equal sublots. Before beginning production, provide the Engineer with the number and size of the sublots.

i. Pre-Production Mix. Test and evaluate a pre-production mix, limited to a maximum of 200 tons from each plant and type of mix before production of that mix. Evaluate the pre-production mix at initial start-up and after suspension of production resulting from failing test results. P_b payment shall not be adjusted for pre-production mixes. Provide a pre-production mix that complies with the gradation, P_b, VMA, and laboratory V_a requirements prior to starting or resuming production. For P_b, V_a, and VMA, use the "Single Test Value" listed in **TABLE 614-7** for comparison. For the other tests listed, use the values listed in **TABLE 614-1** for each mix. Except for initial start-up, normal delivery of material to the project before completion of certain test results on pre-production mixes may be authorized by the DME.

Place the material produced for the pre-production mix in locations approved by the DME. The Engineer will pay for material as the material produced. At the direction of the Engineer, remove the pre-production mix if it is both out of specification and the material shortens the pavement life or changes the intended function. The Engineer will pay for the replacement of one pre-production mix at 100% of the contract unit price for the RCI. The payment will be full compensation to the Contractor for the placement and removal of that pre-production mix. KDOT will not be financially responsible for any subsequent failed pre-production mixes (that require removal) for the RCI. The removed material is the property of the Contractor.

The Engineer will not pay for pre-production mixes that are required to be replaced due to poor workmanship or equipment failure. The Engineer will make the final decision to remove a failed pre-production mix with input from the Contractor.

j. Suspension of Mix Production. Suspend production of the mix until appropriate corrections have been made, if 2 consecutive test results for any single mix characteristic fail to fall within the limits established by the tolerances shown in the single test value column of **TABLE 614-7**. Additionally, suspend production of the mix until appropriate corrections have been made, if any 4-point moving average value for any single mix characteristic fails to fall within the limits established by the tolerances shown in the 4-point moving average value column of **TABLE 614-7**. Production remains suspended pending the satisfactory results of a pre-production mix, unless waived by the DME.

The Engineer may stop production of RCI at any time the mix or process is determined to be unsatisfactory. Make the necessary corrections before production will be allowed to resume. Failure to stop production of RCI shall subject all subsequent material to rejection by the Engineer or acceptance at a reduced price, as determined by the Engineer.

614.8 BASIS OF ACCEPTANCE

a. General. Acceptance of the mixture will be contingent upon test results from both the Contractor and KDOT. The Engineer will routinely compare the variances (F-test) and the means (t-test) of the verification test results with the quality control test results for P_b using a spreadsheet provided by KDOT. If KDOT verification test results do not show favorable comparison with the Contractor's quality control test results, then KDOT test results will be used for material acceptance, material rejection and the determination of any pay adjustment on the P_b. Disputed test results will be handled according to **subsection 614.7c**.

KDOT will use a spreadsheet program to calculate pay adjustments for P_b, and to compare Contractor QC and KDOT QA test results. KDOT will provide a copy of this program to the Contractor, when requested. Microsoft Excel software is required to run this program; it is the Contractor's responsibility to obtain the correct software. Values computed using equations referenced in this specification may vary slightly from the spreadsheet values due to rounding of numbers. In such cases, the numbers computed by the spreadsheet will govern.

The comparison of quality control and verification tests will be completed using the t-tests to compare their population means and the F-test to compare their variances. The F & t tests, along with the Excel Spreadsheet used to compare the Contractor's QC results and KDOT's QA results, are described in Section 5.2.6, Part V. Additional information on the program may be obtained from the Bureau of Construction and Materials.

b. Asphalt Binder Pay Adjustment. Asphalt Binder (P_b) Pay Adjustment will be made on a lot basis and based on measured P_b from samples of plant produced material. The P_b pay adjustment factor ($\boldsymbol{P_B}$) (positive or negative) will be determined and used to compute the P_b pay adjustment by multiplying $\boldsymbol{P_B}$ times the number of tons included in the lot times $40 per ton. This adjustment will be paid for under the bid item Asphalt Binder Pay Adjustment. When the statistical comparison between the quality control and the verification tests pass, use the procedures in **subsection 614.8b.(1)** to compute $\boldsymbol{P_B}$. When the statistical comparison fails, calculate $\boldsymbol{P_B}$ using procedures in **subsection 614.8b.(2)**.

Asphalt Binder Lot Size: A lot shall normally be comprised of the results of 4 contiguous individual P_b tests as determined from the ignition oven burn-off procedure (KT-57).

(1) Asphalt Binder Pay Adjustment Factor (Passing t-test). Calculate the upper and lower P_b quality indices ($\boldsymbol{Q_{UB}}$ and $\boldsymbol{Q_{LB}}$) for each lot using Equations 3 and 4, respectively and round to hundredths. Locate the $\boldsymbol{Q_{UB}}$ value in the left column of the Percent Within Limits (PWL) Table in Section 5.2.1, Part V. Select the appropriate upper percent within limit value ($\boldsymbol{PWL_{UB}}$) by moving across the selected quality index row to the column representing the number of samples (N) in the lot. Repeat the process using the $\boldsymbol{Q_{LB}}$ value and select the appropriate value for the lower percent within limits ($\boldsymbol{PWL_{LB}}$). If the $\boldsymbol{Q_{UB}}$ or $\boldsymbol{Q_{LB}}$ value is greater than the largest quality index value shown in the table, then a value of 100.00 is assigned as the value for $\boldsymbol{PWL_{UB}}$ or $\boldsymbol{PWL_{LB}}$, respectively. If both $\boldsymbol{Q_{UB}}$ and $\boldsymbol{Q_{LB}}$ exceed the values shown in the table, a value of 100.00 is assigned as the value for both $\boldsymbol{PWL_{UB}}$ and $\boldsymbol{PWL_{LB}}$. If either $\boldsymbol{Q_{UB}}$ or $\boldsymbol{Q_{LB}}$ is a negative value or $\boldsymbol{PWL_{UB}}$ + $\boldsymbol{PWL_{LB}}$ is less than 150.00, the Engineer will determine if the material in the lot may remain in place. If the Engineer determines that the material may remain in place then the maximum value of $\boldsymbol{P_B}$ for the lot will be equal to –0.060. The Engineer may establish lower values for $\boldsymbol{P_B}$ (-0.100, -0.200, etc.) in such instances. Otherwise, calculate $\boldsymbol{P_B}$ using Equation 3 and round to thousandths.

Equation 1:
$$\boldsymbol{Q}_{UB} = \frac{USL - \overline{X}}{S}$$

Equation 2:
$$\boldsymbol{Q}_{LB} = \frac{\overline{X} - LSL}{S}$$

$\overline{X}$ is the average measured P_b of all samples within a lot rounded to hundredths.
USL is the upper specification limit for P_b, and is defined as 0.30% higher than the JMF P_b.
LSL is the lower specification limit for P_b, and is defined as 0.30% lower than the JMF P_b.
S is the standard deviation of the measured P_b for all samples within a lot and is calculated using equation (4) in Section 5.2.1, Part V, rounded to hundredths.

Equation 3:
$$\boldsymbol{P_B} = ((\boldsymbol{PWL_{UB}} + \boldsymbol{PWL_{LB}} - 100)(0.0015)) - 0.135$$

$\boldsymbol{PWL_{UB}}$ is the upper percent within limits value for P_b.
$\boldsymbol{PWL_{LB}}$ is the lower percent within limits value for P_b.

(2) Asphalt Binder Pay Adjustment (Failing t-Test). If the t-test fails, KDOT's test result will be used to calculate the P_B for the lot. Follow the procedures given in **subsection 614.8b.(1)** to determine the P_B or disposition of the lot. Use the values from **TABLE 614-9** to calculate Q_{UB}, Q_{LB}, PWL_{UB} and PWL_{LB} in Equations 1, 2 and 3 in **subsection 614.8b.(1)**.

TABLE 614-9: Statistical Values for Asphalt Binder Pay Adjustment for Failing t-Test		
Term	**Definition**	**Value**
$\overline{X}$	Average or Mean	KDOT's test result for the lot
S	Standard Deviation	0.20
USL	Upper Specification Limit	0.50% + JMF P_b
LSL	Lower Specification Limit	JMF P_b - 0.50%
N	Sample Size	3

614.9 MEASUREMENT AND PAYMENT

a. HMA-RCI (PG 70-28 RCI). The Engineer will measure HMA -RCI by the ton of material at the time of delivery to the road. Batch weights will not be allowed as a method of measurement unless all the following conditions are met:

- the plant is equipped with an automatic printer system approved by the Engineer;
- the automatic printer system prints the weights of material delivered; and
- the automatic printer system is used in conjunction with an automatic batching and mixing control system approved by the Engineer.

Provide a weigh ticket for each load. Due to possible variations in the specific gravity or weight per cubic foot of the aggregates, the tonnage used may vary from the proposal quantities and no adjustment in contract unit price will be made because of such variances.

Payment for "HMA -RCI" at the contract unit prices is full compensation for the specified work. Any pay adjustments will both be applied and the payment adjusted accordingly.

b. Emulsified Asphalt. The Engineer will measure emulsified asphalt used for tack by the ton. Payment for "Emulsified Asphalt" at the contract unit price is full compensation for the specified work.

c. Quality Control Testing (HMA). The Engineer will measure Quality Control Testing (HMA) performed by the Contractor on a per ton basis of HMA-RCI placed on the project. No adjustment in the bid price will be made for overruns or underruns in the contract quantity. The bid price will constitute payment for all necessary mix design testing, field process control testing, the testing laboratory and all necessary test equipment.

Payment for "Quality Control Testing (HMA)" at the contract unit price is full compensation for the specified work.

SECTION 615

SAW AND SEAL JOINTS (HMA OVERLAY)

615.1 DESCRIPTION

Provide materials for, locate, saw, clean, and seal joints in the HMA overlay at the locations shown in the Contract Documents or as designated by the Engineer.

BID ITEMS	UNITS
Saw and Seal Joint (HMA)	Linear Foot
Asphalt Core (Set Price)	Each

615.2 MATERIALS

Provide hot type joint sealing compound complying with **DIVISION 1500**.

615.3 CONSTRUCTION REQUIREMENTS

a. General. Begin the saw and seal operation a minimum of 48 hours after placing the surface course to allow the mat to cool. Complete the saw and seal operation prior to the end of the construction season (as established for asphalt paving) or project completion, whichever is earlier.

Coordinate the sawing, cleaning and sealing in a continuous operation.

b. Sawing the Joint. Reference the location of the existing joints in the concrete pavement before placing the HMA overlay by methods approved by the Engineer.

Use a saw that will produce a smooth cut for the required depth and width.

Configure the joints according to **FIGURE 1** within 1 inch horizontally above the existing joint.

Saw the entire depth and width in one single pass for the entire length of the cut.

Saw transverse joints the entire width of the HMA Overlay.

Use either a dry or wet saw method.

c. Clean the entire depth of the cracks. If the wet saw method is used, flush wet sawed joints with high pressure water until the water runs clear.

For either saw method, remove all material created by sawing operation and other foreign material that will prevent bonding of the sealant. Remove loose material on the surface immediately adjacent to the joints and cracks. Clean and dry the crack using air compressors equipped with suitable traps capable of removing all surplus water and oil from the compressed air.

d. Joint Depth and Location Verification. Before sealing the joints, the Engineer will randomly identify two transverse joints per lane-mile. Cut a 4-inch core through the entire depth of the HMA and PCCP at these locations.

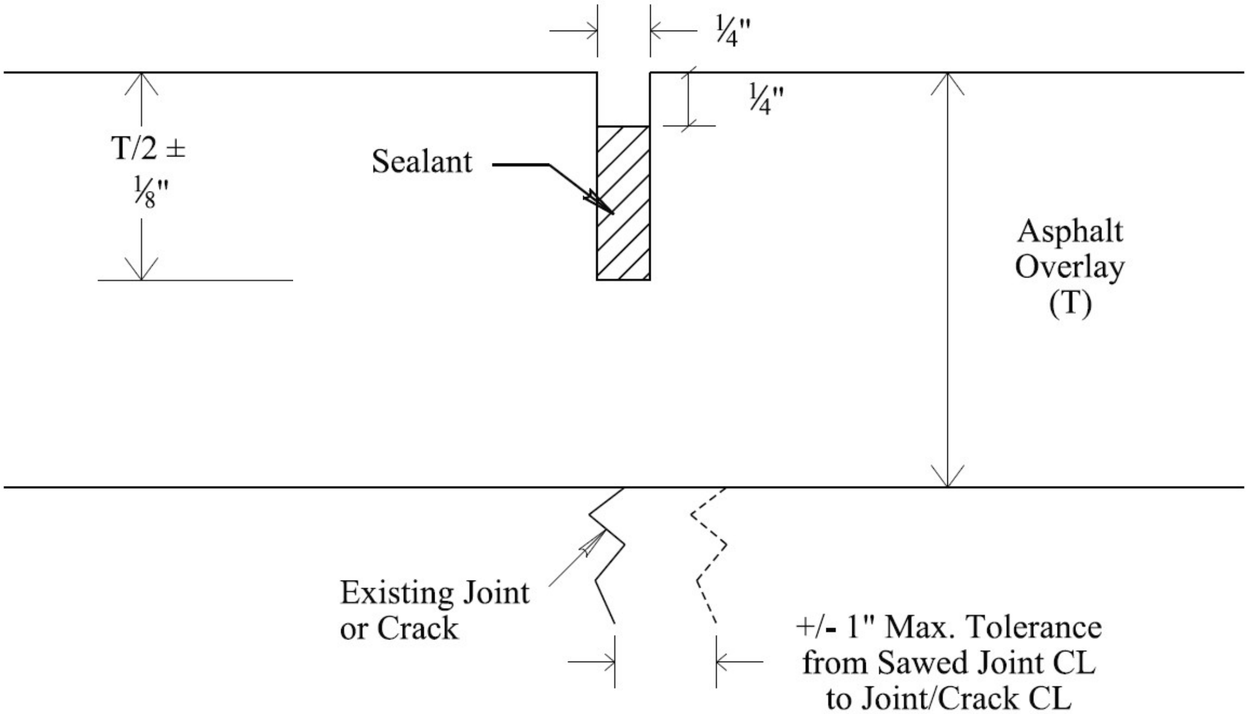
The Engineer will measure the depth of the HMA overlay, the depth of the saw cut and the horizontal offset between the underlying PCCP joint and the sawed joint.

If the sawed joint is offset by more than the 1 inch tolerance, the Contractor will be assessed a Contract Deduct of 40% of the bid price for the lineal feet of joints represented by the deficient core.

(1) HMA Overlay > 1.0 inch. If the depth of the saw cut is less than the half of the HMA thickness, ± 1/8 inch, re-saw every joint to the required depth in the segment represented by the core. Take additional cores for verification of re-sawed joints, at randomly selected locations determined by the Engineer.

Dry the core holes, tack the sides and bottom, fill with the same type of material and properly compact.

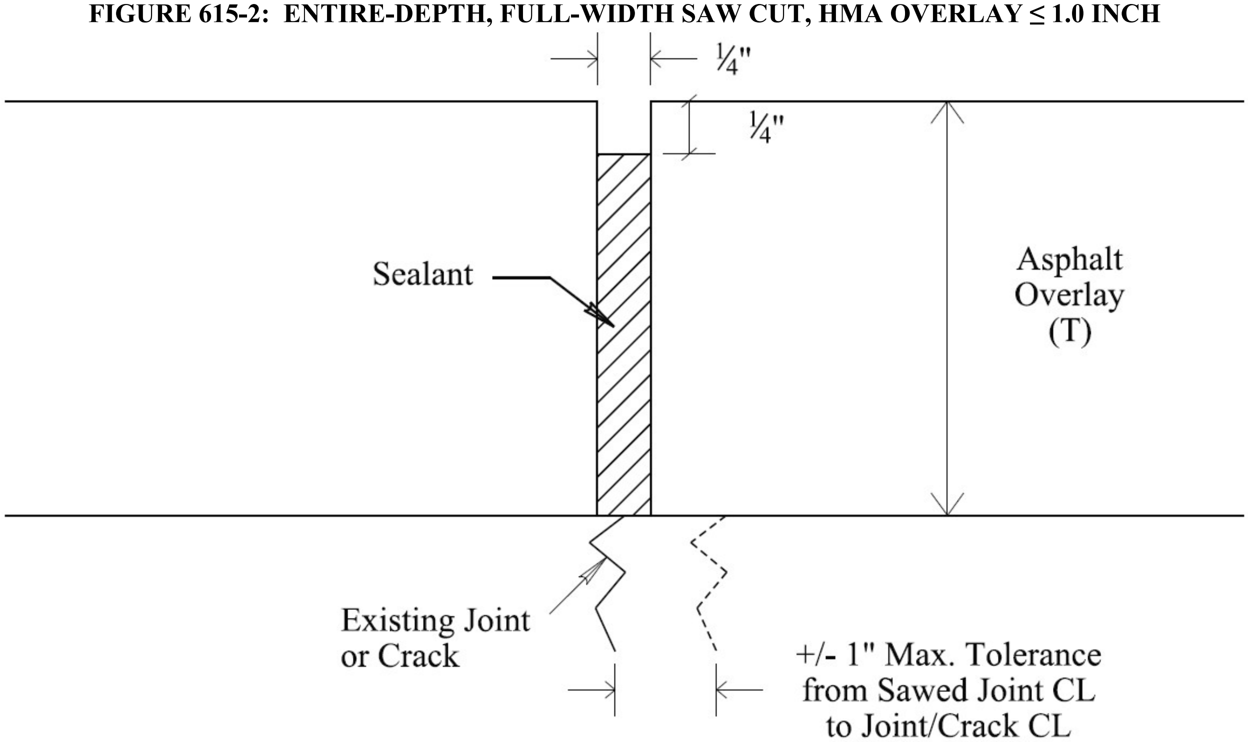
FIGURE 615-1: FULL-WIDTH SAW CUT, HMA OVERLAY > 1.0 INCH



(2) HMA Overlay ≤ 1.0 inch. If the depth of the saw cut is less than the full HMA overlay thickness, re-saw every joint to the required depth in the segment represented by the core. Take additional cores for verification of re-sawed joints, at randomly selected locations determined by the Engineer.

Dry the core holes, tack the sides and bottom, fill with the same type of material and properly compact.

FIGURE 615-2: ENTIRE-DEPTH, FULL-WIDTH SAW CUT, HMA OVERLAY ≤ 1.0 INCH



e. Preparation of Asphalt for Joint Sealing. Provide 2 copies of the manufacturer's recommendations for preparation and application of the sealant. Prepare and use the material according to the manufacturer's recommendations.

f. Sealing the Joint. Apply the joint sealant by an approved mechanical device. Place the sealer the entire depth in close conformity with dimensions shown in the Contract Documents. Fill joints to a level 1/4-inch recessed from the pavement surface.

Do not permit traffic over sealed joints until the sealer is tack free, or until debris from traffic can not imbed into the sealant and sealant does not track under tires.

g. Weather Limitations. Do not place sealant when the ambient air temperature is below 40°F.

615.4 MEASUREMENT AND PAYMENT

The Engineer will measure sawing and sealing joints by the linear foot along the center of the joint. The Engineer will measure each asphalt core required to verify the saw depth and location.

Payment for "Saw and Seal Joint (HMA)" and "Asphalt Core (Set Price)" at the contract unit price will be full compensation for the specified work.

The Engineer will apply a Contract Deduct of 40% of the bid price for lineal feet of deficient joint offsets as determined in **subsection 615.3d.** above. The bid item Contract Deduct will be an item added to the contract.

SECTION 701

TEMPORARY SHORING

701.1 DESCRIPTION

Design and construct temporary shoring for the locations designated in the Contract Documents and any temporary shoring used for the Contractor's convenience.

BID ITEM	**UNITS**
Temporary Shoring	Lump Sum

701.2 MATERIALS

Provide the materials shown in the Temporary Shoring Plan. The Engineer will accept the temporary shoring materials based on compliance with the dimensional requirements and visual inspection for condition.

701.3 CONSTRUCTION REQUIREMENTS

For each location designated in the Contract Documents, submit the Temporary Shoring Plan (including the design calculations) sealed by a licensed Professional Engineer, according to **SECTION 105**, to the Engineer for approval a minimum of 6 weeks before the scheduled beginning of temporary shoring operations, unless shown otherwise in the Contract Documents.

Shore, sheet, brace or otherwise support the excavation or the structure according to the Temporary Shoring Plan. Maintain the temporary shoring until the Engineer authorizes its removal.

701.4 MEASUREMENT AND PAYMENT

The Engineer will measure each location of temporary shoring designated in the Contract Documents by the lump sum. Temporary Shoring shown to be used in multiple locations in conjunction with a structure will be considered as one location for lump sum payment. Unless shown as a bid item in the Contract Documents, the Engineer will not measure for payment any temporary shoring needed to comply with safety standards or due to the Contractor's methods of operation.

Payment for "Temporary Shoring" at the contract unit price is full compensation for the specified work.

SECTION 702

CONTROLLED DEMOLITION

702.1 DESCRIPTION

Controlled demolition is the process of transporting, handling and disassembling the components of an open span structure to result in the complete or partial removal of the entire structure or elements of a structure according to the approved demolition plan. The Contract Documents will identify the category for each structure.

Information on existing structures is made accessible by the Owner, if the information is available. Evaluate project characteristics and prepare demolition plans according to the specified category listed in the General Notes.

Plan and execute all procedures necessary for full or partial removal of the structure in a safe and controlled manner that meets all applicable KDOT specifications and all applicable OSHA requirements.

After concrete removal, or before any steel repairs, test the paint for lead content. Properly handle any lead based paint. See **SECTION 714**.

702.2 DEMOLITION SUPERVISOR

The Demolition Supervisor is the person responsible for all rigging and handling of bridge primary and secondary members. The Demolition Supervisor shall be present at the construction site during the removal of Category B & C Structures.

All Demolition Supervisors must be pre-qualified for the scope, type and complexity of the existing structure. To become pre-qualified, provide proof of experience that the Demolition Supervisor has a minimum of 3 years of experience and at least 5 projects similar in scope, type and complexity.

KDOT will maintain a list of approved Demolition Supervisors on a Pre-Qualified List.

Complete the pre-qualification of the Demolition Supervisor prior to the pre-construction meeting, and/or submit to the KDOT Field Engineer proof of pre-qualification at the pre-construction meeting.

702.3 DEMOLITION PLANS

a. General. The Contract Documents will indicate the demolition category for each structure. Submit shop drawings according to **SECTION 105**.

Develop a unique Demolition Plan for each qualifying existing open span structure in the Contract Documents.

Submit a detailed Demolition Plan to the Owner's Engineer for each open span structure. Address all requirements for removal of the structure to the limits shown in the Contract Documents. Demolition may not proceed until a Demolition Plan has been approved.

During phased/staged demolition, the Contractor's responsibilities extend to the removal limits stated in the Contract Documents for each phase. Do not directly affect the remaining structure outside the removal limits for each phase, or affect the adjacent structure.

Include a Contingency Plan within the Demolition Plan indicating procedures to be carried out if the demolition stage completed does not comply with the Demolition Plan (i.e. the Plan states completion of rail removal, but due to unforeseen obstacles the majority of one rail has been partially disconnected from the existing structure, but it has not been removed).

b. Definitions. The level of review and the requirements for submittals by the Contractor to the Engineer are categorized by risk and complexity.

The Design Engineer will determine and assign the Category of the demolition and will indicate the demolition Category for each open span structure requiring removal on the design plans. Signing and Lighting structures, due to the typical removal procedures, will specify a demolition Category based upon the Signing and Lighting Engineer's engineering judgment. If this information is erroneously omitted, contact the State Bridge Office (SBO). Special considerations will control the selection of the demolition Category.

Controlled demolition of open span structures falls under three separate categories:

(1) Category A. This category requires approval of a Demolition Plan. Demolition typically includes open span structures that will not carry any type of traffic during the demolition operations, structures not adjacent to

traffic, or for structures that do not include a span over any type of traffic. Structures requiring phased removal will be considered for Category A demolition.

(2) Category B. This category requires approval of a Demolition Plan, and a pre-qualified Demolition Supervisor. Demolition will include open span structures with more complex traffic control. Although the removal, or partial removal, may be simple in nature, the structure may continue to carry traffic, be located adjacent to traffic, or include one or more spans over traffic or railroad. Deck or rail replacement, partial depth patching, substructure repair projects or similar controlled demolition activities have the potential to become projects which require a more stringent demolition Category, and as such may be included in this Category.

(3) Category C. This category requires an approved Demolition Plan reviewed by the SBO (or Bureau of Local Projects), a pre-qualified Demolition Supervisor, and the stamp of the Contractor's Professional Engineer. Demolition is defined as the category for open span structures with complex traffic control plans and removal sequences. Complex structures required to carry traffic during demolition operations, are adjacent to traffic, or structures that include one or more spans over traffic (curved structures, severely skewed structures, multi-level interchange structures, etc.) may be included in this Category. A structure with components being removed over traffic or with the potential to fall into traffic is considered to be a Category C structure.

c. Submittals.

Category A Demolition Plans. Provide the Field Engineer with one set of Demolition Plans before demolition begins. Demolition Plans will include at a minimum, as applicable:

(1) A list of all equipment that will be used;
(2) Sequence and limits of removal/partial removal/repair;
(3) Measures to contain falling, or rolling, debris;
(4) Heavy stockpile/equipment loads on the bridge, detailed in accordance with **subsection 702.6**; and
(5) Traffic Control Plan Modification will be according to **SECTION 805**.

No additional requirements apply to this Demolition Category.

Category B Demolition Plans. Provide the Field Engineer with one set of Demolition Plans 2 weeks prior to the demolition meeting. Meet each requirement for a Category A Demolition and at a minimum the following:

(1) A removal sequence showing gravity loads imposed by Contractor equipment and materials.
(2) Proposed methods of demolition, as applicable:

- A list of all equipment that will be used;
- Details of methods to brace the existing structure during demo process;
- Saw cut and/or break point locations;
- Crane pick locations, loads, positions, charts, and rigging;
- Location of protective covers or shields;
- Temporary drainage plan; and
- Proposed backfill after removal of below grade structures.

(3) Specific details for removal will be clearly defined, as applicable:

- Practical environmental conditions limits for removal;
- Detailed Pick descriptions (Length, Center of Gravity, weight, etc.);
- Cross-frame or diaphragm removal sequence; and
- Temporary shoring/falsework details in compliance with **SECTION 708**.

(4) On the Demolition Plans, list the name of the person who is responsible for all rigging and handling of all elements requiring removal. This person, referred to as the Demolition Supervisor, must be present at the site during the demolition of all elements requiring removal. All field operations and field changes are under the authority and responsibility of the Contractor's Demolition Supervisor.

(5) Do not suspend/swing any elements over highway traffic at any time during any stage of the removal procedure.

No additional requirements apply to this Demolition Category.

Category C Demolition Plans. Meet each requirement for a Category B Demolition. In addition, submit the final Demolition Plan details, according to **SECTION 105**, to the SBO (or Bureau of Local Projects) for review at least 4 weeks before the pre-demolition meeting.

(1) The Engineer will require a pre-demolition meeting before any Category C demolition operations begin. The Demolition Supervisor will attend this pre-demolition meeting to discuss any field concerns related to the demolition procedures and to increase familiarity with each existing structure to be removed.

(2) Intermediate Stability. Defined as the point in time when the composite nature, or redundancy of the as-built structure, or elements of the structure, can no longer be relied upon to be stable under dead or live loads. This condition may be due to general or localized degradation of the structure, or due to demolition preparations. Before any connection between the existing structure and the element being removed has been compromised, provide protective stability measures for the existing structure, and for the element being removed. The existing state of the overall structural stability, or stability of particular elements of the structure, may be a major factor in the decision for complete, or partial removal.

- The composite nature and structural integrity of an as-built structure shall be verified before it is relied upon. This requires calculations, procedures and drawings to be developed and sealed by the Contractor's Professional Engineer.
- Field changes causing increased load effects at any controlling portion of the structure must be approved and resealed by the Engineer who originally developed the plans before work begins. This work is under the authority of the Contractor's Professional Engineer.

In no case will the Engineer allow any type of traffic to travel under incomplete structures undergoing demolition without compliance of the Demolition Plan.

d. Calculations. Include the following as a minimum:

(1) Calculations to substantiate structural adequacy and stability for each stage of demolition, accounting for the structure's lack of completeness, various stages of partial connections, or complex structural geometry.

(2) Primary member bearing calculations clearly stating minimum net downward forces at bearing locations at critical stages of removal.

(3) Calculations to determine translations and rotations at intermediate removal conditions.

(4) Design calculations indicating and verifying the load capacity and stability of all temporary supports, falsework bents, shields or covers, and bracing when used to allow traffic to travel under the incomplete structure.

(5) Calculations indicating structural redundancy of the incomplete structure will be required at intermediate stages of demolition. These calculations will be required to account for unforeseen obstacles to the removal process that necessitate halting demolition at an undesignated stopping point.

(6) Using alternative dead and live loading patterns producing the maximum load effect at controlling locations of the as-built structure, the Contractor's Engineer may create an envelope of allowable means and methods for the demolition procedures.

702.4 DEMOLITION INFORMATION RESPONSIBILITY SUMMARY

The Contractor's Engineer shall provide the following information (Category C):

- Plan of the work area showing the as-built permanent support structures of the structure to be disconnected or removed, roads, railroad tracks, waterways (including navigational channel), overhead and underground utilities and other information pertinent to the demolition procedure.
- Removal sequence for all elements of the structure noting any temporary support conditions, such as holding crane positions, temporary supports or bracing, shoring, protective shields or covers, dead man cables, anchor blocks, etc.
- Details describing the number and location of the permanent, or temporary, cross-frames or diaphragms for each stage of removal.
- Details addressing the expected condition of each bearing device for each stage of construction. State the minimum number of positive bearing connections or supplemental connections to each bent cap which will resist potential destabilizing forces.
- Details addressing modified traffic control, utility and railroad issues.
- Demolition Plans to meet general falsework requirements in **DIVISION 700** if falsework bents, temporary shoring, or strong-backs are used to maintain the stability of the remaining structure.

- Contingency Plan specifying the various unintended partial stages of demolition and removal, including end-of-day bracing and stability requirements. The Contractor's Engineer will also need to address real-time concerns arising from the on-going demolition process.

The Contractor's Demolition Supervisor shall provide the following information (Category B or C):

- Verification to the Contractor and the Field Engineer that member reference marks, as described in the Demolition Plan, have been transferred to the existing structure to allow the Contractor and the Field Engineer to conduct a field review;
- Limits for windspeed/gust, or other environmental concerns for crane operations;
- Proposed crane locations for primary picks showing all necessary information;
- Capacity chart for each crane configuration;
- Center of gravity, lift weight (including rigging) for all picks;
- Primary/secondary element removal location and storage;
- Details of any temporary lifting devices to be bolted/welded to permanent members, including stage and method of attachment, capacity, and stage of removal and
- Temporary support details for bridge bearings.

The Owner's Inspector shall require the following (Category A, B and C):

- A dimensionally accurate Demolition Plan, clearly stating the limits of removal, girder line locations, etc., to permanently transfer to the existing structure;
- Requirements for bracing. At the end of each workday, remove, or temporarily brace, the structural elements not properly stabilized to bring these elements into compliance with the Demolition Contingency Plan; and
- All rigging must have capacity stamps, tags or be otherwise permanently marked on the device (per OSHA Standards).

702.5 PRECONSTRUCTION CONFERENCE

Discuss the Demolition Plan at the pre-construction or pre-demolition meeting.

Resolve any questions during the meeting concerning the Demolition Plan or specific demolition procedures to the satisfaction of the Contractor, Contractor's personnel, and the Engineer before demolition begins.

Additional circumstances may be addressed to include within the Contingency Plan. Modify the Contingency Plan to include all situations agreed upon during the meeting.

702.6 CONSTRUCTION REQUIREMENTS

Do not perform any demolition work without an approved Demolition Plan.

Keep the approved Demolition Plans available on site at all times.

Maintain a consistent, core group of staff (supervisors and laborers) through the completion of demolition.

Demolish the existing structure and perform all work required to remove the structure to the limits stated and as detailed in the Contract Documents. Upon completion of the demolition, remove all obstructions or debris resulting from these operations.

Without prior written approval by the KDOT Area Engineer, do not stock pile construction materials, debris, or rubble exceeding the lesser of the posted load limit, or 20 tons. Equipment on the structure must not exceed the lesser of the posted load limit, or the Operating Load Rating for the structure. To request written approval, provide the KDOT Area Engineer plans showing the location, quantity and weight of the proposed materials, debris and/or equipment exceeding the stated limits.

Perform demolition in a reasonable, controlled, methodical fashion. Demolition Plan approval by the Engineer will not and does not relieve the Contractor of the responsibility for the safety of the methods used, safety of the equipment, or from carrying out the work in full accordance with **SECTION 107**.

Demolition is complete when all elements are removed to the limits shown in the Contract Documents and any shoring and debris are removed.

702.7 MEASUREMENT AND PAYMENT

The Engineer will not measure Controlled Demolition, Demolition Plans and Contingency Plans for separate payment. All required work is subsidiary to the other bridge items in the contract.

SECTION 703

DRILLED SHAFTS

703.1 DESCRIPTION

Construct drilled shafts by the cased or uncased method depending upon site conditions and Contract Document requirements.

BID ITEMS	UNITS
Drilled Shaft (*) (**)	Linear Foot
Permanent Casing (*) (Set Price)	Linear Foot
Sonic Test (Drilled Shaft) (Set Price)	Each
Core Hole (Investigative)	Linear Foot

*Size
**Cased (If Contract Documents specify the cased method.)

703.2 MATERIALS

a. Concrete. Unless otherwise shown in the Contract Documents, provide Grade 4.0 concrete that complies with **SECTIONS 401, 402 and 1102**. Provide a mix design with a target slump of 9 inches ± 1 inch. Do not withhold mix water at the plant and do not add water at the site.

b. Grout/Flowable Fill. For backfilling the cross-hole sonic testing pipes and core holes, provide cementitious grout (mixed according to the manufacturer's directions) that complies with **DIVISION 1700**.

Provide grout or flowable fill for backfilling the void space between the temporary and permanent casing with:

- 28 day strength of 1000 psi;
- mortar sand, FA-M (**SECTION 1102**) mixed with 2 bags of Type II portland cement per cubic yard; and
- water-to-cement ratio less than 1.

c. Granular Backfill Material. Provide granular backfill material for backfilling the void space between the temporary and permanent casing that is fine enough to fill the entire volume. The Engineer will accept the granular material based on a visual inspection.

d. Reinforcing Steel. Provide steel bars for concrete reinforcement that comply with **DIVISION 1600**.

e. Casing. Provide casing of sufficient thickness to carry the working stresses and loads imposed on the casing during construction. At a minimum, use 14-gage corrugated metal pipe (CMP) for the permanent casing.

If required, provide a permanent casing that is less than or equal to 1 inch out-of-round. The deviation of a chord from end to end shall be a maximum of 2 inches.

The Engineer will accept the casing based on compliance with the specified requirements, and visual inspection for condition.

f. Pipe for Sonic Testing. Provide pipe that complies with **DIVISION 1900**.

703.3 CONSTRUCTION REQUIREMENTS

a. General. Drilled shaft lengths shown in the Contract Documents are an estimate from the top of formation elevations determined from borings. Actual formation elevations encountered at each shaft, may require the actual length of each drilled shaft be adjusted. If the Engineer changes the drilled shaft lengths, the Contractor will be advised (in writing) of the revised bottom of rock socket elevation.

A minimum of 28 days before constructing the drilled shafts, submit an installation plan to the Engineer for review. Include the following:

- Name and experience record of the drilled shaft superintendent in charge of drilled shaft operations;

- List of proposed equipment, such as cranes, drills, augers, bailing buckets, final cleaning equipment, de-sanding equipment, slurry pumps, core-sampling equipment, tremies or concrete pumps and casing; and
- Details of concrete placement, including proposed operational procedures for tremie and pumping methods and method of achieving a sealed tremie or pump.

b. Investigative Core Hole. Provide NX sized (2.125 inches) core samples organized in descending elevation and stored in standard core cardboard boxes. Perform this work, from the existing ground surface elevation, 15 working days in advance of the drilled shaft construction, at locations shown in the Contract Documents or ordered by the Engineer. Extract and maintain a core of the foundation material from 4 feet above the top of the plan tip elevation to 6 feet below the plan tip elevation shown in the Contract Documents. Discard all material extracted above 4 feet above the top of the plan tip elevation. Maintain, protect and label (elevation and location) these samples for review by the KDOT. While drilling, prepare a continuous standard drilling/coring log. The logs shall remain with the sample for review. Survey the location of the core hole with the same construction tolerance as **subsection 703.3c**.

c. Excavating the Drilled Shaft. Prior to constructing drilled shafts, complete the excavation for the entire element.

Locate the top of the shaft within 2 inches of the location shown in the Contract Documents. Unless otherwise shown in the Contract Documents, bore all shafts plumb to within a tolerance of 1 inch per 10 feet of length of shaft, not to exceed 6 inches over the full length of the shaft. The bottom of the shaft shall be nearly flat. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of $\pm 3/8$ inch per foot of diameter.

Depending upon site conditions and requirements in the Contract Documents, construct the drilled shaft by either the cased or uncased method:

(1) Uncased Method. Use this method at locations anticipated to be free of caving soil or excess water inflow into the excavated shaft. Do not use the uncased method if the actual conditions show the shaft is prone to caving soil, or has water inflow that exceeds the dry pour method requirements in **subsection 703.3f**.

Excavate the shaft without the use of added water or drilling fluid. Completely excavate the shaft in a continuous operation, unless encountering rock or obstructions. Place the concrete without delay.

(2) Cased Method. Use this method at locations with caving soil or excess water inflow into the excavated shaft. Use either a permanent smooth, thick-walled casing, or a combination of a smooth, thick-walled temporary and permanent CMP casing together. All permanent casings shall be watertight.

Advancing shaft excavation by stabilizing the hole with drilling fluid is acceptable. Do not allow drilling fluid to get into the rock socket.

The concrete placement method used in a cased shaft depends on the water inflow requirements in **subsection 703.3f**.

After removal of the overburden, complete the excavation below the top of rock as an uncased core (rock socket) of the diameter shown in the Contract Documents.

Do not excavate closely spaced drilled shafts (3 drilled shaft diameters or less, center to center) until adjacent shafts are completed and cured according to the following criteria:

- Completed shafts have been allowed to set for a minimum of 24 hours after the concrete placement; and
- Developed a compressive strength of 1800 psi; or
- Without testing, the Engineer may allow excavation to proceed when the shaft has cured 72 hours after completion of the concrete placement.

If the Contract Documents specify or the Contractor elects to use permanent thick-walled casing for the closely spaced shafts, the Contractor may excavate multiple closely spaced drilled shafts. Once the concrete is placed, it must be cured according to the criteria above before excavating additional closely spaced drilled shafts.

For drilled shafts equal to or greater than 72 inches in diameter founded in shale, or as required in the Bridge Foundation Geology Report, perform the following, prior to placement of the reinforcing cage:

- Use a full diameter flight auger or core barrel. Extensions to the auger to increase the diameter of the hole are prohibited, except when excavating a belled rock socket with an under ream attachment;
- Use a full size, clean-out bucket a minimum of 95% of the diameter of the rock socket, when needed;

- In the presence of the Engineer, sound the bottom of the finished shaft. Use a weighted tape in a 12-inch grid across the base of the shaft;
- Provide access to the entire perimeter of the shaft;
- Flocculate the finished shaft to increase the visibility in the water, prior to using the underwater video camera. Use a commercially available flocculent agent per the manufacture's recommendations.
- Prior to concrete placement, perform a video inspection to inspect the sides and base of the rock socket. Along with the Engineer, review the video to verify the socket meets the cleanliness portion of this specification, prior to concrete placement;
- Perform sonic testing for all shafts. Submit test results to the Chief Geologist for review. No work will be done above the top of drilled shaft without the approval of the Chief Geologist; and
- Any required repairs or additional testing are the Contractor's expense.

d. Placing Reinforcing Steel and Sonic Testing Pipes. Tie reinforcing steel at all intersections of reinforcement, and place reinforcing steel as a unit for the full length of the shaft, prior to placing any concrete by either pour method. Use a minimum of 1 non-corrosive circular spacer per 30 inches of circumference of the reinforcing steel cage, within 2 to 4 feet of the bottom and top, and at intervals not to exceed 10 feet vertically. If the shaft is deepened and additional reinforcing steel cage is required, make the splice at the bottom of the steel cage.

Remove any corrosion protection coating from the sonic testing pipes by sandblasting. Sandblast the pipes to bare metal. Place the sonic testing pipes within 7 days of sandblasting.

In each shaft, place the number of testing pipes shown in the Contract Documents. All sonic testing pipes shall be the full length of the shaft from the bottom of the rock socket a minimum of 12 inches above the top of the shaft concrete. Before placement, measure and record the length of the sonic testing pipes and elevation of any pipe joints.

If multiple sections of pipe are required to reach the full length, the joints shall be watertight. The joints for all testing pipes in the shaft shall be at the same elevation. Completely seal the bottom of the pipe. After installation, fill pipes with potable water and install threaded caps. All testing pipes shall remain watertight until testing is complete.

Regardless of the connection used, conduct a pressure test of each pipe upon installation in the reinforcement cage.

Test all pipes after being placed and tied in the reinforcement cage. When the drilled shaft is greater than 30 feet in length, perform a second pressure test after the reinforcement and pipes are installed in the drilled shaft but prior to placing the concrete. Pressurize the pipe to 100 psi. Seal the pipe for 3 minutes. Pressure loss can not be greater than 5% in 3 minutes.

e. Final Inspection and Access. At the time of placing the concrete, a minimum of 75% of the base of the shaft must have less than ½ inch of sediment. The Engineer will determine the shaft cleanliness before concrete placement by:

- Visual inspection; or
- Underwater inspection using probes; or
- Down hole television camera and video recordings

Provide access to 100% of the hole from probing purposes. Probing will be done by a tape with a minimum weight of 1 pound.

Review and inspection by the Engineer prior to concrete placement does not relieve the Contractor of the responsibility for producing a defect-free shaft per specifications.

When directed by the Engineer, operate the camera and recorder such that the optimum clarity of the details can be obtained and all surface areas of the shaft, including the rock socket sides and base can be observed. Record video and store tapes such that later review is possible. Label the recorded media, which will become the property of KDOT.

f. Placing Drilled Shaft Concrete. Depending upon site conditions, place concrete by either the dry pour or wet pour method:

- Use the dry pour method if water inflow does not fill the shaft more than 4 inches in depth in a 5 minute period, and the shaft can be dewatered so a maximum of 2 inches of water is standing in the shaft when concrete placement begins.

- When the above 2 conditions can not be met, use the wet pour method.

For both the dry and wet pour methods, the following common requirements for concrete placed in a cased or uncased shaft shall apply:

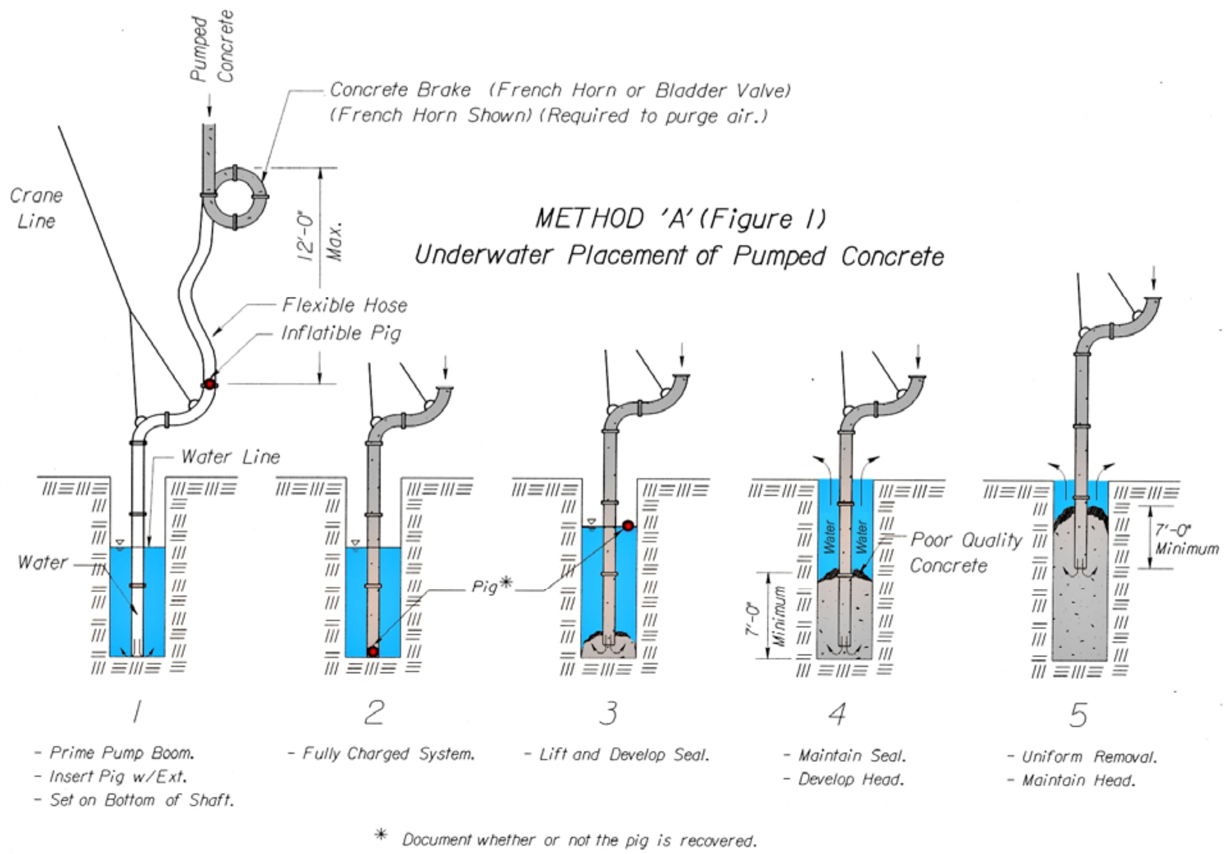
- Target slump is 9 inches ± 1 inch;
- Place concrete in the shaft with a continuous operation, without construction joints;
- Do not vibrate concrete;
- Determine the top elevation of the fresh concrete and inform the Engineer; and
- Do not use aluminum concrete pump discharge tubes or tremie tubes.

(1) Dry Pour Method. Use a centering device to deposit concrete so the falling concrete shall not come into contact with vertical and horizontal reinforcing steel and wire supports. To control the fall, extend the centering device a minimum of 8 feet into the shaft. For a cased shaft, concrete may free fall to the bottom. For an uncased shaft, the maximum fall for concrete is 5 feet.

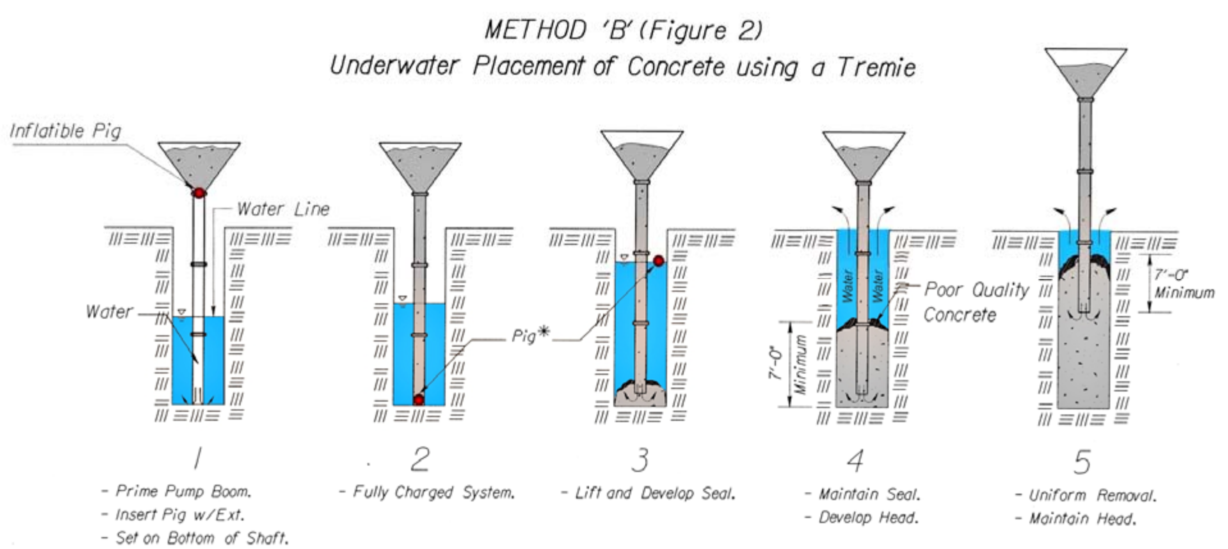
(2) Wet Pour Method. Prior to starting concrete placement, allow the water level in the shaft to reach its static level. Place concrete with either a sealed (watertight) tremie tube or pump with a rigid and watertight extension tube. In either case, use a device (i.e. commercially available pig or flap gate) that prevents water from entering the tube while charging with concrete. The commercially available pig shall be a minimum of 110% the diameter of the tube. Clearly label the outside of the tremie and pump tubes in 12-inch increments (starting at the bottom).

Lower the rigid tube into the shaft with the bottom of the tube resting on the bottom of the rock socket, and fully charge the system (tube and hopper or pumping system) with concrete. Once the system is fully charged, raise the tube off the bottom of the rock socket by 1 tube diameter, and allow the concrete to seal the discharge end of the tube. Maintain the tube at this elevation until a minimum of 7-foot head of concrete is developed. Maintain a minimum 7-foot head of concrete during the concrete placement. Prior to raising the tube, determine the top elevation of the fresh concrete and inform the Engineer.

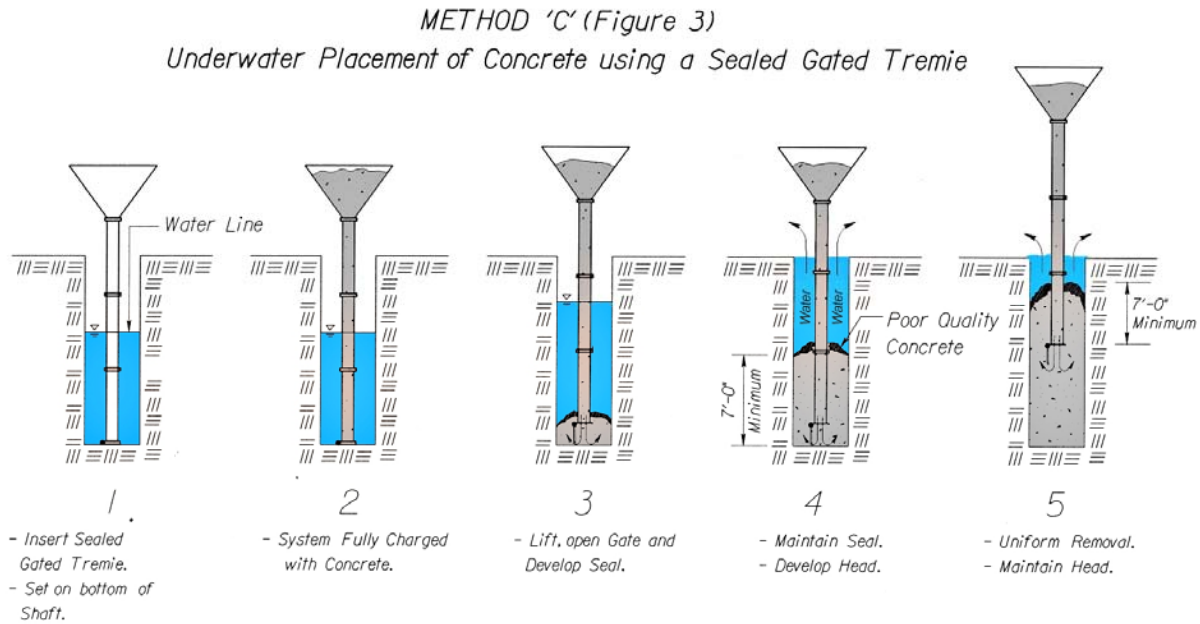
For wet pours, follow the steps listed in the previous paragraph, regardless of the Method (A, B or C) used to place concrete in the shaft:



Method A (Figure 1): Use a pump and extension tube, with a pig separating the ground water and concrete, to place concrete into the shaft. Install a concrete brake (e.g. bladder valve or French horn) at the end of the pump boom to purge the air from the pump line. Fully charge the boom with concrete (no air gaps) then install the pig in the top of the extension tube.



Method B (Figure 2): Use a tremie tube, with a pig separating the ground water and concrete, to place concrete into the shaft. Once the tremie tube is resting on the bottom of the shaft, install the pig just below the hopper in the top of the tremie tube. Fully charge the tremie tube and hopper (forcing the pig to the bottom of the tremie tube), then raise the tremie tube by 1 tremie diameter and seal the discharge end of the tremie tube with the fresh concrete.



Method C (Figure 3): Use a tremie tube, with a sealed gate separating ground water and concrete, to place concrete in the shaft. Fully charge the tremie tube and hopper, then raise the tremie tube by 1 tremie diameter and seal the discharge end of the tremie tube with the fresh concrete.

When the concrete reaches the top of the shaft, continue placing concrete (over-pump) to expel any excess water, debris or unsound concrete. If the casing extends above the planned shaft elevation the excess material must be expelled by providing an outlet in the casing above the planned elevation if the shaft. Do not bail the excess material out of the shaft. On all wet pours, regardless of the method used, the Engineer will make a set of cylinders (in addition to normal concrete cylinder sampling requirements) from the top of the shaft after completing over-pumping. This set of cylinders will be used to verify a compressive strength of 1800 psi before proceeding with subsequent substructure (i.e. columns, abutments, etc.) construction.

Prior to constructing the portion of the substructure that attaches to the drilled shaft, thoroughly clean the top of the drilled shaft to facilitate the bond at the cold joint.

g. Raising Temporary Casing. Do not remove the temporary casing until the concrete in the shaft has met the following conditions:

- Completed shafts have been allowed to set for a minimum of 24 hours after the concrete placement; and
- Developed a compressive strength of 1800 psi; or
- If compressive strength does not meet 1800 psi, the Engineer may allow the Contractor to proceed when the shaft has cured 5 days after completion of the concrete placement.

However, immediately after completing concrete placement in the permanent casing, it is acceptable to raise and hold the temporary casing at the embedment depth plus 6 inches.

Before raising the temporary casing completely, backfill the space between the 2 casings according to **subsection 703.3j**.

h. Curing. Cure the exposed surfaces of the shafts with wet burlap a minimum of 2 days. Do not use liquid membrane curing.

Cure all cylinders in the field, alongside and under the same conditions as the concrete they represent.

i. Sonic Testing.

(1) General. Perform sonic testing on all drilled shafts constructed by the wet pour method. Perform sonic testing on any dry pour method as directed by the Engineer. Conduct the sonic testing between 2 and 21 days after the drilled shaft is completed. The Engineer has the option to require additional testing.

Secure the services of an independent, experienced testing organization to take the cross-hole sonic logging measurements and issue reports. Submit to the Engineer, the testing organization's record of experience, a written description of the testing procedures, operation manuals for the testing equipment, and samples of previous test results indicating both sound and defective concrete.

(2) Sonic Logging Equipment. Provide sonic logging equipment capable of identifying any faults, honeycombing or poor concrete at KDOT specified operating settings:

- A time base that shall provide the "zero signal" and "first arrival" are 2 to 3 divisions apart on the horizontal axis; and
- Select a gain to produce an amplitude signal that fills ⅔ to ¾ of the screen along the vertical access of the waveform plot for portions of the shaft that correspond to good quality concrete;

Provide test results on thermal or graphical printouts with the vertical scale representing the vertical position along shaft, and the horizontal scale representing the propagation time.

(3) Sonic Logging Test Procedure. Immediately prior to testing, verify the pipes are free from blockages and filled with water. Determine the elevation of the top of the drilled shaft and the top of each pipe. Measure each pipe to determine the depth, and provide the information to the Engineer.

Conduct the sonic logging test procedure between all possible combinations of pipes (i.e. 4 pipes have 6 different combinations, 5 pipes have 10 different combinations, 6 pipes have 15 different combinations, 7 pipes have 21 different combinations, 8 pipes have 28 different combinations, etc.). If the sonic testing detects faults, the Engineer may require retesting with the probes in the same or different horizontal plane.

The testing organization shall make suggestions for changes in the Crosshole Sonic Logging (CSL) testing procedure based on known shaft construction issues or survey access issues. Such changes could include, but would not be limited to changing the frequency of data collection along the length of the shaft or offsetting the transducers from the horizontal plane. Any such suggested changes in CSL data collection procedures must be approved in advance by the Engineer.

Immediately prior to testing, verify the pipes are free from blockages and filled with water. Determine the elevation of the top of the drilled shaft and the top of each pipe. Plumb each pipe to determine the depth, and provide the information to the Engineer.

Configure sonic logging to settings in **subsection 703.3i.(2)**.

Use a winch to simultaneously raise the probes from the bottom of the pipes at a maximum rate of 12 inches per second. Take all slack out of the cables before switching on the analyzer.

(4) Record of Testing. After completing sonic testing, provide the Chief Geologist the report of the CSL test results stamped by a licensed Professional Engineer that includes data plots (recorded on thermal or graphical printouts) with the profiles referenced to the top of the shaft or top of the pipe elevation. A copy of the report shall be sent by the testing organization to the Contractor. No work shall be done above the top of the drilled shaft without approval from the Chief Geologist. Inform the Engineer on site of any faults, honeycombing or poor concrete detected by a fainting of the signals and a sudden lengthening of the propagation time. Diagram (horizontal and vertical cross-sections) any defects found within the shaft to identify the location, width and thickness of the defect. Provide the report of CSL results, stamped by a licensed Professional Engineer, within 1 week of conducting the sonic test. The CSL practitioner does not have the information available to make recommendations for shaft acceptance or correction as part of the normal course of testing a shaft.

(5) Coring. If the sonic logging inspection indicates an anomaly for any zone of the shaft represented by loss of signal, a reduction in apparent sonic velocity greater than 15%, or where the velocity is equal to or less than 15% and as directed by the Chief Geologist, or where a survey was not complete due to problems associated with access tubes, drill cores (NX size, 2.125 inches or larger) at locations and depths approved by the Engineer. Drill cores NX size (2.125 inches, or larger), however if the location of the anomaly prevents an NX size core, with the approval of the Engineer, drill a smaller size (minimum A size, 1.25 inch) core. Mark the beginning and end of each core and record the total length of the core and the total length recovered, core recover must be greater than 95%. Provide the Engineer the recorded information and the core samples labeled with their location and relative elevation. If the concrete is defective, submit a written proposal to repair the drilled shaft. The proposal must be approved by the Engineer before repairs commence.

(6) Filling Core Holes. Fill core holes by pressure grouting with non-shrink grout described in **subsection 703.2b**. Use a pipe extending to the bottom of the hole to fill it from the bottom to the top.

(7) Filling Pipes. After completing sonic testing and final acceptance of the drilled shaft is made, fill the sonic testing pipes with the specified non-shrink grout. If the Contractor can expel enough water from sonic testing pipes leaving 2 feet or less of standing water in the sonic testing pipe, grout may free fall to the bottom of the pipe. If more than 2 feet of water remains in the bottom of the sonic testing pipe, prevent the grout from free falling through the water using a tremie tube extending to the bottom of the sonic testing pipe.

j. Backfill. When a temporary casing and a permanent casing are used, backfill the space (between casings) with the material specified in the Contract Documents:

- Granular material fine enough to fill the entire volume; or
- Grout or flowable fill described in **subsection 703.2b**.
  - If the space contains water, use a pump with an extension pipe or tremie (extending to the bottom of the space) to fill the space.
  - If the space is dry, the grout/flowable fill may free fall to the bottom of the shaft.
  - Fill the space with grout/flowable fill to the top of the casing, then, completely remove the temporary casing.

When the Contract Documents do not specify a material for backfill, use the granular material before extracting the temporary casing. After extracting the temporary casing, fill the rest of the space with granular material.

703.4 MEASUREMENT AND PAYMENT

a. Drilled Shafts. The Engineer will measure drilled shafts by the linear foot measured from the bottom of the rock socket to the top of the completed drilled shaft. The Engineer will not consider a request for additional compensation, unless the overall length of a drilled shaft changes by more than 20%.

b. Permanent Casing. The Engineer will measure the accepted permanent casing by the linear foot, if a permanent casing is required, but not specified in the Contract Documents. The Engineer will not measure the permanent casing if:

- Contract Documents require Drilled Shafts (Cased).
- Contractor uses the casing for their convenience.
- Casing is a temporary casing.

c. Sonic Test (Drilled Shaft) (Set Price).

(1) Sonic Testing specified in Contract Documents. When shown in the Contract Documents, the Engineer will measure each designated sonic test, per shaft (i.e. sonic logging between all possible combinations of pipes represents a single sonic test).

(2) Sonic Testing requested by the Engineer.

- When the Engineer requests sonic tests not shown in the Contract Documents, and the sonic testing indicates the concrete is acceptable, the Engineer will measure each sonic test, per shaft (i.e. sonic logging between all possible combinations of pipes represents a single sonic test).
- When the Engineer requests sonic testing not shown in the Contract Documents, and the sonic testing indicates defective concrete in the drilled shaft, the Engineer will not measure for payment the sonic testing of that shaft.
- When the Engineer requests sonic testing not shown in the Contract Documents, the sonic testing indicates defective concrete in the drilled shaft, the Engineer requests cores from the shaft, and the cores reveal unsound concrete, the Engineer will not measure for payment the sonic testing or cores for that shaft.
- When the Engineer requests sonic testing not shown in the Contract Documents, the sonic testing indicates defective concrete in the drilled shaft, and the Engineer requests cores from the shaft, and the cores reveal sound concrete, the Engineer will measure for payment each sonic test, per shaft (i.e. sonic logging between all possible combinations of pipes represents a single sonic test). The Engineer will also pay for the cores as Extra Work according to **SECTION 104**.

(3) Core Hole (Investigative) specified in the Contract Documents. When shown in the Contract Documents, the Engineer will measure the investigative core hole by the linear foot, from the existing ground surface to 6 feet below the drilled shaft tip elevation.

d. Payment. Payment for "Drilled Shaft" and "Core Hole (Investigative)" at the contract unit prices, and "Permanent Casing" and "Sonic Test" at the contract set unit prices is full compensation for the specified work.

If the Engineer lengthens the drilled shaft during construction, the Engineer will measure and pay for additional reinforcing steel as Extra Work according to **SECTION 104**.

SECTION 704

PILING

704.1 DESCRIPTION

Drive the specified types of piles to the penetration and bearing values shown in the Contract Documents.

BID ITEMS	UNITS
Piles (*) (**)	Linear Foot
Test Piles (*) (**)	Linear Foot
Test Piles (Special) (*) (**)	Linear Foot
Cast Steel Pile Points	Each
Pre-Drilled Pile Holes	Linear Foot

*Type: Cast-In-Place Concrete, Prestressed Concrete, Steel or Steel Sheet, Corrugated Metal Sheet $^{+}$
**Size
$^{+}$Black or Galvanized

704.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTIONS 1102**
Prestressed Concrete Piles	**DIVISION 700**
Steel Bars for Concrete Reinforcement	**DIVISION 1600**
Steel Piling and Steel Pile Points	**DIVISION 1600**
Type B Preformed Expansion Joint Filler	**DIVISION 1500**
Paint Materials	**DIVISION 1800**

704.3 PILE DRIVING EQUIPMENT

a. General. Pile driving hammers other than drop hammers shall be of the size needed to develop the energy required to drive piles at a penetration rate of not less than 0.10 inches per blow at the minimum driving resistance according to the appropriate pile driving formula in **TABLE 704-1**.

In addition to all other requirements, single and double acting diesel hammers and air/steam hammers require the following.

(1) Open-End (Single Acting) Diesel Hammer. Equip open-end (single acting) diesel hammers with a device such as rings on the ram or a scale (jump stick) extending above the ram cylinder, to permit the Engineer to visually determine hammer stroke at all times during pile driving operation. Also, provide the Engineer a chart from the hammer manufacturer equating stroke and blows per minute for the open-end diesel hammer to be used.

(2) Closed-End (Double Acting) Diesel Hammer. Equip closed-end (double acting) diesel hammers with a bounce chamber pressure gauge, mounted near ground level so as to be easily read by the Engineer. Also, provide the Engineer a chart, calibrated to actual hammer performance, equating bounce chamber pressure to either equivalent energy or stroke for the closed-end diesel hammer to be used.

(3) The weight of the striking part of air/steam hammers used shall be a minimum of ⅓ the weight of the pile and drive cap, and in no case shall the striking part have a weight less than 2,750 pounds.

b. Hammers for Steel Piles, Steel Sheet Piles and Shells for Cast-in-Place Concrete Piles. If a gravity hammer is used for driving steel piles, steel sheet and shells for cast-in-place concrete piles, use one with a minimum weight of 3,500 pounds. In no case may the weight of the gravity hammer be less than the pile being driven plus the weight of the driving cap. In lieu of weighing the hammer, a certification may be provided by the Contractor. Equip all gravity hammers with hammer guides to maintain concentric impact on the drive head or pile cushion. Regulate the fall to avoid injury to the piles. The fall shall be a maximum of 12 feet. If diesel or air/steam hammers are used, the maximum fall shall be 90% of the maximum fall recommended by the hammer manufacturer.

If steam or diesel hammers are used, its rated gross energy in foot-pounds shall be a minimum of 2 ½ times the weight of the pile in pounds. The hammer shall develop a minimum of 6,000 foot-pounds of energy per blow.

c. Hammers for Pre-stressed Concrete Piles. Unless otherwise provided, drive pre-stressed concrete piles with a diesel or air/steam hammer that can develop an energy per blow at each full stroke of the piston of a minimum of 1 foot-pound for each pound of weight driven. The hammer shall develop a minimum of 6,000 foot-pounds of energy per blow.

d. Vibratory Hammers. Vibratory hammers may only be used when specifically allowed by the Contract Documents or in writing by the Engineer. If approved, vibratory hammers shall be used in combination with pile load testing and re-tapping with an impact hammer. In addition, 1 of every 10 piles driven with a vibratory hammer shall be re-tapped with an impact hammer of suitable energy to verify that acceptable load capacity was achieved.

e. Additional Equipment. The plant and equipment provided for air/steam hammers shall have sufficient capacity to maintain, under working conditions, the pressure at the hammer specified by the manufacturer. In case the required penetration or bearing is not obtained by the use of a hammer complying with the above minimum requirements, provide a hammer of greater energy or when permitted, resort to jetting or pre-drilling at Contractor expense. Use of the pile driving analyzer may be required when minimum requirements are not obtained or results are doubtful.

f. Leads. Construct pile-driving leads to afford freedom of movement for the hammer. Hold them in position with guys or stiff braces to support the pile during driving. Except where piles are driven through water, use leads of sufficient length that the use of a follower shall not be necessary. Leads shall be of sufficient length to allow them to be spiked into the ground at the onset of driving.

g. Hammer Cushion. Equip all impact pile driving equipment except gravity hammers with a suitable thickness of hammer cushion material to prevent damage to the hammer or pile and to maintain uniform driving behavior. Use hammer cushions made of durable, manufactured material that shall retain uniform properties during driving. Wire rope and asbestos hammer cushions are prohibited. Place a striking plate on the hammer cushion to maintain uniform compression of the cushion material. Inspect the hammer cushion in the presence of the Engineer when beginning pile driving at each structure or after each 100 hours of pile driving, whichever is more frequent. Replace the hammer cushion whenever there is a reduction of hammer cushion thickness exceeding 25% of the original thickness, or when the cushion begins deteriorating, tearing, etc., before continuing driving.

The following are acceptable types of pile cap material. Other materials may be used with approval of the Bureau of Construction and Materials.

(1) Micarta (Conbest) - This is an electrical insulating material composed of fabric and phenol. Replace when it starts to powderize or when it disintegrates into various layers.

(2) Nylon (2-inch thick blocks) - Occasional vertical cracking is not detrimental. However, replace after the cushion develops horizontal cracks.

(3) Hamortex (metallized paper reels) - Pay attention as it may compress or disintegrate.

(4) Force 10, Forbon, and Fosterlon - These materials are provided by manufacturers of pile driving equipment.

(5) Aluminum - Aluminum is often used to separate layers of softer cushioning material. Replace once the aluminum is deformed or broken.

(6) Wood (plywood or hardwood) should only be used with gravity hammers.

h. Pile Driving Head. Fit piles driven with impact hammers with an adequate driving head to distribute the hammer blow to the pile head. Axially align the driving head with the hammer and the pile. The driving head is guided by the leads and shall not be free swinging. The driving head shall fit around the pile head in a manner that prevents transfer of torsional force during driving while maintaining proper alignment of hammer and pile.

i. Water Jets. When jets are permitted, the number of jets and the volume and pressure of water at the jet nozzle shall be sufficient to freely erode the material adjacent to the pile. Use a plant with sufficient capacity to deliver a minimum of 100 pounds per square inch pressure at ¾-inch jet nozzles at all times. At a minimum of 5 feet before the desired penetration is reached, withdraw the jets and drive the piles to secure the final penetration with an approved hammer.

704.4 CONSTRUCTION REQUIREMENTS

a. Order Lists, Piles and Test Piles. The order list is the same as the estimated quantity (number and length of piles) shown in the Contract Documents.

For piles and test piles, provide the Engineer with the completed "Pile and Driving Equipment Data" sheet a minimum of 3 weeks before the scheduled date of driving piling. The Engineer will forward this information for Test Pile (Special) to the Chief Geologist.

When a restrike is required by the Engineer, follow **subsection 704.4e.** for restrike procedures. Provide piles for the structure according to the order list (number and length of piles) prepared by the Engineer.

Drive the specified test piles at the locations shown in the Contract Documents. The Engineer will use the test pile information to determine the pile tip elevation.

If multiple hammers are used on a project requiring test pile or test pile (special), drive a test pile or test pile (special), whichever is specified, with each hammer.

b. Test Pile (Special). Pile Driving Analyzer (PDA). The Engineer will use the PDA to monitor the driving of the test piles (special). Provide the Engineer with the completed "Pile and Driving Equipment Data" sheet a minimum of 3 weeks before the scheduled date of driving piling. The Engineer will forward this information to the Chief Geologist.

In order to mobilize the PDA, notify the Engineer a minimum of 5 working days before driving the test piles (special). Prior to driving the test pile (special), the Engineer will require approximately 1½ hours to prepare the test piling (special) and install the dynamic measuring equipment. If with prior approval, the piles are to be welded prior to the Engineer attaching the testing equipment, provide the Engineer with safe and reasonable means of access to the pile for preparing the pile and attaching the instruments.

When a restrike is required by the Engineer, follow **subsection 704.4e.(3).** for restrike procedures.

To obtain the estimated ultimate loads, the Engineer will use the PDA to take dynamic measurements as the test pile (special) is driven to the required driving resistance. If non-axial driving is indicated by dynamic test equipment measurements, immediately realign the driving system. The Engineer will use the PDA results to provide the Contractor with a blow count for production driving.

c. Driving Piles. Drive the piles with a gravity hammer, a diesel hammer, an air/steam hammer or a combination of pre-drilled holes or water jetting and a hammer. Use equipment that complies with **subsection 704.3**.

Drive the piles at the locations and to the vertical or battered lines shown in the Contract Documents. Use leads of sufficient length to allow them to be spiked into the ground at the onset of driving the pile.

Do not drive piles until the footing, webwall or abutment excavation is completed. Drive all of the piles required for the footing or abutment before placing any concrete in the footing or abutment, unless the foundation is a minimum of 20 feet away or has cured a minimum of 24 hours.

When specified, drill pile holes before driving the piles. Drill the holes accurately so that the piles are set as shown in the Contract Documents. The maximum size of the pre-drilled holes is equal to the diameter of the pile plus 3 inches. The depth of pre-drilled pile holes is shown in the Contract Documents. If pre-drilled pile holes are not specified, the Contractor may choose to pre-drill pile holes, provided the Engineer approves the Contractor's method and limits. After the piles are driven to their final positions in the pre-drilled holes, fill the holes with loose sand or material specified in the Contract Documents. If concrete is specified, allow sufficient concrete slump and provide vibration to fill all voids around the pile.

Drive all pile heads perpendicular to the longitudinal axis of the piles to prevent eccentric impacts from the drive head of the hammer. Use pile caps on all piles during the pile driving operations. For pile caps of concrete piles and prestressed concrete piles, use a suitable cushion next to the pile head that fits into a casting that supports a timber shock block. On pile caps for steel piles and steel sheet piles, provide grooves in the bottom of the cap to accommodate the shape of the piles to hold the axis of piles in line with the axis of the hammer. On pipe pile, use a helmet with a minimum interior guide of 6 inches.

If specified, use the type of cast steel pile points shown in the Contract Documents. Use pile points that provide full bearing for the piles. Provide an experienced welder to attach the cast steel pile points to the piles.

Use full-length piles where practicable. It is preferred that steel piling is not spliced. Splices may be made with the permission of the Engineer, or when shown in the Contract Documents. Make splices as shown in the Contract Documents. Use an approved welding process as provided in **DIVISION 700** to make the splices. Provide an experienced welder qualified under **SECTION 713** to make the welded splices for structural steel piling and shell piling. Correct or replace any failure in the splice at own expense.

Avoid extensions, splices or build-ups on prestressed concrete piles whenever possible. When splicing is necessary, make them as shown in the Contract Documents.

If the pile driving procedure causes crushing or spalling of the prestressed concrete piles, or deformation of the steel piles, remove and replace the damaged piles with new, longer piles. A second pile may be driven adjacent to the damaged pile, when approved by the Engineer and can be accomplished without detriment to the structure.

Do not force misaligned piles into proper position. Remove and replace piles driven out of their proper location with new, longer piles.

- If the driven pile is 35 feet or less in length, the maximum allowable variation from the vertical or battered lines shown in the Contract Documents is ¼ inch per foot of length.
- If the driven pile is greater than 35 feet in length, the maximum allowable variation from the vertical or battered lines shown in the Contract Documents is ⅛ inch per foot of length.
- The maximum allowable variation on the head of the driven pile from the position shown on the Contract Documents is 2 inches for piles used in bents, and 6 inches for foundation piles.
- Drive all piles in the orientation shown on the Plans. If the axial orientation of the pile rotates or twists by more than 10°, the Field Engineer will contact the Bureau of Structures and Geotechnical Services.

Re-drive all piles pushed up by the driving of adjacent piles, or by any other cause.

d. Bearing Values and Required Penetration. Drive the piling to attain, as a minimum, the specified bearing value, penetration and pile tip elevation. Stop driving the piling (regardless of the penetration) if 1½ times the specified minimum driving resistance is attained. Stop driving the piling if, in the opinion of the Engineer, the specified minimum driving resistance, penetration and pile tip elevation can not be attained without damage to the piling. If the specified minimum driving resistance is not attained with the specified number and length of piling, the Engineer may allow additional piling be driven so that the maximum load on any pile does not exceed its safe carrying capacity.

In the absence of loading tests, determine the safe bearing values of piles by the formulas in **TABLE 704-1**.

TABLE 704-1: PILE FORMULAS		
Hammer	**Pile Type**	**Formula**
Gravity	Timber	$P = \frac{2 \quad W \quad H}{S + 1.0}$
Gravity	Steel Steel Shell Steel Sheet	$P = \frac{3 \quad W \quad H}{S + 0.35} \left(\frac{W}{(W+X)} \right)$
Air/Steam (Single Acting)	All Types	$P = \frac{2 \quad W \quad H}{S + 0.1}$
Air/Steam (Double Acting)	All Types	$P = \frac{2 \quad E}{S + 0.1}$
Delmag and McKierman-Terry*	All Types	$P = \frac{1.6 \quad W \quad H}{S + 0.1 \left(\frac{X^{**}}{W} \right)}$
Link-Belt*	All Types	$P = \frac{1.6 \quad E}{S + 0.1 \left(\frac{X^{**}}{W} \right)}$

*diesel hammers
** For diesel hammers, the quantity X/W shall not be less than 1.
P = safe bearing power in pounds
W = weight in pounds, of striking part of hammer
H = height of fall in feet
E = energy of ram in foot-pounds per blow
S = the average penetration in inches per blow for the last 5 blows for gravity hammers and the last 20 blows for air/steam or diesel hammers
X = weight in pounds of the pile plus the weight of any cap and/or anvil used on the pile during driving

The above formulas are applicable only when:

- The hammer has a free fall;
- The penetration is reasonably quick and uniform; and
- There is no appreciable bounce after the blow.

If water jets are used in connection with the driving, determine the bearing capacity by the formulas above from the results of driving after the jets have been withdrawn, or a load test may be applied.

The energy rating used to determine if any type or brand of diesel hammer is of adequate size other than those shown in **TABLE 704-1**, is 80% of the energy rating as listed by the manufacturer.

Use an energy rating of 100% of the energy rating listed by the manufacturer for computing bearing values and to determine if an air/steam is of adequate size. If the number of blows per minute for an air/steam hammer deviates significantly from the number designated by the manufacturer, take corrective action as directed by the manufacturer.

e. Piling Restrike Procedure.

If a pile does not attain the minimum driving resistance within a few feet of the plan elevation, the pile restrike procedure may be used. Contact the Regional Geology Office for guidance before using the restrike procedure. Restrike procedures differ depending on whether a Test Pile, Test Pile (Special) or neither is called for in the Contract Documents. When a PDA is used, the restrike procedure will be as directed by the Regional Geologist.

(1) Use the following procedure when neither a Test Pile nor a Test Pile (Special) is called for in the Contract Documents, and the PDA is not available. The following procedure shall be used.

- Drive all of the piling in a group to within 2 feet of plan elevation;
- A group of piling is defined as all piles contained within a single footing.
- All of the piling in the pile group shall sit undisturbed for a minimum of 24 hours;
- Prior to starting the restrike procedure, warm the hammer up at a location as far away from the pile group as practical, preferably in another substructure member or pile group;

- Using the warmed up hammer, immediately restrike 20% of the piles in a group, with a minimum of 2 in a group restruck. Of these, restrike the piles in a single group with the furthest spacing away from each other. When possible, restrike those with the lowest resistance during driving.
- Restrike for 30 blows or until the pile penetrates an additional 4 inches, whichever comes first. Record the penetration for every 5 blows. In the event the pile movement is less than ½ inch during the restrike, the restrike may be terminated after 20 blows.
- Restrike additional (the 20% or 2 minimum specified above) pile in the group as directed by the Engineer.

The driving resistance of the piling is computed based on the average penetration, if any, for the first 5 blows. The driving resistance of each piling is the driving resistance computed for the pile that was restruck. If the computed driving resistance is less than the design pile load, splice additional length onto each piling in the group and resume driving each piling until the required driving resistance is achieved.

(2) Use the following procedure when a Test Pile is called for in the Contract Documents, and the PDA is not available. The following procedure must be used.

- Drive the Test Pile to within 2 feet of plan elevation;
- The Test Pile shall sit undisturbed for a minimum of 24 hours;
- Prior to starting the restrike procedure, warm the hammer up at a location as far away from the Test Pile as practical, preferably in another substructure member or pile group;
- The Test Pile is then immediately restruck with the warmed-up hammer for 30 blows or until the pile penetrates an additional 4 inches, whichever comes first. Record the penetration for every 5 blows. In the event the pile movement is less than ½ inch during the restrike, the restrike may be terminated after 20 blows.

The driving resistance of the Test Pile is computed based on the average penetration, if any, for the first 5 blows. If the computed driving resistance is less than the design pile load, splice additional length and resume driving until the minimum driving resistance is achieved.

(3) When a Test Pile (Special) is called for on the plans, or a PDA is available, follow the recommendations of the Regional Geologist for the Restrike Procedure.

f. Pile Cut-Off and Pile Painting.

(1) After the piles are driven as specified, cut the piles off at the designated elevation. If capping is required, make the connection as shown in the Contract Documents.

Pile cut-off material becomes the property of KDOT, if the Engineer determines the pile cut-off material is worth salvaging. Store the salvageable material at the site selected by the Engineer. Pile cut-off material determined to not be salvageable becomes the property of the Contractor.

(2) Paint the exposed portion of steel piles, steel sheet piles, or the shells or castings of cast-in-place concrete piles. Unless otherwise noted in the Contract Documents, apply the paint in the field. Use the same kind of paint and total number of coats as specified for the structural steel on the structure. If a paint system is not specified for the structure, use a prime coat of inorganic zinc as required for the shop coat and an acrylic or polyurethane finish coat, as specified in **DIVISION 700** for the final coat. Apply the paint to the pile for a distance of 1 foot below the bottom of the channel, top of the embankment, natural ground or normal low water elevation.

g. Cast-In-Place Concrete Piles. After the steel shells are driven as specified, remove all loose material from inside the steel shell. Unless specified otherwise in the Contract Documents, use Grade 3.5 concrete to fill the steel shells. Do not place concrete in the steel shell until the driving of all steel shells within a radius of 15 feet from the pile is completed, or until all the piles for any one bent are driven. If this can not be done, discontinue all driving within the above limits until the concrete in the last pile cast is a minimum of 7 days old. Remove accumulations of water from inside the steel shells before concrete is placed. Consolidate the concrete in the upper 15 feet of the steel shell by internal vibration.

h. Sheet Pile. Use a fabricated or cast driving head with corrugations to match the top of the sheeting while driving the sheet piling.

704.5 MEASUREMENT AND PAYMENT

The Engineer will measure the length of steel pile, steel sheet pile, cast-in-place concrete pile and prestressed concrete pile remaining in the structure, by the linear foot.

The Engineer will measure the length of prestressed concrete from the tip of the pile to the point that concrete is removed to provide the connection with the cap or footing. This measurement does not include the length of reinforcing steel extending beyond the pile and into the cap or footing.

The Engineer will measure the actual length of ordered and accepted test pile and test pile (special) by the linear foot.

The Engineer will measure each cast steel pile point used.

If after driving the ordered and accepted length of pile, plan bearing is not achieved and additional pile is required, the Engineer will measure for payment each pile splice needed to lengthen the pile to achieve bearing. The Engineer will not measure for payment pile splices shown in the Contract Documents or pile splices approved for the Contractor's convenience.

The Engineer will measure pre-drilled pile holes by the linear foot. The Engineer will measure pre-drilled pile holes from the elevation at the bottom of the hole to the bottom of the footing or abutment elevation shown in the Contract Documents. If the Contractor drills the pile holes to an elevation below that shown in the Contract Documents for bottom of hole, the additional drilling below the elevation shown in the Contract Documents is not measured for payment. Pre-drilled pile holes not specified, but drilled for the Contractor's convenience are not measured for payment.

The Engineer will measure pile cut-off by the linear foot for Pile (*) (**). Pile cut-off is the difference between the length of pile ordered and accepted and the actual length of pile remaining in the structure. If the Contractor (for convenience or method of operation) uses a length of pile that exceeds the length of pile ordered and accepted, the excess length is not measured as pile cut-off.

The Engineer will not measure pile cut-off of Test Pile (*) (**) and Test Pile (Special) (*) (**) for payment. If the pile for these items is cutoff and used/spliced on the project, the pile will not be measured for separate payment. Splices will be paid for according to this subsection.

The Pile Restrike procedure shall not be paid for separately, but shall be subsidiary to the bid item "Piling", "Test Pile" and "Test Pile (Special)".

Payment for the various types of "Piles" and "Test Piles", "Cast Steel Pile Points" and "Pre-Drilled Pile Holes" at the contract unit prices is full compensation for the specified work.

Payment for pile splices at 4 times the contract unit price of the type of pile spliced is full compensation for the specified work.

Payment for pile cut-off per linear foot as shown in **TABLE 704-2** is full compensation for the specified work.

TABLE 704-2: PILE CUT-OFF PAYMENT

Pile Type	% of Contract Unit Price Paid
Cast-in-place (Shell)	60
Pre-stressed concrete	75
Steel	75
Steel Sheet	75

The costs of all load tests ordered by the Engineer will be paid for as Extra Work as shown in **SECTION 104**.

SECTION 705

STRUCTURAL STEEL FABRICATION - BRIDGES

705.1 DESCRIPTION

Shop fabricate the structural steel according to the Contract Documents. This specification applies to bridges on highways and public roads carrying vehicular traffic. See **SECTION 744** for all other steel or aluminum shop fabrication.

705.2 MATERIALS

a. General. Provide materials that comply with the applicable requirements.

Castings	**DIVISION 1600**
Structural Steel	**DIVISION 1600**
Welded Stud Shear Connectors	**DIVISION 1600**
Steel Fasteners	**DIVISION 1600**

b. Preliminary Shop Requirements.

(1) Point of Fabrication. Within 10 business days after signing the contract, notify the State Bridge Office and the Bureau Chief of Construction and Materials in writing of the firm (name and location) that will fabricate the structure. Produce and fabricate all structural steel within the Continental United States (see **SECTION 106**). Use fabricators of bridge beams and girders that are certified by the American Institute of Steel Construction in the appropriate category for the type of work being performed.

(2) Shop Drawings. The Contractor or fabricator must submit shop drawings of both structural steel and castings according to **SECTION 105**. Do not perform any fabrication until the approved shop drawings are in the hands of the Inspector and fabricator, and the Engineer has authorized fabrication. Any purchase of materials before fabrication authorization is at the Contractor's risk.

Changes on approved shop drawings or contract plans are subject to the approval of the Engineer. Notify the Engineer with a record of such changes. Submit revised sheets of the same size as the shop drawings originally submitted.

Show approved welding procedure numbers in the tail of weld symbols on submitted shop drawings. Submit 2 copies of each procedure requiring approval to the Bureau of Construction and Materials. All weld procedures referenced in a set of shop drawings must be approved before the shop drawings can be approved.

Provide a diagram on the shop detail plans for each span giving sufficient dimensions for accurate fabrication and inspection of the structure. These dimensions must include, but are not limited to:

- Bearing-to-bearing lengths; and
- Vertical and horizontal curvature offsets at bearing points and splices. Use the bottom of the web or the top of the bottom flange at the centerline of the web as the reference point.

The Contractor is responsible for the correctness of the shop fit-up and field connections, even though the shop drawings have been approved by the Engineer. See **SECTION 105**.

(3) Notice of Beginning of Work. In order to provide inspection, notify the Engineer before beginning work in the shop. Give a minimum of 24 hours' notice before beginning work in shops in the State of Kansas, and give a minimum of 7 calendar days' notice before beginning work in shops in the contiguous United States.

(4) Material Acceptance. Submit to the Bureau Chief of Construction and Materials, 1 copy of each mill test report for each heat number to be used before the layout, and use such steel in the fabrication of the structure.

Submit a fabricator's guarantee indicating that the attached certified mill test reports pertain to all heat numbers used in the structure, and all material complies with the Contract Documents. Include the following in the guarantee:

- fabricator's name;
- KDOT project number;
- bridge or station number;
- fabricator's purchase order number;

- list heat numbers;
- size and shape of pieces;
- number of pieces to be used for each size of each heat; and
- steel manufacturer's name and the ASTM or AASHTO designation for the steel that is required in the Contract Documents.

The guarantee must include the notarized signature of an official of the company who is authorized to legally bind the statement on the company's behalf.

All structural steel shall comply with the ASTM A 6 quality requirements until released for shipment. Repair welding shall comply with the requirements of AASHTO/AWS D1.5-2010, "Bridge Welding Code" with the exceptions and additions noted later in this section.

The term "mill" means any rolling mill or foundry where material for the work is manufactured. When any ASTM or AASHTO steel is specified in the Contract Documents, the mill must certify that the material complies with the specified chemical and physical requirements. When the letter "T" or "F" and a temperature zone number follow the grade designation of an AASHTO or ASTM steel, the mill test report must include Charpy V-notch test results.

When weathering steel is allowed or specified in the Contract Documents: ASTM A709 Grade 50W may be substituted for ASTM A709 Grade 36 or Grade 50, and AASHTO M270 Grade 50WT2 may be substituted for AASHTO M270 Grade 50T2. When substituting weathering steel for the structural steel shown in the Contract Documents, use the same size plate or rolled member. Do not use weathering steel in rocker bearing devices (or any component with finished surfaces), expansion devices or expansion device armoring.

Except as noted in the previous paragraph, the fabricator must obtain written permission from KDOT to substitute a grade of steel that is not indicated in the Contract Documents for one that is shown in the Contract Documents.

(5) Facilities for Inspection and Testing. During all hours of operation allow the Engineer free access to all parts of the work and the shop where fabrication is performed.

Provide an enclosed office area for the exclusive use of the Engineer at the location of fabrication. The area must satisfy the requirements of a Field Office (Special) in **SECTION 803**, except as modified below:

- Minimum floor area = 120 square feet;
- Single workbench or table - 30 inch by 8 feet (minimum dimensions);
- Desk - 30 inch by 5 feet, with drawers;
- Swivel desk chair with arm rests;
- Waste paper basket; and
- Storage/Filing cabinet with lock and key

When directed by the Engineer, promptly repair or replace any damaged or non-functioning items. Provide parking near the office with direct accessibility to the office and shop.

(6) Test Specimens. When directed by the Engineer, prepare 4-inch by 24-inch test specimens of the base metal. Orient the specimen so the direction of rolling is according to the latest edition of ASTM A 6. Provide "all-weld-metal" tension specimens and specimens for other weld tests as directed by the Engineer. Preparation and possible shipment of specimens are subsidiary to the fabrication of the structure.

(7) Heat Curving Procedure. Girders and rolled beams may be heat curved by either the continuous or "V" heating methods. Before starting any fabrication and before submittal of shop drawings for the structural steel, the Contractor or fabricator may request permission to heat-curve rolled beams in the shop or to heat-curve welded plate girders in lieu of flame cutting flanges to the desired horizontal curvature. Submit the request and proposed shop procedure to the Engineer for approval. The submittal must indicate the type of heating, heating temperature, position for heating, sequence of operations and the values to be used to compensate for possible loss of camber of heat-curved girders in service. The proposed procedure must comply with the latest editions of AASHTO/AWS D1.5, "Bridge Welding Code", AASHTO's "Standard Specifications for Highway Bridges" and AASHTO's "LRFD Bridge Construction Specifications".

c. Handling. Conduct the loading, transporting, unloading and storing of structural steel to keep the metal clean, above ground and free from injury. Use protective devices or softeners to safeguard plate edges.

Store structural steel, either plain or fabricated, above the ground on platforms, skids or other supports, and keep free from corrosion, dirt, grease and other foreign matter. Store girders and beams upright with sufficient support to prevent warping or change in design camber.

d. Shop Fabrication.

(1) Steel Identification. All pieces of all grades of steel used in fabrication of main members, including webs, flanges, bearing stiffeners, bearing devices, splice plates and any cross member carrying stringers and their connection plates, must bear the heat number assigned by the rolling mill. Preserve the heat number until the Engineer advises the fabricator that the unit is acceptable for cleaning and painting. Identify the grade as specified in ASTM A 6.

(2) Straightening Material. All mill material must be straight before being laid out for work. If straightening is required, do not injure the metal. Heat straightening must comply with the latest versions of AASHTO/AWS D1.5, "Bridge Welding Code"; AASHTO's "Standard Specifications for Highway Bridges"; AASHTO's "LRFD Bridge Construction Specifications"; and the FHWA report, "Heat-Straightening Repairs of Damaged Steel Bridges". Submit the proposed heat straightening procedure to the Engineer for approval. Sharp kinks and bends are cause for rejection of the material. Mill material must not exceed dimensional tolerances outlined in the latest edition of ASTM A 6.

(3) Welding and Gas Cutting. Perform welding and gas cutting of structural steel according to the applicable requirements of the AASHTO/AWS D1.5-2010, "Bridge Welding Code" with the exceptions and additions noted in this specification.

Perform welding and gas cutting on steel bearings, bridge drainage systems, finger plate or modular expansion devices, and bridge rails according to **SECTION 744**. At the option of the Engineer, steel bearing device inspection will require that either 1 device in 10, or fraction thereof, be tested 100%, or a10% of each device will be tested using liquid penetrant or magnetic particle. When tested at the 1 in 10 rate, the Engineer will select which device to test. When tested at the 10% rate, the Engineer will select the weld locations to test, which can vary from device to device. The welding of dissimilar metals is not prequalified.

(4) Finish. Neatly finish all work. Carefully and accurately shear and clip. Fabricate finished members true to line and detailed dimension, and free from twists, bends, open joints or other defects.

(5) Pins and Rollers. Accurately turn pins and rollers to the dimensions shown in the Contract Documents and keep them straight, smooth and free from flaws. Produce the final surface by a finishing cut.

Forge and anneal pins and rollers larger than 7 inches in diameter, unless shown otherwise in the Contract Documents.

In addition, for pins larger than 9 inches in diameter, after the forging has been allowed to cool to a temperature below the critical range, under normal conditions, and before being annealed, bore a hole a minimum of 2 inches in diameter full length along the axis.

(6) Boring Pin Holes. Bore pin holes true to the specified diameter, smooth and straight, at right angles with the axis of the member and parallel with each other, unless otherwise specified. Produce the final surface by a finishing cut.

Do not vary the distance outside-to-outside of holes in tension members and inside-to-inside of holes in compression members from the specified dimension more than 1/32 inch. Bore holes in built-up members after final assembly.

(7) Pin Clearances. Do not exceed the diameter of the pin hole by that of the pin more than 1/50 inch for pins 5 inches or less in diameter, or 1/32 inch for pins greater than 5 inches in diameter.

(8) Threads. Closely match threads of bolts to the nut threads. Threads must be ANSI Unified Coarse Series (UNC), except make pin ends of diameters greater than 1 ½ inches, with 6 threads per inch.

(9) Pilot and Driving Nuts. Provide 2 pilot nuts and 2 driving nuts for each size of pin, unless otherwise specified.

(10) Fit of Stiffeners. Mill, grind or machine cut bearing stiffeners intended as supports for concentrated loads to secure full bearing against the flange. Use intermediate stiffeners with a tight fit and uniform distance between the flange plates and the ends of the stiffeners, unless shown otherwise in the Contract Documents.

(11) Facing of Bearing Surfaces. Plane or heat straighten the top and bottom surfaces of steel slabs, base plates, bearing devices, cap plates of columns and pedestals to have full contact when assembled to the main members. Mill parts of members in contact with these items to true surfaces and correct bevels, after the main sections of these members and the end connection angles have been fully welded or bolted. Plane cast pedestals on surfaces in contact with steel.

Unless shown otherwise in the Contract Documents, adhere to the following surface roughness requirements as defined in ANSI B46.1, Surface Texture, Roughness, Waviness, and Lay, Part 1 for the surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or concrete. Surfaces will be evaluated by visual or actual comparison with roughness comparison specimens.

Sliding Bearings	ANSI	125 Microinches
Bridge Rollers and Rockers	ANSI	250 Microinches
Pins and Pin Holes	ANSI	125 Microinches
Steel Slabs	ANSI	2000 Microinches
Heavy Plates in Contact with Shoes to be Welded	ANSI	1000 Microinches
Milled Ends of Compression Members, Milled or Ground Ends of stiffeners and Fillers	ANSI	500 Microinches

(12) Welded Stud Shear Connectors. Apply welded stud shear connectors to the designated structural members during shop fabrication.

If the circumstances warrant, and if the Engineer approves the Contractor's procedures, welded stud shear connectors may be field applied. Approval is based on demonstrating to the Engineer's satisfaction, that the Contractor can:

- remove any shop applied coating removed from the top flange without damaging the structural member;
- weld the stud shear connectors to the structural member; and
- blast clean and prime coat the top flange and stud shear connectors.

(13) Holes for Bolted Connections. When field bolts are required, adjust the girders or beams so the maximum final clearance between abutting ends of the web plates or flange plates is ¼ inch. Attach the web splice plates using sub-drilled holes in each corner of the splice plate. Secure them with bolts and drill the remaining holes full diameter from the solid. Add additional bolts and full size pins as the holes are drilled to secure the splice plates to the web. Clamp the flange splice plates and bars into position, and drill the bolt holes full diameter from the solid.

Add additional bolts as the holes are drilled to secure the splice plates to the flanges. Other methods of preparing flange and web field splices may be utilized with written approval of the Engineer. Fill plate thicknesses shown in the Contract Documents are based on nominal ASTM A 6 shape dimensions. Revise plan fill plate thicknesses as necessary to account for as-rolled variations in flange and web thickness or overall beam depth. Minimum fill plate thickness is ⅛ inch or as required so that surfaces to be in contact shall be offset a maximum of 1/16 inch.

Either punch or drill all holes for bolts except in flanges and webs of beams, girders or stringers. Material forming parts of a member composed of a maximum of 5 thicknesses of metal may be punched 1/16 inch larger than the nominal diameter of the bolts whenever the total thickness of the material is a maximum of ¾ inch for structural steel, ⅝ inch for high-strength steel or ½ inch for quenched and tempered alloy steel.

If there are more than 5 thicknesses, or if the material is thicker than ¾ inch for structural steel, ⅝ inch for high-strength steel, or ½ inch for quenched and tempered alloy steel, either sub-drill and ream or drill all holes full size.

The diameter of the die for punched holes may not exceed the diameter of the punch more than 1/16 inch. If any holes must be enlarged to admit the bolts, ream such holes. Clean cut holes leaving no torn or ragged edges. Poor matching of holes will be cause for rejection.

(14) Shop Assembly for Final Inspection. Unless otherwise provided both in writing and shown on the approved shop drawings, assemble, securely support, adjust and maintain to proper line, grade, camber and suitable clearances all welded plate girders, rolled wide flange beams, trapezoidal plate "tub" sections and other sections of main members.

After the assembly is completely set up, the fabricator's quality control personnel must check blocking, sweep and bearing-to-bearing measurements prior to any checking by the Engineer.

Reference "affect" measurements to the bottom of the web or the top face of the bottom flange at or near the centerline of the web. Alternate reference points may be accepted by the Engineer for Type "A" or "C" (vertical web) assemblies.

Drill all splice holes and adequately bolt or pin splice plates in place before the assembly is checked by the Engineer. Use a minimum of 6 full size drift pins, full size bolts or a combination of both full size pins bolts at each flange and web splice for girders and rolled beams. For the purposes of checking the assembly, full size means the diameter equal to the diameter of the hole.

In making the final assembly, if re-cutting is necessary to form a uniform width opening across the joint, finish the butt joint by precision flame cutting or flame cutting and grinding to produce the same smoothness as the precision cut. Mechanical chipping is prohibited.

Fit, drill or ream and bolt into place erection angles, while the beams or girders are in the fit-up position so that standard drift pins can be driven through any combination of holes, and the beams or girders can be pulled to correct spacing for field welding when erected at the bridge location.

The types of assemblies are as follows:

- Type "A" Assembly (For structures with horizontal curvature transitions, super elevation or ramp tie-ins) requires a minimum of 2 spans (bearing to bearing) laid-out full bridge width, with separators attached at pier points (a minimum) or as directed by the Engineer. When released, carry the pier pieces back for the next additions. Include the girder or beam expansion devices in position in the assembly, if attached directly to the structural steel. Requests for a lesser width of the assembly for lack of shop space must be approved in writing by the Bureau of Construction and Materials. If the request is approved, the Contractor may be back charged for excessive shop inspection trips and expenses.
- Type "B" Assembly requires a minimum of 2 lines and 2 spans (bearing to bearing) in each line laid-out to correct line with webs vertical or horizontal. When released, carry 1 pier piece per line back for the next additions.
- Type "C" Assembly (for long span, deep girders) requires a minimum of 2 spans (bearing to bearing) laid-out to correct alignment with webs horizontal or vertical. The spans may all be from different lines. When released, carry 1 pier piece per line back for the next additions.

All assemblies are Type "B" unless stated otherwise in the Contract Documents. All desired changes to the requirements of the type of assembly for a particular structure must be approved in writing before submitting the shop drawings for approval. Submit requests for assembly changes to the Bureau of Construction and Materials. Without written approval from the Bureau of Construction and Materials, the fabricator must set up assemblies according to the original requirements in the Contract Documents, even if approved shop drawings show changes to the type of assembly.

Take down the assembly only after being inspected and accepted by the Engineer. No welding on girders or beams will be permitted after the final assembly has been inspected and accepted by the Engineer.

Use numbered tapes calibrated by the National Institute of Standards and Technology (NIST) or tapes calibrated from a certified master tape in order to check assemblies for bridges with spans over 100 feet. Provide a copy of the certification papers, calibration charts, and tape identification numbers before the first assembly is set up. In addition, submit to the Engineer for approval, procedures for calibrating tapes and the shop's practices when using calibrated tapes. This approval is required prior to initial assembly set-up. Calibrate measuring tapes for a minimum tension of 5 pounds. Prior to calibrating or measuring, allow time for the tapes to reach uniform ambient temperatures so that temperature corrections are not required. Replace or repair, and re-certify or re-calibrate damaged tapes. Re-certify master and re-calibrate NIST tapes every 5 years, or as directed by the Engineer.

(15) Matchmarking. Matchmark all butt joints (girders, expansion devices, end separators under expansion devices or other specialties to be field assembled and welded or bolted into the final unit) while shop assembled, in the manner indicated as "Typical Matchmark", and shown on the approved shop drawings. Use a coordinate system of capital letter and numbers as follows:

- Mark each line of girders with a capital letter. Looking upstream, mark the outside line, left of centerline, with the first letter of a series. Mark the girders in the next line to the right with a second letter of the series, etc., until all lines have been marked; and
- Mark the field splices (points of contraflexure) with numbers. Place the lowest number on the splices nearest abutment number 1 and the highest number on the splices nearest abutment number 2. Number the splices consecutively from abutment number 1 to abutment number 2. Place these on each of the girder ends that comprise the splice and within 3 feet of the field splices in the center of the web. Use low stress steel die marks placed before shop blasting and painting. Orient letters and numbers so they are upright when the top flange is up.

Matchmark essential special fit-ups discovered in shop production. Provide a corrected set of shop details and erection drawings showing these special fit-ups.

Do not matchmark the exposed surface of "Weathering" Steels with paint, crayon or any other type of material which will impair the weathering process of the steel.

(16) Shop Painting. Prepare the structural steel surfaces and shop paint the prepared surfaces according to **SECTION 714**.

(17) Shop Bolted Connections. Perform all bolting according to **SECTION 712**. The maximum deviation from detailed flatness for a connected plate (flange, web, splice, filler, etc.) shall not exceed $D/(144*T^{0.5})$ inches or 3/16 inch, whichever is greater. D equals the least clear dimension (in inches) of the panel from edge to edge, flange to flange, web to web, stiffener to stiffener, or any combination thereof and T equals the thickness (in inches) of the connected plate. After snug tightening all fasteners, no gaps between the connected layers can be present except at the edges of splice plates away from bolt holes.

(18) Enclosed structures not accessible after fabrication. All interior welds and connections as well as overall fit and finish must be inspected and accepted prior to full enclosure. Failure to provide the Engineer this opportunity will be cause for rejection of the fabricated element.

(19) Rejection. Repair or replace rejected items as directed by the Engineer.

(20) Release for Shipment. Do not release fabricated elements for shipment from the fabrication shop or paint shop without approval of the Engineer.

e. Supplemental Requirements to the Welding Code. The section and paragraph references cited in the paragraphs below are to AASHTO/AWS D1.5-2010.

SUBSECTION 1.3 WELDING PROCESSES

Delete paragraph 1.3.2 and add the following:

1.3.2 Electrogas welding shall not be used.

Replace the third sentence of paragraph 1.3.3 with the following:

Only the “narrow-gap improved” ESW process (ESW-NG) shall be permitted.

Add 2 new subsections as follows:

SUBSECTION 1.12 EQUIPMENT CHECK

Each DC generator shall have a service check by an NEWA member, a commercial electrical equipment company or by the fabricating plant's electrical maintenance engineer once each year. A service certificate shall be issued with each equipment check and shall be available for inspection by the Engineer.

SUBSECTION 1.13 TEMPORARY WELDING AND TACKING

The attachment of temporary fabrication, erection and construction items to main members by welding or tacking is prohibited except by written permission from the Bureau Chief of Construction and Materials. Permissible locations for such welds and tacks shall be only at locations shown on approved shop drawings or at locations designated in writing by the Engineer. All such tacks or temporary welds shall be made according to Paragraphs 3.3.6 and 3.3.7 and welders and/or tackers shall be qualified according to AWS requirements.

SUBSECTION 2.9 DETAILS OF PLUG AND SLOT WELDS

Add the following to paragraph 2.9.1.1:

Plug welding is prohibited without the written approval of the Engineer. As a requirement for approval, all plug welding shall be QC tested by nondestructive testing at no cost to the state. The type of testing shall be determined by the Engineer.

SUBSECTION 3.4 CONTROL OF DISTORTION AND SHRINKAGE

Add the following to paragraph 3.4.8:

Do not use mechanical straightening methods without the approval of the Engineer, even when used in conjunction with the application of heat.

SUBSECTION 3.5 DIMENSIONAL TOLERANCES

Add the following to paragraph 3.5.1.2:

Permissible variations in straightness of rolled beams, regardless of cross-section, shall not exceed 0.01inch/foot of beam length or 1 inch.

Delete paragraph 3.5.1.3 and add the following:

3.5.1.3 Permissible variations in specified camber and blocking of welded girders and rolled beams, regardless of cross-section shall not exceed:

-0, +¼ inch for spans (typ., bearing to bearing) 0 thru 100 feet

-0, +½ inch for spans greater than 100 feet

Permissible variations in blocking of rolled beams at field splices, regardless of cross-section, shall not exceed:

-¼, +¼ inch for spans 0 through 100 feet
-⅜, +⅜ inch for spans greater than 100 feet

Permissible variations in blocking of welded girders and rolled beams, regardless of cross-section, shall not exceed:

0 for all supports

Sign convention: (-) below, (+) above the detailed values or shape in the no-load condition.

Delete paragraph 3.5.1.9 and replace with the following:

The bearing ends of bearing stiffeners shall be flush and square with the web and shall have no less than 75% of the end area in contact with the flanges.

"Contact" is achieved when a 0.005 inch feeler gauge cannot be inserted between stiffener and flange. The gap between stiffener and flange for the remaining "non-contact" area shall be no greater than 1/32 inch.

For steel slabs, base plates, bearing devices, cap plates of columns and pedestals bearings against or welded to beams and girders, no less than 75% of the common area shall be in contact with the flanges. Do not exceed a 1/32 inch gap for the 25% "non-contact" area.

Add 3 new paragraphs as follows:

3.5.1.16 The permissible variation in length of beams or girders between the center line of bearing devices shall not exceed plus or minus ¼ inch for any one span or plus or minus ⅜ inch for any two or more spans. The actual centerline of any bearing device shall lie within the thickness of the bearing stiffener.

3.5.1.17 During shop assembly of horizontally curved welded beams or girders, the allowable variation in specified sweep at internal supports shall be ¼ inch.

3.5.1.18 During shop assembly of horizontally curved welded beams or girders, the allowable variation in specified sweep at any point between supports shall be the greater of: ⅛ inch per 10 feet of length, calculated using the distance to the nearest support, or ¼ inch.

SECTION 4. TECHNIQUE.

Add the following notes to Table 4.1:

- Only low hydrogen electrodes shall be used.
- E 7028 Electrodes may be used for shop fillet welds except for the attachment of gusset plates and bearing stiffeners to girders, bearing stiffeners to beams, web to flange welds and for welding floor beam truss assemblies. Welding shall be in the horizontal and flat positions only.

SUBSECTION 5.2 WPS QUALIFICATION RESPONSIBILITY

Replace the first sentence of paragraph 5.2.3 with the following:

All welder, welding operator, and tack welder and PQR tests must be witnessed by the Engineer, another state's representative approved by the Engineer, or an independent third party approved by the Engineer. If representatives from other states or third parties witnessed a test, provide records of the test signed by the witness. All mechanical and nondestructive tests performed by independent laboratories on qualification specimens will be at no charge to the State. Provide signed documentation of the independent lab's test results to the Engineer. When requested by the Engineer, allow KDOT access to the test samples and the independent lab's radiographs for inspection.

Delete paragraph 5.2.4 and replace with the following:

5.2.4 Additional Testing. The Engineer may order tests of welders, welding operators, tack welders, or WPSs whenever there is evidence that unacceptable welds are being or have been produced. This additional testing is at the fabricator's expense. The Engineer may disqualify personnel working for the fabricator who fail the additional testing, who commit serious violations of the specifications, or who repeatedly exhibit poor workmanship on KDOT projects.

Revise paragraph 5.2.5 as follows:

Replace "those authorized to examine them." with "the Engineer."

SUBSECTION 5.21 GENERAL REQUIREMENTS FOR WELDER QUALIFICATION

Add the following to paragraph 5.21.6.1:

All tests must be witnessed by the Engineer, another state's representative approved by the Engineer, or an independent third party approved by the Engineer.

Revise paragraph 5.21.7 as follows:

Replace "those authorized to examine them." with "the Engineer."

Add the following to paragraph 5.21.7:

If representatives from other states or third parties witnessed a test, records of the test must by signed by the witness.

SUBSECTION 6.1 INSPECTION – GENERAL REQUIREMENTS

Add the following to paragraph 6.1.1.1:

Within a KDOT project, QC shall not be performed by an inspector or their assistants who are, or were previously, engaged in the welding, the general assembly, or the application of coatings. This requirement also applies to work done under other AWS welding codes.

SUBSECTION 6.7 NONDESTRUCTIVE TESTING (NDT)

Delete paragraphs 6.7.1, 6.7.1.1, and 6.7.1.2 and add the following:

6.7.1 Groove welds in main members as identified in Contract Documents shall be QC tested by nondestructive testing. Unless otherwise specified, radiographic testing shall be used on butt joints. Groove welds in T and corner joints shall be tested by ultrasonic testing. The requirements for radiographic testing and ultrasonic testing apply equally to shop and field welds.

6.7.1.1 Radiographic testing of welds shall be performed according to the following requirements:

(1) 100% of all welded girder and rolled beam flange butt joints.

(2) All except the middle ⅓ of all welded girder or rolled beam web butt joints.

6.7.1.2 Ultrasonic testing of welds shall be performed according to the following requirements:

(1) 100% of each joint subject to calculated tension or stress reversal.

(2) 25% of each joint subject to compression or shear. If unacceptable discontinuities are found in spot testing, the entire length shall be tested.

Delete paragraphs 6.7.6, 6.7.6.1, 6.7.6.2, 6.7.6.3, 6.7.6.4, and 6.7.6.5 and add the following:

6.7.6 When magnetic particle testing is used, the procedure and techniques shall be in accordance with the dry powder magnetic particle examination of welds using the yoke method.

6.7.6.1 The yoke method shall be performed according to ASTM E 709, and the standard of acceptance with 6.26 of the Code.

(1) The yoke method shall be performed using half-wave rectified direct current or alternating current.

(2) Electromagnetic yokes shall have lifting forces complying with **TABLE 705-1**.

TABLE 705-1: ELECTROMAGNETIC YOKE SPACING		
Current Type	**Yoke Pole Leg Spacing (YPS)**	
	2"≤YPS<4"	**4"≤YPS≤6"**
AC	10 lbs.	Not Applicable
DC	30 lbs.	50 lbs.

6.7.6.2 Prior to magnetic particle testing, the surface shall be examined, and any adjacent area within a minimum of 1 inch of the surface to be tested, shall be dry and free of contaminants such as oil, grease, loose rust, loose sand, loose scale, lint, paint, welding flux, and weld spatter.

Cleaning may be accomplished by detergents, organic solvents, descaling solutions, paint removers, vapor degreasing, sand or grit blasting, and ultrasonic cleaning methods.

6.7.6.3 The poles shall be oriented in two directions approximately 90 degrees apart at each inspection point, to detect both longitudinal and transverse discontinuities. The pole position shall overlap as testing progresses to insure 100 percent inspection of the areas to be tested. Discontinuities are best detected when their axis is normal to the magnetic lines of force. Therefore, the yoke technique is most sensitive to discontinuities whose major access is normal to a line drawn between the two poles.

6.7.6.4 A report of magnetic particle examination shall be prepared and provided to the owner.

(1) The report shall include the following minimum information:

(a) Part identification

(b) Examination procedure number (if applicable)

(c) Date of examination

(d) Technicians name, certification level, and signature

(e) Name and signature of contractors or owners, Inspectors, or both who witnessed the examination

(f) Examination results
(g) Equipment make and model
(h) Yoke spacing used
(i) Particle manufacturer's name and color

(2) One copy of the report shall be provided to the contractor for the owner.

Delete paragraph 6.7.7 and add the following:

6.7.7 For detecting discontinuities in non-magnetic materials including stainless steel to stainless steel or stainless steel to carbon steel, liquid penetrate inspection will be used in lieu of magnetic particle inspection. The standard methods, set forth in ASTM E 165 shall be used for liquid penetrate, and the standards of acceptance shall be in accordance with 6.26 of this code.

SUBSECTION 6.10 RADIOGRAPHIC TESTING (RT) - PROCEDURE

Delete paragraph 6.10.9 and add the following:

6.10.9 FILM SIZE - When the joint thickness is less than 3 inches, radiographs shall be 4 1/2 inches x 17 inches in size. When the length of the joint is such that more than one radiograph is required, one of the films may be shortened to 4 1/2 inches x 10 at the contractor option. When joint thicknesses are 3 inches or greater, the minimum film size shall be 7 inches x 17 inches. Larger radiographs may be required in areas where there have been excessive repairs or where there are joints with unusual dimensions.

Delete paragraph 6.10.12 and add the following:

6.10.12 One radiograph identification number shall be painted on the steel no closer than 3/4 inch from the weld edge at each radiograph location. Corresponding lead numbers shall be superimposed on the painted numbers to produce an image on the radiograph. A combination of letters and numbers may also be used. Two location dots shall be painted on the steel at each radiograph location no closer than 3/8 inch from the weld edge. The dots shall be placed at a random distance from the steel plate edges which are perpendicular to the length of the weld. The dots shall be placed in different locations for each radiograph location. One lead arrow shall be placed so that its tip is superimposed on each of the two location dots. A location letter shall be painted immediately under each arrow and a lead letter shall be superimposed on each painted letter. When radiographs are viewed, only those films representing the same joint should have location arrows and location letters perfectly superimposed. Any additional information shall be produced on the radiograph no less the 3/4 inches from the edge of the weld either by pre-printing or by placing lead letters and numbers on the steel. See Figure 1 and Figure 2.

Delete paragraph 6.10.13 and add the following:

6.10.13 Information required to be shown on the radiograph shall include: the complete KDOT bridge number, initials of the radiographic inspection company, initials of the fabricator, the fabricator's shop order number, the radiographic identification number, the date, and the weld repair number if applicable.

Add a new paragraph 6.10.15:

6.10.15 Unless otherwise noted on the shop drawings all butt welds will be evaluated as tension welds.

FIGURE 1

ITEMS TO BE PAINTED FOR RADIOGRAPHIC IDENTIFICATION

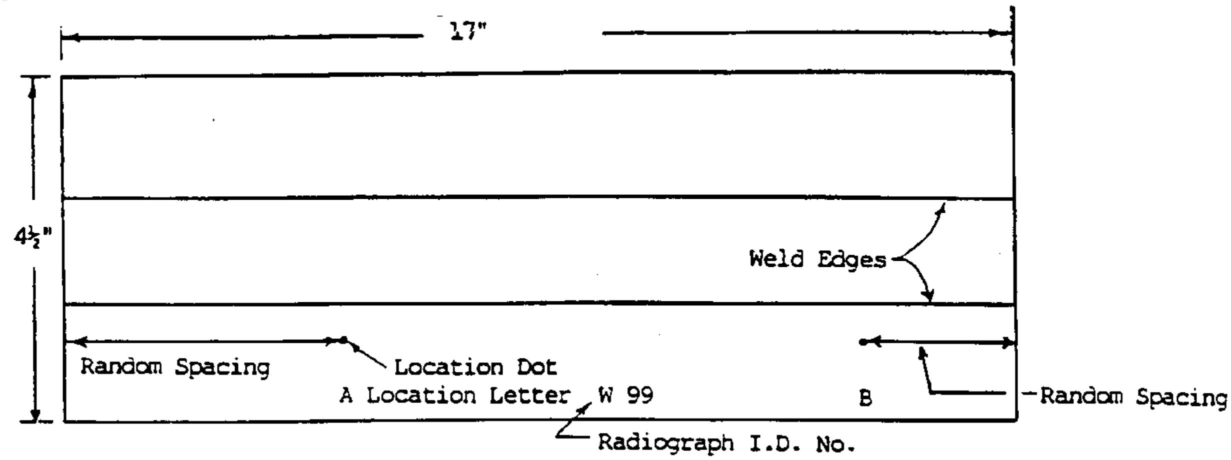
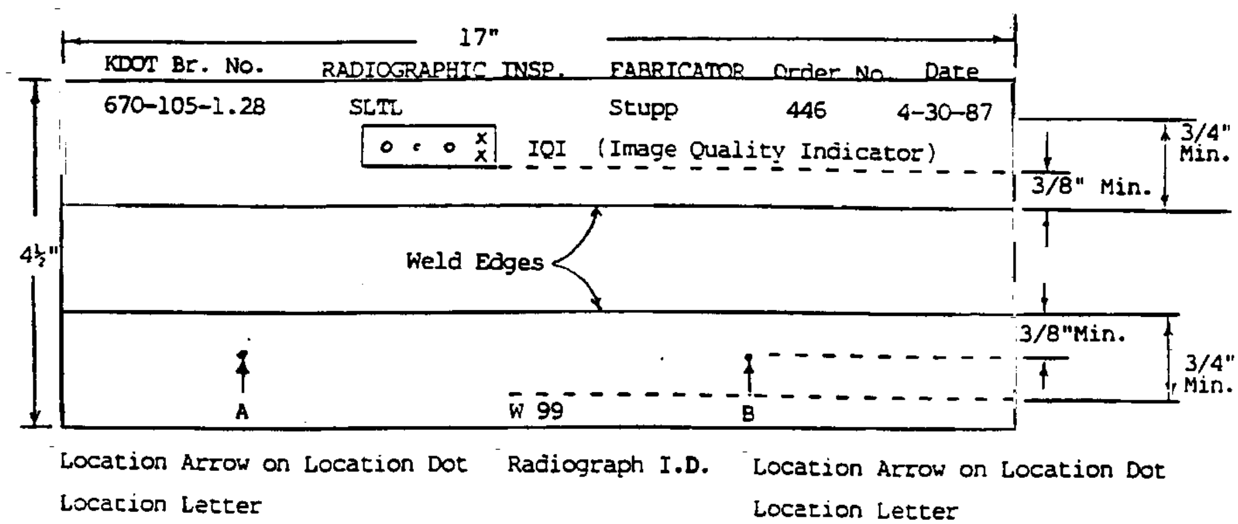


FIGURE 2

LEAD CHARACTER PLACEMENT FOR RADIOGRAPHIC IDENTIFICATION



705.3 MEASUREMENT AND PAYMENT

The Engineer will not measure fabrication of new structural steel for separate payment.

SECTION 706

BEARINGS AND PADS FOR STRUCTURES

706.1 DESCRIPTION

Install the complete factory produced bearings and pads as designated in the Contract Documents. See **SECTION 705** for fabrication of structural steel.

BID ITEMS	UNITS
Elastomeric Bearing Pad (**)	Each
Bearing (*) (**)	Each

*Type (Steel Reinforced Elastomeric, PTFE/Elastomeric, Pot, Disc, Steel, Spherical, etc.)
** Size, if applicable

706.2 MATERIALS

Provide bearings and pads of the types, dimensions and configurations shown in the Contract Documents that comply with **DIVISION 1700**.

706.3 CONSTRUCTION REQUIREMENTS

Submit shop drawings for each location, type and model according to **SECTION 105**. Show all details of fabrication and installation. With the exception of plain elastomeric pads, which do not require drawings, do not perform any fabrication until shop drawing are approved by the Engineer. Changes to approved shop drawings are subject to the approval of the Engineer. Submit revised sheets of the same size as those originally approved.

Paint steel bearings according to **SECTION 714**.

Install the bearings and pads as detailed in the Contract Documents.

Unless shown otherwise in the Contract Documents, place the bearing plates on bearing mats or pads that comply with **SECTION 1701**. Do not place steel masonry bearing plates upon bridge seat bearing areas that are improperly finished, deformed or irregular, or until elevations have been verified. Set bearing plates level in position as shown in the Contract Documents, and with a full and even bearing upon the masonry.

Adjust the nuts on anchor bolts at the expansion ends of spans to permit the free movement of the span. Provide lock nuts or burr the threads of the anchor bolts.

Protect bearings and pads from damage before installation. Clean the operating surfaces thoroughly before final assembly. Provide protection from contamination or damage by other construction operations during and after installation.

706.4 MEASUREMENT AND PAYMENT

The Engineer will measure each bearing and pad of the various types and sizes.

Payment for "Elastomeric Bearing Pad" and "Bearing" at the contract unit prices is full compensation for specified work.

SECTION 707

EXPANSION DEVICES

707.1 DESCRIPTION

Install finger plate, sliding plate and modular expansion devices as designated in the Contract Documents.

BID ITEMS	**UNITS**
Expansion Device (*)	Linear Foot
*Type: Finger Plate, Sliding Plate or Modular	

707.2 MATERIALS

Provide materials that comply with the applicable requirements.

Materials for Plate Expansion Devices .... **DIVISION 1600**
Fabric Troughs for Finger Plate/Sliding Plate .... **DIVISION 1700**
Modular Expansion Devices .... **DIVISION 1700**
Inorganic Zine Paint .... **DIVISION 1800**

707.3 CONSTRUCTION REQUIREMENT

a. General. The Contractor is responsible for preparing shop drawings and coordinating the fabrication of the joint assemblies.

Submit shop drawings, for each location, type and model of expansion device used, according to **SECTION 105**. Include a table of temperature corrections, required for installation, for each expansion device on the shop drawings. Do not perform any fabrication until the approved shop drawings are in the hands of the Inspector and fabricator, and the Engineer has authorized fabrication. Any purchase of materials before fabrication authorization is at the Contractor's risk. Changes to approved shop drawings are subject to the approval of the Engineer. Submit revised sheets of the same size as those originally approved.

Fabricate expansion devices according to **SECTION 705**. After fabrication, hot-dip galvanize all carbon steel components of modular expansion devices. Shop paint or hot-dip galvanize steel components of finger plate or sliding plate expansion devices, except support angles and finger plate or sliding plates, which must be shop painted.

- Galvanize according to ASTM A 123.
- Prepare steel surfaces and apply inorganic zinc according to **SECTION 714**, except provide a nominal dry film thickness of 3 mils.

The Contractor is responsible for coordinating the fabricator of the expansion device with the fabricator of the structural steel members for the bridge superstructure.

Complete the final sealing of the finished expansion joint as soon as possible after installation. Fill all bolts, exposed ends, joints between units and other areas of possible leakage with sealant. Scrape excess sealant away before it has set.

b. Expansion Device (Finger Plate or Sliding Plate). Place alignment marks on the anchor plates and finger plates or sliding plates on each side of the expansion gap to facilitate accurate installation.

Align the finger plate or sliding plate joint assemblies in position and check the expansion opening. The expansion opening must be adjusted for temperature prior to bolting, welding or placing concrete on each side of the joint. To adjust for the effects of sunlight on the girders, place reference marks on the bridge prior to sunrise. Use these reference marks to set the expansion opening using the table on the plans and the average ambient temperature over the previous 24 hours.

Test fit the finger plates or sliding plates with all the armoring and anchorages in place. Install the finger joint centered over the expansion gap, for both finger plates and sliding plates. Verify that the joint is in plane and sloped per the roadway. For fingers plates, make sure the fingers do not rub during the full range of temperature movement.

The Engineer will confirm the procedure, opening and alignment prior to concrete placement. After confirmation, remove the finger plates or sliding plates before concreting. Place concrete around the joint and vibrate so the concrete paste comes up through the air vents and no voids exist under the anchor unit. Start concrete placement at the low end of the joint and work toward the high end. If the bridge has a normal crown, start at the edge and work toward the center from both sides.

Three days after concrete placement, the Engineer will check for voids and loose bolts by sounding the anchor plate. Fill any voids by drilling through the anchor plate and pumping in an approved epoxy mortar at a minimum pressure of 75 psi. This work will be subsidiary to the bid item "Expansion Device (Finger Plate or Sliding Plate)".

Install the fabric trough and the finger or sliding plates according to the Contract Documents.

Thoroughly clean the top of the anchor plates to remove dried concrete paste before final assembly. Lubricate anchor bolts with bee's wax or equivalent and torque the nut according to **TABLE 707-1**.

TABLE 707-1: FINGER PLATE or SLIDING PLATE TORQUES (ft-lbs.)				
Size (inches)	**⅞**	**15/16**	**1**	**1 ⅛**
AASHTO M 314 Grade 36	176	218	264	387
AASHTO M 314 Grade 55	277	342	415	608

After installation of the finger plates or sliding plates, the Engineer will inspect the plates for alignment. Any plates that the Engineer determines are misaligned so that they may be struck by a snow plow, shall be ground as directed by the Engineer. This work will be subsidiary to the bid item "Expansion Device (Finger Plate or Sliding Plate)".

Install fabric troughs below the finger plate or sliding plate and clean the trough of all foreign material after the completion of all superstructure work.

c. Expansion Device (Modular). Place the adjacent concrete deck before installing modular expansion devices. When placing the concrete, block-out for the modular expansion devices according to the Contract Documents.

Install expansion devices according to the Contract Documents, and the manufacturer's recommendations. Do not field cut expansion devices. The manufacturer of modular expansion devices shall have a technical service representative on the project site to review the fabrication of the devices and supervise the installation of the devices.

If the expansion devices are installed within 10°F above or below the mean temperature shown in the Contract Documents, place the modular type in a "relaxed" or "free" condition with the distance between anchor bolts as shown in the Contract Documents.

If the installation temperatures are outside the range specified, expand or contract the device before it is anchored in place, making temperature corrections for distance between anchor bolts according to the manufacturer's table of temperature corrections shown on the expansion device shop drawings or on the general plans.

707.4 MEASUREMENT AND PAYMENT

The Engineer will measure expansion devices by the linear foot, along the centerline of the expansion joint.

Payment for "Expansion Device (*)" at the contract unit price is full compensation for the specified work.

SECTION 708

FALSEWORK AND FORM CONSTRUCTION

708.1 DESCRIPTION

Design and construct safe, adequate falsework to provide the necessary rigidity, support the loads imposed and produce the final structure to the lines and grades shown in the Contract Documents. Falsework is defined to be any temporary structure which supports structural members or form work.

BID ITEM	UNITS
Falsework Inspection	Lump Sum

708.2 MATERIALS

Use sound falsework piling to withstand driving, is reasonably straight, and is of sufficient size to provide the strength to safely carry the actual loads imposed. Use sound timber in good condition and free from defects that might impair its strength.

All approved metal or wood forms shall present a smooth surface, be mortar tight and sufficiently rigid to prevent distortion due to the pressure of the concrete and other loads incident to the construction operations, including placement and vibration of the concrete.

Do not use aluminum forms in contact with concrete.

708.3 CONSTRUCTION REQUIREMENTS

a. Falsework Design.

(1) General Falsework Design Requirements. Design falsework according to the KDOT Bridge Design Manual, Falsework Design, Analysis and Inspection.

Include the type, size, grade and finish of all lumber used. Provide adequate details of the proposed method of construction. The Engineer may request additional information.

In designing forms and centering, regard concrete as a liquid. In computing loads, assume a weight of 150 pounds per cubic foot for the vertical pressure, and a minimum of 85 pounds per cubic foot in computing horizontal pressure.

Do not place cast-in-place shear bolts, coil inserts or other devices used as falsework support in pier columns without the approval of the Engineer. Through bolts are permitted. Do not drill and grout bolts or other devices into the pier columns unless shown in the Contract Documents.

(2) Category 1 Structures. On the structures listed below, submit to the Engineer for review (See **SECTION 105**) by the State Bridge Office (SBO) (or Bureau of Local Projects) and, if applicable, the railroad company, 7 copies of detailed falsework plans designed and sealed by a Professional Engineer.

- All structures over or under railroad tracks;
- All structures built over highways or streets carrying traffic;
- All structures requiring falsework that directly carries highway traffic loads during construction;
- Deck overhangs greater than beam depth or greater than 54 inches;
- Superstructure forming with "non-typical" support (i.e. needlebeams); and
- All structures that require falsework plans to be submitted to the SBO (or Bureau of Local Projects) as noted in the Contract Documents.

(3) Category 2 Structures. If not included in the Category 1 structures above, submit to the Engineer for review (See **SECTION 105**) by the Field Engineer, 3 copies of detailed falsework plans designed and sealed by a Professional Engineer on the Category 2 structures listed below.

- All cast-in-place span structures supported on falsework;
- Concrete Box Structures with cell spans greater than 16 feet or cell heights greater than 14 feet;
- Decks with girder spacing equal to or greater than 14 feet; and
- Substructure forming with "non-typical" support.

Falsework or formwork details for deck construction are not required for all other structural steel, prestressed concrete girder and reinforced concrete box bridge construction.

b. Falsework Construction. Adhere to all falsework details.

Drive falsework piling to a satisfactory depth and bearing value to support all falsework that is not founded on rock, shale or thick deposits of other compact material in their natural beds. Do not use mudsills on earth, sand, gravel and similar materials, unless otherwise noted in the Contract Documents. Do not support falsework on any part of the structure, except the footings, without written approval from the Engineer. The number and spacing of falsework piling, the adequacy of sills, caps and stringers, and the amount of bracing in the falsework framing is subject to approval of the Engineer.

If the falsework piling or vertical members are of sufficient length to cap at the desired elevation for the horizontal members, cap them and construct frames to the proper elevation. If falsework piling are not of sufficient length, extend them using an approved pile splice. Do not use wedges at pile splices. Cut the ends of the piling or vertical members square for full bearing. If vertical splices are necessary, the abutting members shall be of the same approximate size, with the ends cut square for full bearing. Provide an adequate splice to maintain rigidity of the joint, including inserting a #9 reinforcing bar 18 inches into each end of the abutting members.

Upon completion, remove all forms and falsework according to **SECTION 710**. Pull or cut off falsework piling 12 inches below low water level, the natural ground or the bottom of a channel change. On grade separation structures, pull or cut off the falsework piling 12 inches below subgrade elevation of the roadbed that the piles are driven into. Pull or cut off all other falsework piling 12 inches below finished grade.

Unless the Contract Documents provide for permanent camber, construct the falsework to provide only sufficient camber to prevent final settlement below the finish grades shown in the Contract Documents. Use adequate hardwood wedges or screw jacks in all falsework construction, and place and adjust them to provide the proper form alignment. If required, provide a means for adjusting forms to offset any excessive settlement. When screw jacks are used, adequately brace and secure them to prevent tipping of the jacks in any direction.

c. Falsework Inspection Requirements. For Category 1 structures, the falsework designer of record shall make a Falsework Inspection of the as-built falsework for substantial compliance with the falsework plans prior to placing concrete in the structure.

Conduct an on-site review of the falsework. Items to be reviewed include but are not limited to:

- The condition of the materials used for piling, cross bracing, beams, plywood decking, shims and jacks.
- The size and spacing of all structural members regarding their compliance to the submitted falsework plan.
- The condition and compliance of all splices.

Provide written documentation to the Engineer stating the falsework as-built is acceptable and in compliance with the original sealed plans. If the falsework is not in compliance, make corrections to the falsework or submit a revised, sealed falsework design prior to the placement of any concrete. When modifications are made to the falsework, the designer of record shall make Falsework Inspections until written documentation is provided to the Engineer stating that the falsework is in compliance, at no additional cost to KDOT.

For Category 2 falsework plans, conduct a walk-though review of the falsework with the Field Engineer, prior to placing concrete in the structure. Variations and deficiencies from the plan will be noted in writing and supported with photos or sketches. Forward the documentation to the falsework designer. The designer must respond in writing that the deficiencies are minor and the falsework is in substantial compliance, or must propose a new falsework plan which addresses the deficiencies.

The Engineer will refuse approval to proceed with other phases of the work if the falsework is determined to be unsafe or inadequate to properly support the subjected loads.

d. Forms. Do not separate forms at joints. Design the forms to permit easy removal without injury to the concrete. Use form lining such as plywood or metal forms for all exterior exposed surfaces which shall be visible after backfilling. The inside surface of the walls and slab of box culverts and bridges, the inside arch ring of arch culverts and bridges, the underneath surface of all floor slabs and the interior vertical surfaces of girders do not require form lining. Extend the forms to low water level, 1 foot below the bottom of the channel, or the top of the completed backfill. Use forms in the largest practical panels to minimize joints. Do not use small panels. If wooden panels are used, place the adjacent panels so that the grain of the wood shall be in the same general direction (all horizontal or all vertical). Undressed lumber of uniform thickness may be used as backing for the form lining. Dressed, sized lumber of uniform thickness may be used for all other exposed surfaces. Wooden plyform of adequate thickness, which is supported to meet these requirements, may be used alone in lieu of the lined forms.

Maintain forms to eliminate warping and shrinkage. Check dimensions and condition immediately before placing concrete. The Engineer may at any time require the revision or reconstruction of forms to maintain satisfactory work, and may refuse approval to place concrete within the forms until they are satisfactorily constructed. If during or after placing the concrete, the forms show signs of sagging or bulging, remove the concrete to the extent directed by the Engineer, bring the forms to the proper position and place new concrete.

Metal forms shall be of such thickness that the forms shall remain true to shape, line and grade. Countersink all bolt and rivet heads. Design clamps, pins or other connecting devices to hold the forms rigidly together, and allow removal without injury to the concrete. Exercise care to keep metal forms free from rust, grease or other foreign matter. Any form which will leave permanent impressions or ridges will not be approved.

Before placing the reinforcing steel, oil the inside of all forms for exposed surfaces (except those lined with certain composition materials) with a light, clear, paraffin base oil that will not discolor or otherwise injure the surface of the concrete.

Moisten wooden forms with water before placing the concrete.

Consider the nature of the work when determining the width and thickness of the lumber, and the size and spacing of studs and wales. Provide the size and spacing of studs and wales to maintain rigidity of the forms, and prevent distortion of the forms due to the pressure of the concrete.

Use either steel or non-metallic form bolts, rods and ties. Use the type that permits the major part of the tie to remain permanently in the structure. Hold forms in place by devices attached to the wales capable of developing the strength of the ties. The Engineer may permit the use of wire ties on irregular sections and incidental construction if the concrete pressures are nominal and the form alignment is maintained by other means. Remove the ties on all exposed surfaces. Remove steel ties to a depth a minimum of ½ inch below the concrete surface. Non-metallic ties may be removed flush with the concrete surface. Cut wire ties back a minimum of ¼ inch below the concrete surface. Fill the cavities on exposed surfaces with cement mortar and leave the surface sound, smooth, even and uniform in color. Tar or roofing cement is acceptable for filling cavities on unexposed surfaces. Do not use form ties through forms for handrail. Remove wood, or metal spreaders as the concrete is placed. Do not use cofferdam braces or struts that extend through the forms for any concrete section. An exception may be approved in unusual situations.

Where the bottom of the forms is inaccessible, make provisions so that extraneous material can be removed from the forms immediately before placing the concrete.

Bevel all exposed edges by using dressed, triangular molding having ¾-inch sides unless provided otherwise in the Contract Documents.

Steel traveling forms may be used on reinforced concrete box structures or other applications when approved by the Engineer. Continuance of the use of such forms is based on satisfactory performance. Steel traveling forms may be discontinued at any time the Engineer determines their use is unsatisfactory. If traveling forms are used, provide supports as listed in **TABLE 708-1** before loosening and moving the forms.

TABLE 708-1: MAXIMUM SPACING PERMITTED FOR SUPPORTS	
spans up to 9 feet	1 support located at center of span
spans 9 to 14 feet	2 supports located at third points of span
spans over 14 to 18 feet	3 supports located at quarter points of span

The maximum longitudinal spacing of the supports is at 4 foot centers. The time the supports must be left in place is specified in **TABLE 710-3**. Do not loosen and move the forms until the concrete has been in place a minimum of 14 hours. When concrete is exposed as a result of moving the forms after the minimum 14 hours, but before the stipulated curing time, immediately coat the concrete with liquid membrane-forming compound applied according to **DIVISION 700**.

708.4 MEASUREMENT AND PAYMENT

The Engineer will not measure Falsework Design, Falsework Construction or Forms (design or construction) for payment.

On structures designated as Category 1 by KDOT, the Engineer will measure falsework inspection by the Lump Sum. Falsework inspection on Category 2 structures is subsidiary to other items of the contract. If KDOT designated the structure as Category 2, and the Contractor's operations (use of non-typical supports) cause the falsework to become Category 1, the Engineer will not measure the falsework inspection for separate payment.

Payment for "Falsework Inspection" on structures designated by KDOT as Category 1 will be made on the paid invoice amount +5%, not to exceed the "Lump Sum" amount set in the contract and is full compensation for the specified work.

SECTION 709

STEEL PERMANENT DECK FORMS

709.1 DESCRIPTION

If designated in the Contract Documents, the use of steel permanent deck forms (for forming the roadway slab between the exterior beams or girders) in lieu of conventional removable forms is the Contractor's option. Do not use steel permanent deck forms where longitudinal deck construction joints are located between stringers, or on the overhang.

709.2 MATERIALS

Provide steel permanent deck forms that comply with **DIVISION 1600**.

709.3 CONSTRUCTION REQUIREMENTS

Submit shop drawings for the steel permanent deck forms to the Engineer for approval according to **SECTION 105**. Shop drawings must include the material, dimension details and the Contractor's erection procedures.

Form support hangers must be the non-welded support system. Make no welds to the structural steel, or welds that induce local heat spots on the structural steel. Field variations shall require the support angle to be field welded to the continuous edge angle and to the support strap across the structural steel flange. If steel permanent deck forms are to be used on concrete girder bridges, the method of attachment must be approved by the Engineer prior to fabrication of the girders.

Install the steel permanent deck forms according to the manufacturer's instructions.

Do not locate screed supports directly on the form sheets, form supports or reinforcing steel.

Locate transverse deck slab construction joints at the bottom of a flute, and field drill ¼-inch weep holes at 12-inch centers along the line of the joint.

Fabricate the corrugated metal sheets for the placement sequence used, with the joints between the sections of sheets overlapped or securely fastened to eliminate differential deflections between the sections. Close the ends of each piece. Pre-closed (tapered) ends or separate end closures may be used.

Provide care and protection for the metal form sheets, supports and accessory items during handling, shipping and storage. Do not damage ends, corners and edges of the form sheets, supports and accessory items during loading, hoisting and unloading operations. If the form units and accessories are to be stored prior to installation, do not place metal form sheets, supports, and accessories in contact with the ground. Cover and protect the material.

Repair damaged galvanized coating on any form metal that will be permanently exposed, by cleaning and wire brushing the damaged area, followed by painting with 2 coats of zinc rich paint as specified in **DIVISION 1800**, no color added. Minor heat discoloration in areas of welds need not be touched up. Before placing concrete, remove and replace any sheets damaged after setting.

All reinforcement must have the minimum specified concrete cover. Center bars in the bottom layer of the main reinforcement over the valleys of the form to achieve the minimum concrete cover. The distance from the top of the deck slab to the bottom layer of deck slab reinforcement may not be less than that shown in the Contract Documents. Do not leave loose sheets or miscellaneous hardware on the deck forms at the end of the working day.

The Engineer will spot check the underside for soundness. At the Engineer's discretion, form removal may be required to perform a visual inspection for soundness or surface irregularities.

709.4 MEASUREMENT AND PAYMENT

The Engineer will not measure the steel permanent deck forms for payment.

SECTION 710

CONCRETE STRUCTURE CONSTRUCTION

710.1 DESCRIPTION

Construct concrete structures according to the Contract Documents. When Bridge Deck Grooving is a bid item in the contract, perform the grooving as shown in the Contract Documents.

BID ITEMS	UNITS
Concrete (*) (**) (***) (****)	Cubic Yard
Bridge Deck Grooving	Square Yard

*Grade of Concrete
**AE (air-entrained), if specified
***Aggregate, if specified
****MPC (Moderate Permeability Concrete), if specified

710.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete[+]	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTION 1102**
Concrete Curing Materials	**DIVISION 1400**
Joint Sealing Compounds	**DIVISION 1500**
Type B Preformed Expansion Joint Filler	**DIVISION 1500**
Preformed Elastomeric Compression Joint Seals	**DIVISION 1500**
Bridge Number Plates	**DIVISION 1600**

[+] If Moderate Permeability Concrete (MPC) is not specified, the concrete shall meet the requirements for Standard Permeability Concrete.

710.3 CONSTRUCTION REQUIREMENTS

a. Falsework and Forms. Construct falsework and forms according to **SECTION 708**.

b. Handling and Placing Concrete. At a progress project meeting prior to placing concrete, discuss with the Engineer the method and equipment used for deck placement; include the equipment for controlling the evaporation rate, procedures used to minimize the evaporation rate, and method to place saturated burlap within the specified 15 minute limit.

Fogging using hand-held equipment may be required by the Engineer during unanticipated delays in the placing, finishing or curing operations. If fogging is required by the Engineer, do not allow water to drip, flow or puddle on the concrete surface during fogging, placement of absorptive material, or at any time before the concrete has achieved final set.

When needed, produce a fog spray from nozzles that atomize the droplets and a system capable of keeping a large surface area damp without depositing excess water. Use high pressure equipment that generates a minimum of 1200 psi at 2.2 gpm, or low pressure equipment having nozzles capable of supplying a maximum flow rate of 1.6 gpm.

Use a method and sequence of placing concrete approved by the Engineer. Do not place concrete until the forms and reinforcing steel have been checked and approved. Before placing concrete, clean all forms of debris. Drive all foundation piling in any one pier or abutment before concrete is poured in any footing or column of that pier or abutment.

On bridges skewed greater than 10º, place concrete on the deck forms across the deck on the same skew as the bridge, unless approved otherwise by State Bridge Office (SBO). Operate the bridge deck finishing machine on the same skew as the bridge, unless approved otherwise by the SBO.

Maintain environmental conditions on the entire bridge deck such that the evaporation rate is less than 0.2 lb/sq ft/hr. This may require placing the deck at night, in the early morning or on another day. The evaporation rate (as determined in the American Concrete Institute Manual of Concrete Practice 305R, Chapter 2) is a function of air temperature, concrete temperature, wind speed and humidity.

Just prior to and at least once per hour during placement of the concrete, the Engineer will measure and record the air temperature, concrete temperature, wind speed and humidity on the bridge deck. The Engineer will take the air temperature, wind and humidity measurements approximately 12 inches above the surface of the deck. With this information, the Engineer will determine the evaporation rate by using KDOT software or by using **FIGURE 710-1** (Figure 2.1.5 from the American Concrete Institute Manual of Concrete Practice 305R, Chapter 2).

When the evaporation rate is equal to or above 0.2 lb/ft^2/hr, take actions (such as cooling the concrete, installing wind breaks, sun screens etc.) to create and maintain an evaporation rate less than 0.2 lb/ft^2/hr on the entire bridge deck.

Place concrete to avoid segregation of the materials and displacement of the reinforcement. Do not deposit concrete in large quantities at any point in the forms, and then run or work the concrete along the forms.

Deposit the concrete in the forms in horizontal layers. Perform the work rapidly and continuously between predetermined planes. Vibrate through each plane.

Fill each part of the form by depositing the concrete as near to the final position as possible. If the chutes for placement of concrete are on steep slopes, equip them with baffle boards or assemble in short lengths that reverse the direction of movement. Do not drop concrete in the forms a distance of more than 5 feet, unless confined by clean, smooth, closed chutes or pipes.

Work the coarse aggregate back from the forms and around the reinforcement without displacing the bars. After initial set of the concrete, do not disturb the forms, or place any strain on the ends of projecting reinforcement.

If placing concrete by pumping, place the concrete in the pipeline to avoid contamination or separation of the concrete, or loss of air by fitting the pump with a concrete brake (e.g. french horn or bladder valve) at the end of the pump boom. Obtain sample concrete for slump and air test requirements at the discharge end of the piping.

Do not use chutes, troughs or pipes made of aluminum.

Uniformly consolidate the concrete without voids.

Accomplish consolidation of the concrete on all span bridges that require finishing machines by means of a mechanical device on which internal (spud or tube type) concrete vibrators of the same type and size are mounted (**subsection 154.2**). Observe special requirements for vibrators in contact with epoxy coated reinforcing steel as specified in **subsection 154.2**. Provide stand-by vibrators for emergency use to avoid delays in case of failure.

Operate the mechanical device so vibrator insertions are made on a maximum spacing of 12-inch centers over the entire deck surface. Provide a uniform time per insertion of all vibrators of 3 to 15 seconds, or until the course aggregate settles below the surface of the concrete, unless otherwise designated by the Engineer. Provide positive control of vibrators using a timed light, buzzer, automatic control. Smoothly extract the vibrators from the concrete at a rate to avoid leaving any large voids or holes in the consolidated concrete. Do not drag the vibrators horizontally through the concrete.

Use hand held vibrators (**subsection 154.2**) in inaccessible and confined areas such as along hubguards. When required, supplement vibrating by hand spading with suitable tools to provide required consolidation.

Reconsolidate any voids left by workers.

Deposit concrete in water, only with approval from the Engineer. Do not place concrete in running water.

Use forms that are reasonably watertight to hold concrete deposited under water. Increase the minimum cement factor of the grade of concrete being deposited in water by 10%, obtaining approximately a 6-inch slump. Carefully deposit the concrete in place, in a compact mass, using a tremie pumped through piping, bottom-dumping bucket or other approved method that does not permit the concrete to fall through the water. Do not pump water from the inside of the foundation forms while concrete is being placed. Do not disturb the concrete after being deposited. If necessary to prevent flooding, place a seal of concrete through a closed chute or tremie, and allow it to set.

Continuously place concrete in any floor slab until complete, unless shown otherwise in the Contract Documents.

The method used for transporting concrete batches, materials or equipment over previously placed single pour (non-overlaid) floor slabs or floor units, or over units of structures of continuous design types is subject to approval by the Engineer.

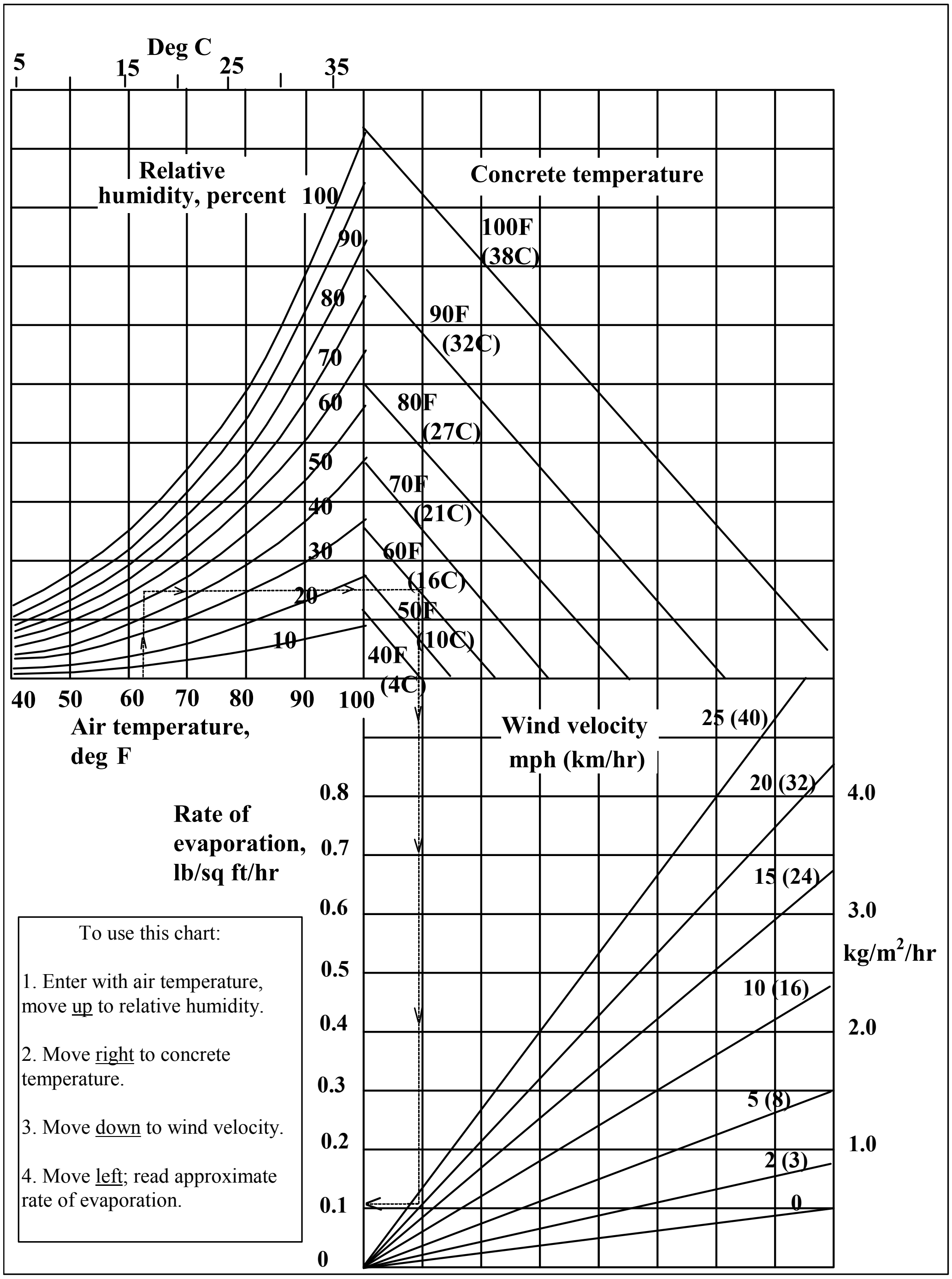
Do not operate bridge deck finishing equipment on previously placed concrete spans until:

- A minimum of 72 hours on structures that are fully supported with falsework;
- A minimum of 72 hours on structures with concrete girder spans with concrete decks; and
- A minimum of 96 hours on structures with steel girder spans with concrete decks.

The time delays begin after the day's pour has been completed.

Follow **TABLE 710-2** for load limitations after concrete placement. Prior to permitting approved traffic on the bridge deck, construct temporary bridge approaches and maintain them in a condition to prevent damage to the bridge ends.

FIGURE 710-1: STANDARD PRACTICE FOR CURING CONCRETE



Effect of concrete and air temperatures, relative humidity, and wind velocity on the rate of evaporation of surface moisture from concrete. This chart provides a graphic method of estimating the loss of surface moisture for various weather conditions. To use the chart, follow the four steps outlined above. When the evaporation rate exceeds 0.2 lb/ft^2/hr (1.0 kg/ m^2/hr), measures shall be taken to prevent excessive moisture loss from the surface of unhardened concrete; when the rate is less than 0.2 lb/ft^2/hr (1.0 kg/m^2/hr) such measures may be needed. When excessive moisture loss is not prevented, plastic cracking is likely to occur.

c. Construction Joints, Expansion Joints and End of Wearing Surface (EWS) Treatment. Locate the construction joints as shown in the Contract Documents. If construction joints are not shown in the Contract Documents, submit proposed locations for approval by the Engineer.

If the work of placing concrete is delayed and the concrete has taken its initial set, stop the placement, saw the nearest construction joint approved by the Engineer and remove all concrete beyond the construction joint. On post-tensioned structures construct a stepped joint as shown in the Contract Documents.

When the Contract Documents show a construction joint in the wall of the RCB 3 inches above the floor, the Contractor has the option of constructing the joint as shown on the Contract Documents, or constructing the joint level with the floor of the RCB. When the Contract Documents show a construction joint in the wall of the RFB 2 inches above the floor haunch, the Contractor has the option of constructing the joint as shown on the Contract Documents, or even with the top of the floor haunch of the RFB.

If dowels, reinforcing bars or other tie devices are not required by the Contract Documents, make a key in the construction joint. Construct keyed joints by embedding water-soaked beveled timbers of a size shown on the Contract Documents, into the soft concrete. Remove the timber when the concrete has set. When resuming work, thoroughly clean the surface of the concrete previously placed, and when required by the Engineer roughen the key with a steel tool. Before placing concrete against the keyed construction joint, the joint shall be cleaned of surface laitance, curing compound, and all other foreign material, use of abrasive blasting may be required to achieve the level of cleanliness required. Thoroughly wash the surface of the keyed joint with clean water, and allow the joint to dry to a saturated surface dry condition immediately prior to placing fresh concrete against the joint key.

(1) Bridges With Tied Approaches. When concrete is placed at the bridge EWS, embed 3 (½-inch by 8-inch) bolts to hold a header board for each traffic lane into the vertical surface of the EWS. Finish the surface of the EWS using an edging tool with a ¼ inch radius. Immediately after the vertical forms on the EWS are removed, protect the exposed EWS by bolting a wooden header (minimum dimension of 2 ⅝ inches by 7 ½ inches) to the exposed vertical surface of the EWS. Extend the header board the full width of the EWS, or use 1 section of header board for each lane of traffic. Shape the header board to comply with the crown of the bridge surface, and install it flush with the concrete wearing surface. Do not bend the reinforcing steel which will tie the approach slab to the EWS or damage the concrete at the EWS.

(2) Bridges Without Tied Approaches. Place the concrete for the approach slab, and at the end of the approach slab away from the EWS place bolts and attach a header board in the same manner required for bridges with tied approaches. If the Contractor needs to drive on the bridge before the approach slabs can be placed and cured construct a temporary bridge from the approach over the EWS capable of supporting the anticipated loads. The method of bridging must be approved by the Engineer.

d. Finishing. Finish all top surfaces, such as the top of retaining walls, curbs, abutments and rails, with a wooden float by tamping and floating, flushing the mortar to the surface and provide a uniform surface, free from pits or porous places. Trowel the surface producing a smooth surface, and brush lightly with a damp brush to remove the glazed surface.

Strike off bridge decks with a self-propelled finishing machine, which may be manually operated by winches to reach a temporary bulkhead when approved by the Engineer. The screed on the finish machine must be self-oscillating, and operate or finish from a position either on the skew or transverse to the bridge roadway centerline.

On decks skewed greater than 10º, operate the finishing machine on the same skew as the bridge, unless approved otherwise by the SBO. Before placing concrete, position the finisher throughout the proposed placement area allowing the Engineer to verify the reinforcing steel positioning.

Irregular sections may be finished by other methods approved by the Engineer. Reinforced concrete box bridges that will be under fill may be struck off by other approved methods.

Float and straightedge the wearing surface so the finished surface is at the cross-section shown in the Contract Documents. Do not add water to the surface of concrete, unless approved by the Engineer, and when approved apply as a fog spray.

Secure a smooth riding bridge deck, correcting surface variations exceeding ⅛ inch in 10 feet by use of an approved profiling device, or other method approved by the Engineer.

Straightedge decks that are to receive an overlay, leaving them with an acceptable float or machine pan finish.

For decks not receiving an overlay, and without the bid item Bridge Deck Grooving, finish the deck with the rough burlap drag.

For decks not receiving an overlay, and with the bid item Bridge Deck Grooving, see **subsection 710.3f.** for grooving requirements.

Obtain reasonably true and even concrete surfaces, free from stone pockets, excessive depressions or projections on the surface. Strike off with a straightedge and float the concrete in bridge seats and walls flush with the finished top surface.

As soon as the forms are removed and the concrete is ready to hone, rub the concrete surfaces that are not in an acceptable condition, or are designated in the Contract Documents to be surface finished to a smooth and uniform texture with a carborundum brick and clean water. Remove the loose material formed on the surface, due to the rubbing with a carborundum brick as soon as it dries. The finished surface shall be free from all loose material. Do not use a neat cement wash.

Give handrails, handrail posts, the deck side, and the top and end of all curbs, except curbs of structures having the top of curb below the final shoulder elevation of the road, an acceptable troweled or floated finish. This includes the back of the inside rails of side by side structures, or any rails easily viewed by the traveling public.

Remove the forms as early as possible, and perform the float finish while the concrete is still green. Use mortar during the float finish operation to fill in air and water voids and supplement the float finish. Keep surfaces requiring a rubbed finish moist before and during the rubbing. Do not use a mortar coating after the concrete has cured.

Unless otherwise provided in the Contract Documents, all reasonably true and even surfaces, obtained by use of a form lining, which are of a uniform color, free from stone pockets, honeycomb, excessive depressions or projections beyond the surface, are considered as acceptable surfaces, and a rubbed surface finish is not required.

The Engineer may require the use of a dry carborundum brick for straightening moulding lines, removing fins or requiring a rubbed surface finish on all portions of the structure that do not present an acceptable surface even though a form lining is used.

e. Curing and Protection.

(1) General. Cover concrete surfaces according to **TABLE 710-1**. Cure all pedestrian walkway surfaces in the same manner as the bridge deck. The determination of the time requirement for curing commences after all the concrete for the placement is in place and finished. During cold weather, the specified time limits may be increased at the discretion of the Engineer, based upon the amount of protection and curing afforded the concrete.

Maintain a damp surface until the wet burlap is placed. Fully saturate burlap before placing on concrete surface. Cover all concrete surfaces with saturated burlap within 15 minutes after finishing the concrete, do not mar concrete during placement of the wet burlap. Maintain the curing so that moisture is always present at the concrete surface.

Place and weight down the burlap so it will remain in intimate contact with the surface covered.

When an impermeable sheeting material is used, lap each unit 18 inches with the adjacent unit. Place and weight down the impermeable sheeting material so it will remain in intimate contact with the surface covered. When any burlap or impermeable sheeting material becomes perforated or torn, immediately repair it, or discard and replace it with acceptable material.

TABLE 710-1: MINIMUM CURE TIMES AND CURING MEDIUMS		
Type of Work	**Minimum Cure Time (days)**	**Curing Medium and Use**
Bridge decks (full-depth decks with multi-layer polymer overlays) Bridge subdecks (decks with overlays)	14 Wet	Wet burlap covered with white polyethylene sheeting during the 14-day period.
Bridge decks (full-depth decks with no overlay) Bridge Overlays	14 Wet Plus 7 Curing Membrane	Wet burlap covered with white polyethylene sheeting during the 14-day period. After the wet cure period, apply 2 coats of Type 2 white liquid membrane forming compound. Place the first coat within 30 minutes of removing the sheeting and burlap. Spray the second coat immediately after and at right angles to the first application. Protect the curing membrane against marring for a minimum of 7 days. The Engineer may limit work during this 7-day period.
Other unformed or exposed surfaces	7 Curing Membrane	Apply 2 coats of Type 2 white liquid membrane forming compound. Place the first coat immediately after completion of the concrete finish just as the surface water disappears. Spray the second coat immediately after and at right angles to the first application. Protect the curing membrane against marring for a minimum of 7 days. The Engineer may limit work during this 7-day period. Should the compound be subjected to continuous damage, the Engineer will require wet burlap, white polyethylene sheeting or other approved impermeable material to be applied at once for the remainder of the cure time.
Formed sides and ends of bridge wearing surfaces and bridge curbs Other formed surfaces	4 Formed	Formed surfaces will be considered completely cured upon the Engineer's permission to remove the forms, providing the forms have been in place for a minimum of 4 days. If forms are removed before the end of the 4-day cure period, cure the surface with an application of Type 1-D liquid membrane forming compound.

(2) Liquid Membrane Forming Compounds. Use spraying equipment capable of supplying a constant and uniform pressure to provide uniform distribution at the rates required. Agitate the liquid membrane forming compound continuously during application. The surface must be kept wet from the time it is finished until the liquid membrane forming compound is applied. Apply liquid membrane forming compound at a minimum rate per coat of 1 gallon per 200 square feet of concrete surface.

Give marred or otherwise damaged applications an additional coating.

If rain falls on the newly coated concrete before the film has dried sufficiently to resist damage from the rain, or if the film is damaged by any other means, apply a new coat of the membrane to the affected portion equal in curing value to the original application.

(3) Bridge Subdecks and Decks. Provide a work bridge to facilitate application of all curing materials. Maintain the curing so that moisture is always present at the concrete surface.

Maintain the wet burlap in a fully wet condition using misting hoses, self-propelled, machine-mounted fogging equipment with effective fogging area spanning the deck width, moving continuously across the entire burlap-covered surface, or other approved devices until the concrete has set sufficiently to allow foot traffic. At that time, place soaker hoses on the burlap, and supply running water continuously to maintain continuous saturation of all burlap material to the entire concrete surface. For bridge decks with superelevation, place a minimum of 1 soaker hose along the high edge of the deck to keep the entire deck wet during the curing period.

If the concrete surface temperature is above 90ºF, do not use polyethylene sheeting in direct sunshine during the day for the first 24 hours of the specified curing period (**TABLE 710-1**). White polyethylene sheeting may be used at night to maintain the required damp condition of the burlap. When polyethylene sheeting is used over the burlap at night during the first 24 hours and the concrete surface temperature is above 90ºF, place the polyethylene sheeting a maximum of 1 hour before sunset, and remove the polyethylene sheeting within 1 hour after sunrise. After the first 24 hours, the polyethylene sheeting may be left in place continuously for the remainder of the curing period provided the burlap is kept damp.

Construction loads on the new bridge subdeck, new one-course deck or any concrete overlay are subject to the limitations in **TABLE 710-2**. The use of supplemental cementitious materials will require additional time before specified loading is allowed.

TABLE 710-2: CONCRETE LOAD LIMITATIONS ON BRIDGE DECKS		
Days after concrete is placed	**Element**	**Allowable Loads**
1*	Subdeck, one-course deck or concrete overlay	Foot traffic only.
3*	One-course deck or concrete overlay	Work to place reinforcing steel or forms for the bridge rail or barrier.
7*, Δ	Concrete overlays	Legal Loads; Heavy stationary loads with the Engineer's approval.***
10 *, Δ (15)**, Δ	Subdeck, one-course deck or post-tensioned haunched slab bridges	Light truck traffic (gross vehicle weight less than 5 tons).****
14 *, Δ (21)**, Δ	Subdeck, one-course deck or post-tensioned haunched slab bridges	Legal Loads; Heavy stationary loads with the Engineer's approval.***Overlays on new decks.
28	Bridge decks	Overloads, only with the State Bridge Engineer's approval.***

*Maintain the specified wet cure at all times (**TABLE 710-1**).
** All haunched slab structures.
*** Submit the load information to the appropriate Engineer. Information that will be required is the weight of the material and the footprint of the load, or the axle (or truck) spacing and the width, the size of each tire (or track length and width) and their weight.
****An overlay may be placed using pumps or conveyors until legal loads are allowed on the bridge.
Δ Increase time period by 3 days when supplemental cementitious materials are used October 1 thru April 30.

(4) Surfaces Requiring Rubbed Finish. Apply Type 1-D liquid membrane-forming compound immediately after the surface is completed, and while the concrete is still damp.

(5) Cold Weather Curing. If concrete is placed in cold weather, comply with **SECTION 401**.

If concrete is placed and the ambient air temperature is expected to drop below 40ºF during the entire specified curing period, provide suitable measures such as straw, additional burlap or other suitable blanketing materials or housing and artificial heat to maintain the concrete temperature between 40 and 90ºF as measured on the surface of the concrete. Keep the surface of the concrete moist by the use of an approved moisture barrier such as wet burlap or polyethylene sheeting or both as defined in **TABLE 710-1**. Maintain the moisture barrier in intimate contact with the concrete during the entire specified curing period. After the completion of the required curing period, remove the curing and protection to prevent rapid cooling of the concrete.

(6) If concrete is placed in cofferdams and subsequently flooded with ground water, the specified curing conditions are waived providing the surface of the water does not freeze.

f. Grinding and Grooving. Correct surface variations exceeding ⅛ inch in 10 feet by use of an approved profiling device, or other methods approved by the Engineer after the curing period. Perform grinding on hardened concrete after the specified curing membrane period (**TABLE 710-1**) to achieve a plane surface and grooving of the final wearing surface as shown in the Contract Documents. Apply the corrective measure to the full width of the lane. The corrected areas shall have uniform texture and appearance. The beginning and ending of the corrected areas shall be squared normal to centerline of the paved surface.

If at least 25% of the traveled way of the deck needs ground to correct surface variations, grind the entire deck.

Use a self-propelled grinding machine with diamond blades mounted on a multi-blade arbor. Avoid using equipment that causes excessive ravels, aggregate fractures or spalls. Remove from the project and properly dispose of the material. Do not allow the grinding slurry to flow across lanes being used by traffic, onto shoulder slopes, into streams, lakes, ponds or other bodies of water, or gutters or other drainage facilities. Do not place grinding slurry on foreslopes.

After any required grinding is complete and after the specified curing membrane period (**TABLE 710-1**), give the surface a suitable texture by transverse grooving. Use diamond blades mounted on a self-propelled machine that is designed for texturing pavement. Transverse grooving of the finished surface may be done with equipment that is not self-propelled providing that the Contractor can show proficiency with the equipment. Use equipment that does not cause strain, excessive raveling, aggregate fracture, spalls, disturbance of the transverse or longitudinal joint, or damage to the existing concrete surface. Make the grooving approximately $^{3}/_{16}$ inch in width at ¾ inch centers and the groove depth approximately ⅛ inch. Terminate the transverse bridge deck grooving approximately 2 feet in from the base of the rail, and 1 foot from any deck drains or other appurtenances.

If after corrective measures are made, more than ½ inch of the deck was ground at any location, the Engineer may require a multi-layer polymer concrete overlay over the whole deck, according to **SECTION 729**, at no additional cost to KDOT.

g. Removal of Forms and Falsework. Do not remove forms and falsework without the Engineer's approval. During cold weather, the specified time limits may be increased at the discretion of the Engineer, based upon the amount of protection and curing afforded the concrete.

Do not remove forms and falsework until the minimum amount of time required for strength gain has elapsed regardless if the concrete is fully cured per **TABLE 710-1**.

If forms are removed before expiration of the cure period, maintain the cure as provided in **DIVISION 700**. Remove forms on handrails, ornamental work and other vertical surfaces that require a rubbed finish as soon as the concrete has hardened sufficiently that it shall not be damaged.

Under normal conditions, the Engineer will allow removal of forms and falsework according to **TABLE 710-3**. The determination of the time requirement for the removal of forms commences after all the concrete for the placement is in place and finished. If high early strength concrete is used, the specified time limits may be decreased as determined by the Engineer, and agreed upon before placing the concrete.

TABLE 710-3: MINIMUM STRENGTH GAIN TIME BEFORE REMOVAL OF FORMS & FALSEWORK (DAYS)

Type of Work	Span Length (feet)						
	Less than 10	10 or less	Greater than 10	10 to 20	20 + to 30	Greater than 20	Greater than 30
Cantilevered Piers - Formwork (supporting the pier beam) supported on column		7^{Δ} [4]*	10^{Δ} [6]*				
Column Bent Piers - Falsework supporting pier beam**	4^{Δ}			7^{Δ} [4]*		10^{Δ} [6]*	
Forms and Falsework under slabs, beams, girders, arches and brackets***	4^{Δ}			7^{Δ} $[4]^{+}$	10^{Δ} $[6]^{+}$		15^{Δ} $[10]^{+}$
RCB and RFB top slabs not re-shored		7^{Δ} $[4]^{+}$		7^{Δ} $[4]^{+}$		10^{Δ} $[6]^{+}$	

Type of Work	Time (Days)
Walls, Wing Walls and vertical sides of RCB and RFB structures Do not backfill according to **SECTION 204**, until 3 days after forms are removed.	4^{Δ} [3]*
Footing Supported on Piles - minimum cure before erecting forms and reinforcing steel for columns	4^{Δ} [2]*
Spread Footing founded in rock – minimum before erecting forms and reinforcing steel for columns	2^{Δ}
Footing supported on piles - minimum cure before erecting forms and reinforcing steel for columns	4^{Δ} [2]*
Columns for cantilevered piers - 1. minimum before supporting forms and reinforcing steel for the pier beam on the column. 2. minimum before placing concrete for the pier beam	4^{Δ} $[2]^{+}$ 7^{Δ} $[4]^{+}$
Columns for bent piers - 1. minimum before erecting formwork and reinforcing steel for the pier beam 2. minimum before placing concrete for the pier beam	2^{Δ} 4^{Δ} [2]*
Drilled shafts - minimum before erecting forms and reinforcing steel for the columns	2^{Δ}
Floors for RCB and RFB structures on rock or a seal course - minimum before erecting forms and reinforcing steel	2^{Δ}
Floors for RCB and RFB structures on soil or foundation stabilization - minimum before erecting forms and reinforcing steel	4^{Δ} [2]*
Do not remove forms or falsework from post tensioned elements until all applied post tensioning forces are transferred.	NA

* Contractors may reduce the time required before form removal to the number of days shown in brackets, provided the concrete is shown to have attained a minimum strength of 65% of the specified f'_c. To accomplish this, prepare the necessary cylinders, obtain the services of an approved laboratory to break them at the appropriate time and provide a report to the Engineer. Field cure the cylinders alongside and under the same curing conditions, as the concrete they represent.

** Do not set girders or beams on the pier beams until the falsework under the pier beams is removed.

*** Remove the formwork from subdecks or one-course decks within 6 weeks after the deck has been placed.

$^{+}$ Contractors may reduce the time required before form removal to the number of days shown in brackets, provided the concrete is shown to have attained a minimum strength of 75% of the specified f'_c. To accomplish this, prepare the necessary cylinders, obtain the services of an approved laboratory to break them at the appropriate time and provide a report to the Engineer. Field cure the cylinders alongside and under the same curing conditions, as the concrete they represent.

$^{\Delta}$ Increase the time period 3 days when supplemental cementitious materials are used October 1 thru April 30.

Reshoring of RCB and RFB (classified as culverts or bridges) top slab will be permitted if the Contractor uses traveling forms or to reduce the minimum time shown in **TABLE 710-2**. At the Preconstruction Conference, submit calculations, sealed by a Professional Engineer, to the Engineer that show that the concrete tensile stress is below $0.23 \sqrt{f'_c}$ (ksi) and the shoring has sufficient capacity.

In determining the time for the removal of forms, give consideration to the location and character of the structure, weather and other conditions influencing the setting of concrete. If forms are removed before expiration of the cure period, maintain the cure as provided in **DIVISION 700**.

For additional requirements regarding forms and falsework, see **SECTION 708**.

h. Bridge Number Marking. When designated in the Contract Documents, place bridge numbers on bridges by the use of plates recessed in the concrete during construction, using plates constructed as shown in the Contract Documents. The date placed on the plates is the year in which the structure is completed.

710.4 MEASUREMENT AND PAYMENT

The Engineer will measure the various grades of concrete placed in the structure by the cubic yard. No deductions are made for reinforcing steel and pile heads extending into the concrete. When shown as a bid item in the contract, the Engineer will measure for payment bridge deck grooving by the square yard.

Payment for the various grades of "Concrete" and "Bridge Deck Grooving" at the contract unit prices is full compensation for the specified work.

SECTION 711

REINFORCING STEEL

711.1 DESCRIPTION

Place reinforcing steel as detailed in the Contract Documents.

BID ITEMS	**UNITS**
Reinforcing Steel (*) (**)	Pound
Reinforcing Steel (Repair) (*) (**) (Set Price)	Pound

*Grade
**Epoxy-Coated

711.2 MATERIALS

Provide reinforcing steel, epoxy-coated reinforcing steel, epoxy patching material and reinforcing steel splices that comply with **DIVISION 1600**.

711.3 CONSTRUCTION REQUIREMENTS

a. General.

(1) Storage and Protection. Store the reinforcing steel above ground on platforms or skids, and in a manner that will allow the Engineer to inspect the material for condition and verify the quantity. Identify the reinforcing steel with durable tags or markings.

Protect the reinforcing steel from dirt, detrimental scale, oil and other foreign substances. Do not place contaminated reinforcing steel into the work.

(2) Field Bending and Cutting.

i. Epoxy Coated. Do not field bend or cut epoxy coated reinforcing steel without approval of the Engineer.

ii. Non-epoxy Coated. Field bend the reinforcing steel, only as allowed in **DIVISION 1600**. Bend the reinforcing bars cold, using the proper tools. Do not heat reinforcing bars to facilitate bending. Unless shown in the Contract Documents, do not bend reinforcing bars partially embedded in concrete.

(3) Placing, Supporting and Fastening. Place, support and fasten reinforcing steel in the position shown in the Contract Documents according to the recommended industry practices set forth by the Concrete Reinforcing Steel Institute (CRSI), except as noted otherwise in the Contract Documents. See the Manual of Standard Practice published by CRSI (933 North Plum Grove Road, Schaumburg, IL 60173-4758) for recommended industry practices.

The Engineer must inspect and approve the reinforcement placed in any member, before concrete is placed.

Except for inserting tie bars into concrete pavement, and other special applications approved by the Engineer, do not lay or drive reinforcing steel into the concrete after the concrete is placed. Support all horizontal reinforcement with wire bar supports, plastic bar supports or supplementary bars. Use Class 1 Protection wire bar supports for epoxy-coated reinforcement, and Class 1, 2 or 3 Protection wire bar supports for other reinforcement. Do not use stones, concrete or wood to support the reinforcement. Use bar supports of proper height to maintain the clearance between the reinforcing and the formed surface (or top surface of deck slabs) to within a +¼ inch, -0 inch of that indicated in the Contract Documents. If lengths of continuous bar supports are used, lap the end legs so they are locked or tied together. Do not use alternate methods of supporting the reinforcement without the approval from the Engineer.

The Contract Documents show the (maximum) bar support spacing. The Engineer will determine if the Contractor has sufficient supports to hold the reinforcement in position. Use wire ties to secure the reinforcing steel at bar intersections, and to tie the reinforcing to the supports and spacers. Tie reinforcing steel bars at all intersections around the perimeter of each mat of reinforcement. Tie the remainder of each mat of reinforcement at a minimum of 2 foot centers, or at every intersection, whichever is greater. Bend all wire ties in the top mat of reinforcement downward. Do not weld reinforcing steel to the bar supports or other reinforcement, unless shown in the Contract Documents.

Provide support for work platforms on the forms, not on the reinforcing steel.

(4) Reinforcing Bar Trusses. Place, support and secure bar trusses in proper position. Unless the bar trusses are designed and fabricated with outstanding legs that are in contact with the forms, support them on metal supports and spacers. If the weight of the trusses causes the supporting legs of trusses to indent into the forms, use bar supports as auxiliary support for the truss legs.

(5) Mesh Reinforcement for Structures. Provide mesh reinforcement of the size and spacing shown in the Contract Documents. Lap the sheets of mesh as indicated in the Contract Documents. The method of placing the mesh and securing it in proper position must be approved by the Engineer.

(6) Box Culvert Reinforcing. Use Grade 60 reinforcing steel for road culverts and reinforced concrete box bridges, unless otherwise noted in the Contract Documents.

(7) Area Prepared for Patching (Existing Concrete Bridge Decks) or other Structure Repairs. If during the course of patching or repair, deteriorated existing reinforcing steel is encountered, and the Engineer requires it replaced, provide and place new reinforcing steel according to this specification. This will be paid for as Reinforcing Steel (Repair) (Set Price).

b. Epoxy-coated Reinforcement.

(1) Perform all fabrication and jobsite handling of epoxy-coated reinforcing bars, dowel bars and tie bars for pavement according to ASTM D 3963/D 3963M, "Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars". For epoxy-coated steel wire and welded wire fabric, follow ASTM A 884/A 884M, "Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement". Consider the appendix to ASTM A 884/A 884M (that is identified as nonmandatory information) to be mandatory for this specification. Coating applicators and fabricators must comply with all aspects of above referenced documents.

(2) Storage, Handling and Placement at the Jobsite. When handling coated steel reinforcement, avoid bundle-to-bundle or piece-to-piece abrasion. Do not drop or drag epoxy-coated reinforcement.

Protect contact areas on equipment used for handling coated steel reinforcement. Use padded or non-metallic slings and padded straps when unloading.

Off-load coated steel reinforcement as close as possible to its point of placement, or within reach of the crane so that the material can be hoisted to the area of placement with minimum re-handling.

Store coated steel off the ground on protective cribbing, with timbers placed between bundles if stacking is necessary. Space the supports sufficiently close to prevent sags in the bundles.

Store coated and uncoated steel reinforcement separately.

Minimize long term storage. Due to the uncertainty of how long epoxy-coated steel will remain on the job site before incorporation in concrete, cover it with opaque material immediately on delivery, unless it is placed as soon as it arrives. For stacked material, drape the protective cover around the perimeter of the stack. Secure the covering adequately allowing for air circulation around the coated reinforcement to prevent condensation under the covering.

Tie coated reinforcement with tie wire coated with epoxy, plastic, nylon or other non-conductive material that shall not damage or cut the coating.

Use supports coated with, or made of, a dielectric material compatible with concrete.

After placing, minimize walking on coated steel reinforcement. Plan the placement of mobile equipment to avoid damage to the coated steel. If the epoxy-coated reinforcing steel placed in a structure or on the roadway will not be incorporated in concrete within 30 days, cover the epoxy-coated reinforcing steel with opaque material until the concrete is placed.

For all epoxy-coated steel reinforcement, except dowel bars and tie bars for pavement, use vibrators with heads of rubber or other resilient material for concrete consolidation. Do not use bare steel-headed vibrators. Rubber covers, securely fastened over steel heads will be acceptable.

(3) Repair of Damaged Epoxy. If the extent of the damage to the epoxy coating, by any cause, is a maximum of 1% of the surface area in any 1 foot length, remove all rust from damaged areas, and repair according to patching material manufacturer’s instructions.

Reject the damaged material if the extent of the coating damage exceeds 1% of the surface area of the coated steel reinforcement in any 1 foot length.

c. Splicing. If it is necessary to splice reinforcement at points other than those shown in the Contract Documents, before ordering the reinforcing steel, submit drawings showing the location of each splice to the Engineer for approval. Avoid splices at points of maximum stress. Where possible, stagger the splices, and design them to develop the strength of the bar without exceeding the allowable unit bond stress. Lap bars according to the details shown in the Contract Documents. Do not use lapped splices for bar sizes larger than No. 11 bar. Splicing of reinforcing steel by welding is permitted only when shown in the Contract Documents. Where the bar size exceeds No. 11 bar, use welded splices or other positive connections with the approval of the Engineer. Make welds of direct butt splices, according to the American Welding Society publication, AWS D1.4 "Structural Welding Code-Reinforcing Steel". A welder certified by the American Welding Society is required.

d. Mechanical or Thermomechanical Splices. At locations shown in the Contract Documents, splice reinforcing bars, using a mechanical or thermomechanical splicing process, as specified herein using the designated type of splice. Provide splicing devices and systems prequalified as required in **DIVISION 1600**.

(1) Splice Types.

(a) Thermomechanical splices are made using a process whereby molten filler metal is introduced into an annular space around the bars created by a high strength steel sleeve of larger diameter than the bars. The Engineer will require operator prequalification.

(b) For mechanical splices, use any mechanical device or system complying with the physical requirements in **DIVISION 1600**.

(2) Prequalification of Operators. Before commencing production splicing, operator qualification is required for all splicing systems. The individual that will perform the production splicing must prepare the test specimen. If more than one person will perform the splicing, make a separate set of specimens by each individual.

For qualification, the Contractor's operator must make a set of 3 test splices of the predominant bar size and orientation in the project. The Engineer will observe the Contractor's operator make the splices using manufacturer's standard jigs, clamps, ignition devices and other required accessories. Identify each operator by attaching their name to the test splice. Forward the test splices to the MRC (where they will be tension tested to destruction). The MRC will issue reports of the tests to the operator, Contractor and Field Engineer.

If the splice is attached to one of the bars in a fabricator's shop and the other end of the splice is performed in the field, or mechanical couplers are attached to bars for easy assembly in the field and the system is one identified as requiring operator prequalification, the fabricator must prepare test specimens as outlined above and forward them to the MRC for testing before shipping material to the project. In lieu of observation by the Engineer, the fabricator must provide a notarized certification of the operator's identity along with the specimens.

The Engineer will waive the operator prequalification requirement if the operator provides a copy of a satisfactory KDOT test report, dated within 2 years of the current date that was issued in conjunction with the operator's qualification testing for the same splicing system on previous projects, as outlined in **subsection 711.3d.(1)(a)** or **(b)**. Fabricators must provide a certified copy of such operator qualification to the Engineer along with the shipping documents.

(3) Construction Requirements. Prepare the ends of bars for splicing in compliance with the splice manufacturer's recommendations.

The Engineer will visually examine mechanical or thermal splices. Remove and replace all splices having visible defects. Do not encase any splice in concrete until approved by the Engineer.

For those splicing systems requiring operator qualification, make 1 tension test specimen splice to represent each lot of bars spliced in the field. Unless shown otherwise in the Contract Documents, a lot consists of all bars in a days run for all splices. When possible, take test specimens alternatively between the horizontal and vertical positions. Make specimens by the same operator and under the same conditions as the splices they represent.

If the splicing systems require the entire splice be prepared in a fabricator's shop for later assembly in the field, and unless the field assembly requires operator prequalification, each shipment to the project is considered a separate lot. One specimen is taken from each lot.

For those projects requiring daily sampling, deliver the specimens to the MRC (where they will be tension tested to destruction) as soon as possible. The specimens must develop a minimum of 125% of the specified yield strength of the bar.

To expedite testing for projects remote from the MRC, the Contractor may hire a private laboratory approved by the Engineer of Tests to perform the tests and issue reports. All costs of such testing and reports are borne by the Contractor. Provide 1 copy of all reports issued under such an arrangement to the Field Engineer, and forward 1 copy to the Engineer of Tests.

If any single test specimen fails to meet the strength requirements, cut 2 production splices from the lot represented by the specimen and tension test them. If both re-tests meet strength requirements, all splices in the lot are accepted. If 1 or both re-tests fail to meet the requirements, all splices in the lot are rejected. All costs of removal and re-splicing are borne by the Contractor.

Protect any concrete forms which may be close to thermal bar splices from the heat generated by the splicing operation by overlaying the affected surface of the form with fire protection sheeting, or by other means approved by the Engineer.

711.4 MEASUREMENT AND PAYMENT

The Engineer will measure the reinforcing steel by the pound, based on the theoretical number of pounds shown in the Contract Documents or placed as ordered in writing by the Engineer. No allowance is made for the clips, wire or other fastening devices for holding the steel in place. The Engineer will verify the quantities of materials provided and placed based on the calculated weight of the reinforcing steel placed according to these specifications. Additions and deletions from plan quantity will be computed using **TABLE 711-1**.

TABLE 711-1: BAR SIZE WEIGHTS

Bar Size (US Customary)	Bar Size (SI)	Weight (Pounds / Lin.Ft.)
#3 or 3/8"	9 or 10*	0.376
#4	12 or 13	0.668
#5	15 or 16	1.043
#6	19 or 20	1.502
#7	22	2.044
#8	25	2.670
#9	29 or 30	3.400
#10	32	4.303
#11	35 or 36	5.313
#14	43 or 45	7.650
#18	55 or 57	13.600

*Consult with the State Bridge Office, to determine the correct conversion of the 10mm bars.

No allowance is made for the weight of weld metal used in the fabrication of bar trusses. No separate compensation is allowed for the cost of making and providing splices and test splices.

The Engineer will measure Reinforcing Steel (Repair) (Set Price) by the pound. The Engineer will not measure reinforcing steel damaged or broken through Contractor’s negligence. The Engineer will not measure material in approved splices made for the Contractor’s convenience.

Payment for "Reinforcing Steel" at the contract unit price and "Reinforcing Steel (Repair) (Set Price)" at the contract set unit price is full compensation for the specified work.

SECTION 712

STRUCTURAL STEEL CONSTRUCTION

712.1 DESCRIPTION

Fabricate and erect the structural steel as designated in the Contract Documents. See **SECTION 705** for fabrication of structural steel. Provide and place the castings designated in the Contract Documents.

BID ITEMS	UNITS
Structural Steel (*)(**)(***)	Pound
Structural Steel (Merchant Quality)	Pound
Welded Stud Shear Connectors	Each

*Type
**Grade
***Use

712.2 MATERIALS

Provide materials that comply with the applicable requirements.

Structural Steel Fabrication and Painting	**DIVISION 700**
Cast Steel	**DIVISION 1600**
Structural Steel	**DIVISION 1600**
Steel Fasteners	**DIVISION 1600**
Welded Stud Shear Connectors	**DIVISION 1600**
Bearings or Pads	**DIVISION 1700**

712.3 CONSTRUCTION REQUIREMENTS

a. Erecting Structural Steel.

(1) General. Erect the fabricated structure as detailed in the Contract Documents. Provide all falsework, tools, machinery and appliances, including drift pins and erection bolts required to complete the work. After the structure is erected, remove all falsework, appliances and other obstructions or debris resulting from erection.

Provide the Engineer with safe means (such as scaffolding, safety lines, snoopers or hoist buckets) to inspect any portion of the structure during the erection operations.

(2) Handling Structural Steel. Use protective devices or softeners to safeguard plate edges, when loading, transporting, unloading, storing and erecting structural steel. Store the structural steel above ground on platforms, skids or other supports. Keep the structural steel properly drained, clean and free of dirt, grease and other foreign matter. Protect the structural steel from corrosion. Store girders and beams upright with sufficient support to prevent warping or change in design camber.

(3) Erection Plans. Provide the Engineer with detailed plans for the erection of the structure, including calculations, shop details, camber diagrams, list of field bolts and a copy of shipping statements showing a list of parts and their weights. Provide erection plans, sealed by a licensed Professional Engineer, for span lengths greater than 125 feet.

(4) Falsework. Comply with **DIVISION 700**.

(5) Bearings and Anchorage. Do not place masonry bearing plates upon bridge seat bearing areas which are improperly finished, deformed or irregular and not until the elevations have been verified. Set bearing plates level in exact position and have a full and even bearing upon the masonry. Unless otherwise shown in the Contract Documents, place bearing plates on mats or pads.

Set the anchor bolts according to **SECTION 842-DRILLING AND GROUTING** and preferably, if construction conditions permit, by first setting the bearing devices and superstructure and then drilling the holes or using preformed holes for the anchor bolts. When drilling anchor bolts use a pacometer to avoid drilling in the existing reinforcing steel. When required, cast anchor bolts in place according to the Contract Documents. Vary the location of the anchor bolts in relation to the slotted holes in the expansion shoes with the prevailing temperature.

Adjust the nuts on anchor bolts at the expansion ends of spans to permit the free movement of the span, and either provide lock nuts or burr the threads of the anchor bolts.

(6) Straightening Bent Material. Do not put bent or twisted members in place until all defects are corrected. The Engineer, (based on recommendations from the State Bridge Office) will reject damaged members. Straighten plates or other shapes by approved methods that will not produce fracture or other injury to the metal (i.e. yield strength, ductility, toughness). Do not heat the metal without approval of the Engineer. Submit the heat straightening procedure to the Engineer for approval. When permitted, perform the heat straightening procedure complying with AASHTO/AWS D1.5 (edition referenced in **subsection 705.2e.**) "Bridge Welding Code" and the latest versions of AASHTO's "Standard Specifications for Highway Bridges"; AASHTO's "LRFD Bridge Construction Specifications"; and the FHWA report, "Heat-Straightening Repairs of Damaged Steel Bridges". Following the straightening of a bend or buckle, the surface of the metal will be inspected by the Engineer for evidence of fracture, using the dye penetrant or magnetic particle inspection method.

(7) Assembling the Structural Steel. Use drift pins for all main member fit-up. Main members are defined as all girders and beams, cross-frames on curved girders or as specified in the Contract Documents. Assemble the parts as shown in the Contract Documents and erection diagrams, utilizing the matchmarks. Before the members are assembled, clean bearing surfaces and surfaces to be in permanent contact. Carefully handle the material so that no parts are bent, broken or otherwise damaged. Hammering that will injure or distort the members is prohibited. Misfitting may require revision of erection details and shop drawings by the Contractor with approval of the Engineer.

(8) Erecting Weathering Steel. Erect the fabricated weathering steel according to this subsection, with these additions:

Unless shown otherwise in the Contract Documents, protect the exposed surfaces of the substructure concrete from staining caused by the weathering steel. Cover the surface of piers and front faces of the abutments with polyethylene sheeting or other material approved by the Engineer before erecting the weathering steel. Maintain the protection until the bridge deck is completed.

After the bridge is completed, but before acceptance, sandblast the piers and front face of the abutment to a uniform appearance by removing all laitance, staining, any visible form lines, etc.

b. Bolted Field Connections.

(1) General. During field erection, follow the blocking diagram shown in the shop drawings. When designated, a “no-load” condition for blocking or laydown indicates the pieces were drilled/punched from solid plates laid on their sides without the deadload deflection included. Reproduce this geometry during erection by the use of falsework or cranes to “float” adjacent pieces together to facilitate proper fit-up.

Drift Pins: Use drift pins (cylindrical body pins with tapered ends) to facilitate driving and to line up the open holes in a connection. Use hardened steel drift pins with a minimum yield strength of 50 ksi and with the same nominal diameter as that of the open hole into which they are driven. Drive drift pins only to line up the holes. Do not deform the material.

Erection Bolts: Use A325 bolts the same size as the permanent bolts. Uniquely identify the erection bolts from the permanent bolts. Once erection bolts are no longer required, remove and replace with permanent bolts. Erection bolts may only be reused as such.

Fitting-Up: Accurately align all connections by driving drift pins in all corners and ¼ of the remaining holes in each plate in a well distributed pattern to align or “fair-up” the holes. Light drifting is permitted to affect this fairing-up of the holes. Heavy drifting which would deform the material is prohibited. Before removing any drift pins from structures being connected, or moving the connected members, fully tighten the bolts in a minimum of ¼ of the holes in the splices and field connections. For structures carrying workers and equipment, fully tighten the bolts in ¾ of the holes. Use high-strength erection bolts in combination with drift pins to hold the material together during fit-up.

Use pilot and driving nuts in driving pins (pin connections). Drive the pins so that the members take full bearing on them. Screw pin nuts up tight and burr the threads at the face of the nut with a pointed tool.

Immediately report to the Engineer any error in shop work that prevents the proper assembling and fitting up of parts. Reaming, chipping or cutting is prohibited without approval from the Engineer. Submit correction method for approval by the Engineer. Make the approved correction in the presence of the Engineer.

(2) Field Bolting with non-high-strength bolts. If non-high-strength bolts are specified for miscellaneous connections, use unfinished or machined bolts in bolted connections. Provide unfinished or machined bolts that have hexagonal heads and nuts and are of such length that they shall extend entirely through the nut a maximum of ¼ inch beyond the nut.

The diameter of the unfinished bolt may not be more than $^1/_{16}$ inch smaller than the diameter of the hole.

The threads of machined bolts must be entirely outside the grip. The grip is the area from the finished head of the bolt to the finished nut. Use approved nut locks or flat washers ¼ inch thick under nuts, with the threads burred. Ream the holes for machined bolts. The hole diameters may not be more than $^1/_{32}$ inch greater than the diameter of the finished bolt. In bolted connections, draw the bolts up tight and burr the threads at the face of the nut with a pointed tool.

(3) Field Bolting with High-Strength Steel Bolts and Washers. No reaming, cutting and chipping is allowed for girder flange and web splices.

The slope of surfaces of bolted parts in contact with the bolt head and nut is a maximum of 1:20 with respect to a plane normal to the bolt axis. Do not separate bolted steel parts by gaskets. Steel parts must fit solidly together after the bolts are tightened. Standard holes have a diameter nominally $^1/_{16}$ inch in excess of the nominal bolt diameter. Use a hardened washer under the turned elements (head or nut) for all installations.

Where shown on approved shop drawings, oversized, short-slotted and long-slotted holes may be used with high strength bolts ⅝ inch in diameter and larger in connections assembled as shown in **TABLE 712-1**.

TABLE 712-1: OVERSIZED HOLES	
Bolt diameter, d (inch)	**Excess of nominal bolt diameter (inch)**
d ≤ ⅞	$^3/_{16}$
d = 1	¼
d ≥ 1 ⅛	$^5/_{16}$

Oversized holes may be used in only one of the connected parts of either a friction or bearing connection at an individual faying surface. Install hardened washers (of a sufficient size to completely cover the hole, after installation) over the oversized holes in an outer ply.*

Short-slotted holes shall be nominally equal to a standard hole width, and have a length that does not exceed the oversize diameter provisions for oversize holes by more than $^1/_{16}$ inch. Short-slotted holes may be used in only one of the connected parts of either a friction or bearing connection at an individual faying surface. The slots may be used without regard to direction of loading in friction connections, but must be normal to the direction of the load in bearing connections. Install hardened washers over short-slotted holes in the outer plies that have a size sufficient to completely cover the slots after installation.*

Long-slotted holes shall be nominally equal to a standard hole width and have a length more than allowed for short-slotted holes, but not more than 2 ½ times the nominal bolt diameter. Long-slotted holes may be used in only one of the connected parts of either a friction or bearing connection at an individual faying surface. The slots may be used without regard to direction of loading in friction connections, but must be normal to the direction of the load in bearing connections. Where long-slotted holes are used on an outer ply, provide a plate washer or continuous bar a minimum of $^5/_{16}$ inch thickness with standard holes. This washer or bar shall be of structural grade material, but need not be hardened. Provide washers or bars that have a size sufficient to completely cover the slots after installation. If hardened washers are required by the Contract Documents, place the hardened washers over the outer surface of the plate washer or bar.*

*When ASTM A490 bolts over 1 inch in diameter are used in slotted or oversized holes in external plies, use a single hardened washer complying with ASTM F436, except with $^5/_{16}$ inch minimum thickness, in lieu of the standard washer.

When assembled, all joint surfaces, including those adjacent to the bolt heads, nuts or washers, shall be free of scale, burrs, dirt and other foreign material that would prevent solid seating of the parts. Tight mill scale may be accepted.

(4) Bolting Operation. See **FIGURE 712-1.** The Bolting Operation shall require Calibration, Installation and Inspection Verification.

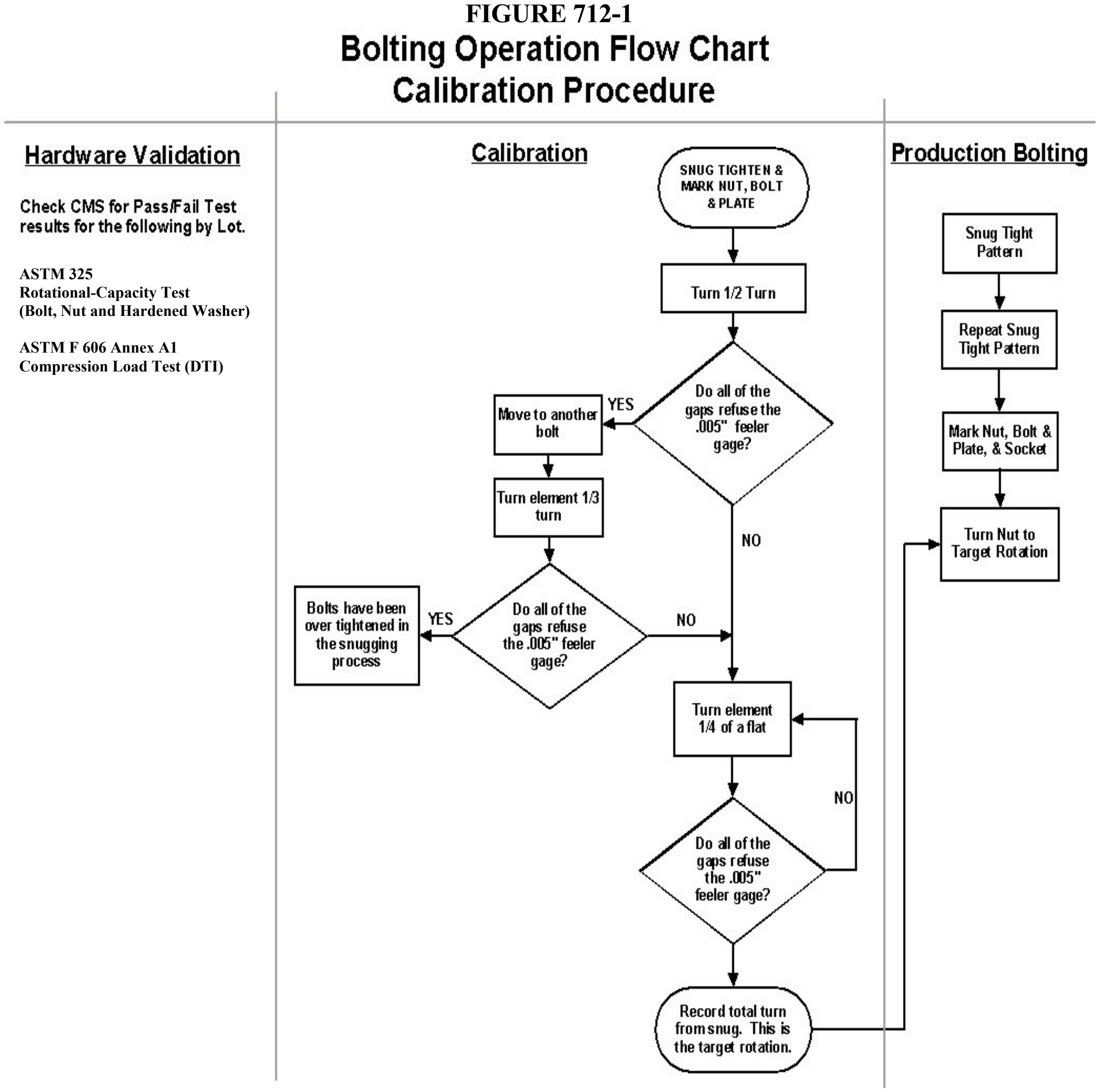
Provide the Engineer applicable test results and certifications for bolt and DTI lots being used on the project: Rotational-Capacity Test (Bolt, Nut and Hardened Washer) & ASTM F 606 Annex A1 Compression Load Test (DTI).

Calibration. Calibration (**FIGURE 712-1**) is the process of determining the correct tightening procedures so that consistency and accuracy are obtained. This procedure is only applicable to calibrating the turn of fasteners using DTI's. This is only used on girder splices and diaphragm connections or as noted in the Contract Documents.

The calibration procedure is as follows:

- Using plies with equivalent grip of the connection and correct bolt hole diameter, snug-tighten the fasteners such that all plates are in uniform contact;
- Place appropriate marks on the bolt, nut and plate so that the amount of nut rotation relative to the bolt can be verified;
- Hold the static element and rotate the turned element one half a turn. Record the number of gaps that refuse the 0.005 inch gage;
- If this rotation causes all of the gaps to refuse the feeler gage, move to another bolt and rotate the turned element ⅓ of a turn and record the number of gaps that refuse the feeler gage;
- Continue rotating the turned element until all the gaps refuse the 0.005 inch gage. Record the rotation. This is the target rotation for the bolting operation for this bolt length and diameter;
- Repeat this procedure for every bolt length and diameter on the project.

FIGURE 712-1



Installation. To achieve uniform results, install bolts after performing calibration tightening procedures.

Tighten threaded bolts by methods described below. If required because of bolt entering and wrench operation clearances, tightening may be accomplished by turning the bolt while the nut is prevented from rotating.

Use impact wrenches of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately 10 seconds.

Indicate in the shop drawings where washers are required. Only use hardened washers. Use an additional hardened washer with all ASTM A 490 bolts under the element not turned, if the material against which it bears has a specified minimum yield point less than 40 ksi.

Where an outer face of the bolt part has a slope greater than 1:20 with respect to a plane normal to the bolt axis, use a beveled washer to compensate for the slope.

Use the turn-of-nut method to provide the required bolt tension for all bolted connections. Install bolts in a minimum of ¼ of the connection holes and bring them to a "snug tight" condition. Snug tight is defined as the condition that exists when the plies of the splice are in firm uniform contact. A few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench should attain this condition. Perform snug tightening systematically from the center of the splice to the free edges, and then re-tighten the bolts in a similar systematic manner until all bolts are snug tight and all splice plates are fully compacted. The connection is then ready for final tightening. For proper installation bring all bolts to “snug tight” in the same manner as in the calibration.

Only use a Direct Tension Indicator (DTI) for girder splices and diaphragm connections, or as noted in the Contract Documents.

Install the DTI’s by one of the following methods:

- Place a DTI under the bolt head and turn nut to tighten. This method is preferred whenever possible. Face the protrusions on the DTI to the underside of the bolt head. Place a hardened flat washer under the nut;
- Place a DTI under the nut and turn the nut to tighten. Place a hardened washer between the nut and the DTI. Place the DTI against the plates with the protrusions facing the washer;
- Place a DTI under the nut and turn the bolt. Face the protrusion on the DTI to the nut. Place a hardened flat washer under the bolt head; or
- Place a DTI under the bolt head and turn the bolt head to tighten. This method is suggested when the nut can not be turned. Place hardened flat washer between bolt head and the DTI. Face the protrusions on the DTI to the underside of the flat washer and bolt head. Place a hardened flat washer under the nut.

On connections specifying the use of DTI’s, use the turn-of-nut method and tighten all bolts in the connection as determined from the "Target Rotation" in **FIGURE 712-1**. During the tightening operation, there must be no rotation of the part not turned by the wrench. Perform tightening systematically from the most rigid part of the joint to its free edges. Place appropriate marks on the bolt, nut and plate so that the amount of nut rotation relative to the bolt can be verified. Use the turn specified in **TABLE 712-2** for all connections other than girder splices and diaphragm connections.

TABLE 712-2 - NUT ROTATION (*) FROM SNUG TIGHT CONDITION

Bolt Length (as measured from underside of head to extreme end of point)	Disposition of Outer Faces of Bolted Parts		
	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20 (bevel washer not used)	Both faces sloped not more than 1:20 from normal bolt axis (bevel washer not used)
Up to and including 4 diameters	1/2 turn	1/2 turn	2/3 turn
Over 4 diameters, but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters, but not exceeding 12 diameters	2/3 turn	5/6 turn	1 turn
Over 12 diameters	The method of tightening bolts over 12 diameters in length is as shown on the shop details and approved by the Engineer		

*Nut rotation is relative to the bolt, regardless of the element (nut or bolt) being turned. For bolts installed by ½ turn and less, the tolerance is ± 30°; for bolts installed by ⅔ turn and more, the tolerance is ± 45°.

Lubricate all galvanized nuts with a lubricant containing a visible dye so a visual check can be made for the lubricant at the time of field installation. Black bolts must be "oily" to the touch when installed. Clean and re-lubricate weathered or rusted bolts before installation. Store bolts in closed containers, at all times when not in use.

Do not reuse ASTM A 490 and A 325 bolts, or any bolt that has been fully tightened.

Inspection Verification. Inspection verification confirms end results of the bolting operation; the inspection provides acceptance or rejection of the finished connection. See **FIGURE 712-2**.

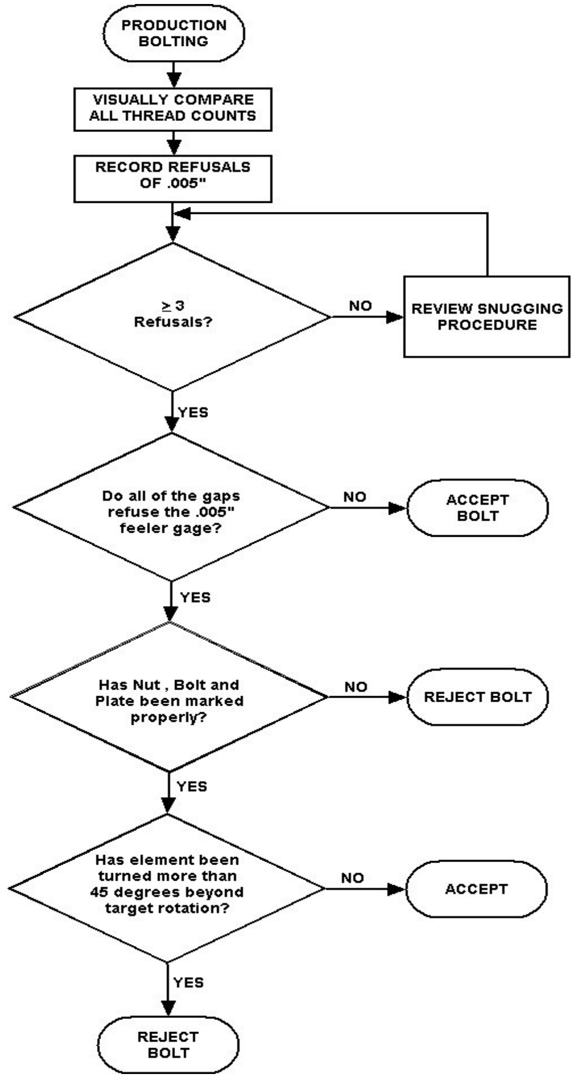
Commencing with each day's bolting operation, the Engineer will inspect each bolt until the Contractor's procedures for that day are confirmed. After the day's procedures are confirmed, a minimum of 20% of all the bolts in all splices will be checked with a feeler gauge. This check should be randomly distributed over all the plates within the splice.

Visually compare the number of threads extending past the face of the nut for uniform appearance. Record the number of refusals using the 0.005 inch gage. (Note: some DTI suppliers provide both 0.005 inch and 0.015 inch gages. Use only the 0.005 inch gage). If the number of refusals is less than 3, tighten until there are a minimum of 3 refusals. If this occurred with the proper rotation, all the plies were not in proper snug-tight condition. If the number of refusals with the 0.005 inch gage is greater than or equal to 3, but less than the number of protrusions, accept the bolt. If all the gaps refuse the 0.005 inch gage, the actual rotation must be compared with the target rotation:

- If the element has been turned more than 45° beyond the target rotation, reject the bolt.
- If the element has been turned less than 45° beyond the target rotation, accept the bolt.

If the feeler gage is refused by all gaps and the bolt, nut and plate have not been marked, the bolt will be rejected.

FIGURE 712-2 – Direct Tension Indicator Verification



Bolt Size	DTI Spaces		Minimum Installation Refusals	
	A 325	A 490	A 325	A 490
5/8	4	5	2	3
3/4	5	6	3	3
7/8	5	6	3	3
1	6	7	3	4
1-1/8	6	7	3	4
1-1/4	7	8	4	4
1-3/8	7	8	4	4

c. Welded Field Connections. Perform field welding and gas cutting of structural steel according to the applicable requirements of **SECTION 705**. The company/individual performing non-destructive testing of field welds shall be separate and independent of the company/individual that performed the field welding. The company/individual performing non-destructive testing of field welds shall be separate and independent of the company/individual that performed the field welding.

Fill erection holes in the girder webs with button head or hex head bolts equipped with regular hex nuts. Use only one type of bolt head. Place the heads of the bolts on the outside faces of the webs.

Erection bolts or other methods approved by the Engineer may be used for closing erection holes in other parts of the structure.

All permanent field welded connections of structural steel, except splices in steel piles, shall be made by welders who have qualified in accordance with the requirements of **SECTION 713**.

d. Welded Stud Shear Connectors. Welded Stud Shear Connectors may be applied during shop fabrication or in the field. If field applied, refer to **subsection 705.2d.(12)**.

e. Field Painting. Prepare the structural steel surfaces and field paint the prepared surfaces according to **DIVISION 700**.

712.4 MEASUREMENT AND PAYMENT

The Engineer will measure structural steel by the pound. The measured quantity for payment of structural steel is the quantity shown in the Contract Documents. If the Contract Documents are altered for changes in design, or if disagreement exists between the Contractor and the Engineer as to the accuracy of the quantities in the Contract Documents, either party has the right to request and cause the quantities involved to be measured. Use **TABLE 712-3** to compute the weights.

TABLE 712-3: CONVERSION UNIT WEIGHTS

Type	Unit Weight (Lb. per Cu. In.)
Structural Steel	0.2833
Bronze	0.315
Cast Iron	0.26

The Engineer will not measure fasteners including erection bolts, button head bolts used for filling erection bolt holes, high-strength bolts for permanent connections, temporary laterals or similar items. The Engineer will not measure weld metal deposited in fillets, or otherwise outside the lines and surfaces of the connected parts; but no deductions are made from the computed quantities of such work to allow for material that is removed by beveling or other cutting, and subsequently replaced with weld metal.

The Engineer will measure each welded stud shear connector either applied during fabrication or in the field.

Payment for "Structural Steel", "Structural Steel (Merchant Quality)" and "Welded Stud Shear Connectors" at the contract unit prices is full compensation for the specified work.

The Engineer will pay for structural steel according to **TABLE 712-4**.

TABLE 712-4: PAYMENT FOR STRUCTURAL STEEL

% Payment of the Contract Quantity	Milestone
90	All structural steel is completely fabricated, in place, inspected and ready to weld or bolt according to the Contract Documents.
95	All structural steel is welded or bolted according to the Contract Documents.*
100	All structural steel is painted according to the Contract Documents, when in the contract.

*If painting of structural steel is not required, pay 100%.

SECTION 713

QUALIFICATION OF FIELD WELDERS

713.1 DESCRIPTION

To field weld structural steel on KDOT projects, become qualified for each welding process by passing tests witnessed by the Regional Materials Engineer or a designated representative, according to this specification and the latest version AASHTO/AWS D1.5 "Bridge Welding Code" (except as modified by this section). Perform testing using portable equipment at an outdoor location selected by the Regional Materials Engineer.

713.2 TEST SPECIMENS

Supply test plates and backing bars. Present mill test reports for each heat used in the test plates and backing bars before the test begins.

a. Base Metal for Test Specimens. Qualification established with any of the steels listed shall be considered as qualification to weld or tack weld any of the other steels listed except qualification to weld or tack weld steel with a minimum yield strength of 90 ksi or greater shall be established with steel meeting the same specification as steel for the project. Use the following base metals for tests: AASHTO M 270 or ASTM A 709. Other steels may be approved by the Regional Materials Engineer.

b. Shielded Metal Arc Welding (SMAW) Restrictions. A welder qualified for SMAW using EXX18 electrodes shall be qualified to weld with all SMAW electrodes allowed by AASHTO/AWS D1.5 except welders required to use an electrode classification of E100XX-X or higher to join metals with a minimum specified yield strength of 90 ksi or greater shall be tested using E10018-X or E11018-X electrodes as necessary to match the yield strength of the base metal to be used in the work.

713.3 PREPARATION OF SPECIMENS

Use test plates as shown in AASHTO/AWS D1.5, Figure 5.17 and free from rust, grease, paint and dirt. Test in the vertical and in the overhead positions.

Securely tack or clamp the plates in position. Then, weld and prepare as follows:

- The weld reinforcing shall be sufficient to obtain full cross-sectional area and in no case shall it be greater than ⅛ inch;
- Deposit all vertical welds from the bottom to the top;
- Use hand chipping and hand brushing to clean between weld passes. Power chippers or grinders are prohibited during the test. Do not modify root or intermediate weld contours by chipping, grinding, cutting, or other means before depositing subsequent weld passes. Perform weld cleaning without moving the test plates out of position during the test;
- Cut out the side bend specimens (see D1.5, Figure 5.17) with a saw. Smoothly cut the edges of the specimens with a grinding wheel or file. If the welder elects to have the test weld radiographically examined, do not make saw cuts; and
- Unless radiography is used, carefully remove the weld reinforcement and backing by grinding or machining so that the weld shall be flush with the parent metal. Perform all grinding or machine marks perpendicular to the weld. Emery cloth or a file finish is recommended. When radiography is used, leave a 3 inch minimum width backing bar in place.

713.4 TESTING OF SPECIMENS

a. General. All testing shall be by or in the presence of the Regional Materials Engineer or a designated representative.

With the exception of fracture critical welder testing, testing may be by mechanical means or by radiography at the welder's option. All radiography will be at the welder's expense. If all specimens meet the test requirements, the welder will be qualified and an identification card will be issued. A card will be issued yearly unless either **subsection 713.5a.** applies, or the welder fails to meet the reporting requirements of **subsection 713.6**.

b. Test Procedure for Mechanical Testing. Each test specimen shall be subjected to a side bend test by bending around a 1 ½ inch diameter pin in a test jig. A specimen whose surface contains undercut or discontinuities exceeding the following dimensions will be considered to have failed the test.

- ⅛ inch measured in any direction on the surface.
- ⅜ inch for the sum of the greatest dimensions of all discontinuities exceeding 1/32 inch, but less than or equal to ⅛ inch.
- ¼ inch for the maximum corner crack, except:
  - When that corner crack results from a visible slag inclusion or other fusion type discontinuity, the ⅛ inch maximum shall apply.
  - Specimens with corner cracks exceeding ¼ inch with no evidence of slag inclusions or other fusion type discontinuities shall be disregarded, and a replacement test specimen from the original welding shall be tested.

c. Procedures for Radiographic Qualification. Ground the weld reinforcement flush with the surface of the test plate. Follow radiographic procedures and techniques that are in compliance with the latest edition of AASHTO/AWS D1.5.

d. Retesting. If any specimen fails to pass the above test requirements, the test may be repeated. The welder shall prepare 2 sets of specimens for retest for each position that failed. If both sets of specimens meet the requirements, the welder will be qualified. If either of the sets of specimens submitted for retest fails to meet the requirements, the welder will not be permitted to take qualification tests for a minimum of 6 months unless evidence of further training is provided.

713.5 REQUALIFICATION

a. General. With the exception of fracture critical field welding, the welder's qualification here-in specified shall be considered as remaining in effect indefinitely unless:

(1) The welder has not welded steel for use on a KDOT project for a period of 1 year.

(2) The welder has not welded for a period exceeding 6 months in a given process of welding for which the welder was qualified. The requalification test need be made only in the ⅜ inch thickness.

(3) The welder has been suspended while welding on a KDOT project due to one of the following:

- Poor workmanship.
- Unsatisfactory appearance of the weld.
- Undercutting.
- Slugging.
- Using electrodes that have not been properly dried or stored.
- Poor cable connection.
- Excessive inclusions determined by radiographic inspection.

b. Test Required for Re-Qualification. When the quality of welder's work becomes unsatisfactory, as defined above, the welder will be suspended and will remain suspended until permitted to re-qualify by the Regional Materials Engineer.

Prepare and test all specimens required for re-qualification tests in the presence of the Regional Materials Engineer or a designated representative.

713.6 EVIDENCE OF WELDING ON KDOT PROJECTS

Regional Materials Engineers will maintain a record on each field welder who is qualified by their office to weld on KDOT projects. Annually submit to the qualifying Regional Materials Engineer a list of KDOT project numbers on which field welding was performed during the past 12 months.

713.7 QUALIFICATION FOR FILLET WELDING ONLY

Some KDOT projects require only fillet welds to attach stiffeners or bearings in the field. In this case, and with the approval of the Regional Materials Engineer, qualification for fillet welding will be done on a job by job basis by testing in the vertical and overhead fillet weld positions according to AASHTO/AWS D1.5 Section 5.26.3.1. See D1.5, Figure 5.21 for the test. No welder's card will be issued to fillet welders. The approval by the Regional Materials Engineer to accept this type of qualification will be based on the structure type, location of work within structure, and the overall complexity of work.

713.8 QUALIFICATION FOR FRACTURE CRITICAL WELDING

Perform fracture critical welder qualification according to AASHTO/AWS D1.5, Section 12.

713.9 REGIONAL MATERIAL'S LABS

Kansas City Regional Materials Lab
P.O. Box 860462
Shawnee Mission, KS 66286-0462
Phone: 913-441-0346

Wichita Regional Materials Lab:
3200 E. 45^{th} St. N.
Wichita, KS 67220
Phone: 316-744-0421

SECTION 714

PAINTING STRUCTURAL STEEL

714.1 DESCRIPTION

Prepare the structural steel surfaces, and paint the structural steel as shown in the Contract Documents. Provide environmental protection as necessary.

BID ITEMS	UNITS
Bridge Painting (*)	Lump Sum
Environmental Protection	Lump Sum
Power Wash	Lump Sum

*Type of Paint System

714.2 MATERIALS

Provide paint materials that comply with **DIVISION 1800**.

Formulate the inorganic zinc or organic zinc coating to provide a tint which distinctly contrasts with blast cleaned metal surfaces and the finish coat.

714.3 CONSTRUCTION REQUIREMENTS

a. General Requirements for Painting Structural Steel.

(1) Surface Preparation Before Applying The Prime Coat. Blast all surfaces with abrasives to produce a height of profile of 1 to 3 mils.

Clean structural steel surfaces to meet the Society for Protective Coatings' (SSPC) specification SSPC-SP10, Near-White Blast Cleaning. Limit staining to a maximum of 5% of each square inch of surface area.

If specified (such as for unpainted surfaces of weathering steel or when repainting existing bridges in kind), clean structural steel surfaces to meet SSPC-SP6, Commercial Blast Cleaning, except wet blasting will not be permitted. Staining is limited to a maximum of 33% of each square inch of surface area. If the original surface is pitted, slight residues of rust and paint may be left in the bottom of pits.

Staining may consist of slight shadows, slight streaks or minor discoloration caused by stains of rust, stains of mill scale or stains of previously applied paint. When viewed without magnification, the blast cleaned surface shall be free of visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter.

Remove all machine cutting oil by cleaning machined surfaces (ANSI 125 micro-inch or smoother). Carefully mask the machined surfaces before blast cleaning the remaining surfaces of the member.

After blast cleaning, remove any trace of blast products. Take care to remove abrasives from pockets and corners.

Give the blast cleaned surfaces a prime coat of paint within 12 hours of cleaning. Re-clean the blast cleaned surfaces if rust tinge appears before the prime coat is applied.

(2) Weather Conditions. Check the air temperature, the steel temperature and the dew point before painting begins each day, and after each suspension of painting due to weather or temperature, if painting is to resume. Do not apply paint if the ambient air temperature is below 40°F, when the air is misty, when the steel temperature is 5º or less above the dew point, or if the Engineer determines conditions are unsatisfactory for painting. Do not apply paint on damp or frosted surfaces. Stop paint application if the Engineer determines the air temperature is so high that the spray dries before reaching the surface, resulting in a dry, powdery coating.

(3) Mixing and Thinning Paint. Thoroughly mix the paint and keep the pigment in suspension. Strain the mixed paint when recommended by the manufacturer.

If multi-component inorganic zinc primer is used, follow the manufacturer's instructions regarding the amount and manner of adding the zinc dust to the liquid portion. Strain the mixed paint through a metal screen having a mesh recommended by the manufacturer. Mix multi-component inorganic zinc paint fresh each day and do not use it past the pot life time stated in the manufacturer's literature.

The Engineer will permit paint thinning if required for proper application, but only as recommended by the manufacturer. If thinner is used, add it to the paint during the mixing process. Do not add additional thinner after the paint is thinned to the proper consistency.

Use thinner recommended by the manufacturer for inorganic zinc paints. Inorganic zinc paint should not require heating in cool weather, but is permitted provided care is taken that the paint is protected from all moisture.

(4) Application of Paint. Apply the paint according to the manufacturer's instructions. Provide the Field Engineer with a printed copy of the paint manufacturer's application instructions.

Apply the paint using either a conventional or an airless sprayer. Spray from a continuously agitated pot.

Apply uniform coatings in tight contact with the metal. Work the coating into all corners and crevices. Apply a coating that is free of all defects.

Allow ample time for each paint coating to dry. Do not apply the next coat of paint until the previous coat is inspected by the Engineer and found dry and hard throughout the entire film thickness.

Remove and replace defective or unauthorized paint. Prepare the surfaces for repainting and repaint the areas according to the requirements for painting structural steel.

When the finish coat is complete, stencil (in black paint) the date the bridge was painted and the code representing the type of paint system used on the bridge. Stencil the legend on the right side of the outside face of the far right stringer near each end of the bridge. Use capital letters, 2 to 3 inches in height. The date stencil shall contain the word "PAINTED" and show the month and the year that the painting was completed. Make the paint system code selection from the following list:

Inorganic Zinc/Acrylic	IZ/A
Inorganic Zinc/Polyurethane	IZ/P
Organic Zinc/Acrylic	OZ/A
Organic Zinc/Polyurethane	OZ/P

(5) Staging and Scaffolding. Use adequate staging and scaffolding while painting the structural steel. Do not climb or work on the finished painted members. Provide the Engineer with safe means (such as scaffolding, snoopers or cherry pickers) to inspect any portion of the structure during the cleaning and painting operations.

(6) Protection of Pedestrians and Property. When painting on the project site, protect all pedestrians, vehicles (on or underneath the bridge), adjoining property along the right-of-way, pipes or ducts owned by utility companies, and portions of the bridge superstructure and substructure against damage or disfigurement from paint material. The Contractor is responsible for repairing any damage resulting from the painting operations.

(7) Maintaining Traffic on Existing Bridges. Provide traffic control as shown in Contract Documents and **SECTION 805**. Unless traffic is detoured, maintain traffic on the existing bridge at all times during the work of cleaning and painting. At the option of the Contractor when work is being performed, ½ of the roadway on that span may be closed to traffic, with one way traffic being maintained over the other half of the roadway. At all other times when work is not being performed, keep the entire bridge roadway open to traffic.

b. Shop Painting Structural Steel (Non-Weathering). The application of the prime coat in the shop must comply with the general requirements for painting structural steel, with these additions and exceptions:

Unless shown otherwise in the Contract Documents, apply 1 coat of inorganic zinc primer to the structural steel in the shop. Mask machined surfaces prior to painting. Use primer that is tinted to contrasts (in color) with the blast-cleaned steel and with the finish coat of paint.

Apply 2 primer coats (not less than 6 mils total thickness) to surfaces that are not in contact with the concrete, but that will be inaccessible after assembly or erection. Apply the second coat between 4 and 24 hours after application of the first coat. Prime the welded stud shear connectors (including the underside of the stud head). Given the complexity, areas of thin primer and some shadows are permissible on the top 1 inch.

Except where otherwise indicated, coat all blast cleaned surfaces of the structural steel, including contact surfaces of high strength bolted connections and areas in contact with concrete. The dry film thickness of the prime coat shall be 3 to 6 mils on flat areas. More thickness is allowed in fillet areas if there is no evidence of mud cracking, and if the coating is tight. The dry film thickness is measured from the peaks of the blast profile to the surface of the paint.

For contact surfaces of high strength bolted connections, the dry film thickness shall be 1.5 to 3 mils. Both sides of steel plates that have holes for high strength fasteners are considered contact surfaces because they come into contact with other steel plates, nuts, washers or fastener heads.

Apply 1.5 mils dry film thickness prime coat to top flanges of structural steel members that will have welded stud shear connectors applied in the field. Do not apply the prime coat to surfaces within 6 inches of field welded connections. Coat unpainted surfaces near field welded connections with a rust preventive coating approved by the Engineer. The temporary coating must be easily removed with mineral spirits prior to field welding.

After the non-machined surfaces of structural steel are prime coated, remove the masking from the machined surfaces and apply a prequalified coating for use on machined surfaces approximately 3 mils thick.

If the dry film thickness of the prime coat is 2 to 3 mils, and less than 24 hours old, either blast clean the deficient area to bare metal and repaint, or apply additional primer. If additional inorganic zinc primer is applied, thin the primer 1:1 with a solvent recommended by the manufacturer of the paint.

If the dry film thickness of the prime coat is 2 to 3 mils thick and more than 24 hours old, or if the dry film thickness is less than 2 mils, blast clean the deficient area to bare metal and repaint. Remove excessive film thickness or dry spray.

Give the inorganic zinc prime coat a thorough single spray of clean water between 2 and 48 hours after application of the inorganic zinc prime coat, when recommended by the manufacturer.

Before the structural steel is shipped to the project site, blast clean to bare metal and repaint defective or damaged areas. Overlap the new prime coat onto the existing prime coat a minimum of 1 inch.

Shop painted structural items, except matchmarked girders and beams, that will receive a field coat of paint must have an identification mark painted on their surface, or they may be tagged with a weatherproof tag.

c. Field Painting New Structural Steel (Non-Weathering).

(1) Prime Coat. Apply a prime coat to the field connections, field welds, nuts, bolts and washers. Re-coat all damaged or defective areas of the shop-applied prime coat. Apply the prime coat in the field complying with the general requirements painting structural steel, with these additions and exceptions:

Overlap the shop coat by applying the field-applied prime coat a minimum of 1 inch beyond any surface preparation.

If the surface prepared for painting or re-coating is 1 square yard or less, apply organic zinc primer. Use organic zinc primer on bolts, nuts, washers and edges of bolted splice plates.

If the surface prepared for painting or re-coating is greater than 1 square yard, blast clean the entire flange or web of the area to be painted or re-coated, and apply inorganic zinc primer. Between 24 and 48 hours after the inorganic zinc primer is applied in the field, apply a coat of organic zinc primer (by brush or spray according to **subsection 714.3b.**) where the new inorganic zinc prime coat meets or overlaps the shop applied inorganic zinc prime coat.

If welded stud shear connectors are applied in the field, blast clean the top of the top flange to SSPC-SP6, Commercial Blast Cleaning. After the welded stud shear connectors are applied, blast clean the top flange and welded stud shear connectors to meet SSPC-SP6, Commercial Blast Cleaning. Thoroughly blast clean the welds. Apply organic zinc primer to the top flange and welded stud shear connectors. Prime the welded stud shear connectors (including the underside of the stud head). Given the complexity, areas of thin primer and some shadows are permissible on the top 1 inch.

(2) Finish coat. Protect the primed structural steel from contamination during transport, storage and erection. Do not walk on the primed structural steel. If the primed structural steel is soiled, use water or light blast cleaning to remove the contamination before applying the finish coat of paint.

The application of the finish coat in the field shall comply with the general requirements for painting structural steel, with these additions and exceptions:

Unless otherwise noted in the Contract Documents, either apply an acrylic or a polyurethane finish coat after the primed structural steel is erected. Apply 1 coat with a dry film thickness of 3 to 6 mils on flat areas. A thickness in excess of 6 mils is allowed in fillet areas if there is no evidence of mud cracking, and if the coating is tight. If bubbles form, allow them to collapse and apply approximately 1 mil of the finish coat to the area where the bubbling occurred.

d. Shop Painting New Weathering Steel. Apply the shop painting of new weathering steel complying with the general requirements for painting structural steel and the shop painting of non-weathering structural steel, with these additions and exceptions:

Blast clean all surfaces of the weathering steel, including all contact surfaces of bolted connections, to meet SSPC-SP6, Commercial Blast Cleaning.

For weathering steel surfaces that require painting, blast clean to meet SSPC-SP10, Near-White Blast Cleaning.

Surfaces that require paint include:

- girder ends that are embedded in the abutment - the entire embedded portion of the girder, including diaphragms, plus an additional distance of 2 inches;
- the top (and sides, if in contact with concrete) of the top flanges, including shear studs and the underside of the stud head. Given the complexity, areas of thin primer and some shadows are permissible on the top 1 inch of shear studs. Note: for welded stud shear connectors applied in the field, the top of the top flange does not require a shop prime coat;
- all surfaces of top flange top splice plates;
- all surfaces of fill plates less than ¼ inch thick. Note: Fill plates need not be weathering steel. Paint fill plates of non-weathering steel, regardless of thickness;
- all structural steel surfaces (not included above) within a distance of 2 times the depth of the girder (2D) on either side of an expansion joint. (Note: A nearby stiffener is a convenient location to stop painting.); and
- the exterior girders according to **FIGURE 714-1**, if drainage is allowed over the side of the deck on a plate girder bridge, and the entire length of the exterior girder is to be painted. Note: If drainage is allowed over the side of the deck on a rolled beam bridge, painting of the exterior beam, except top flange, is not required.

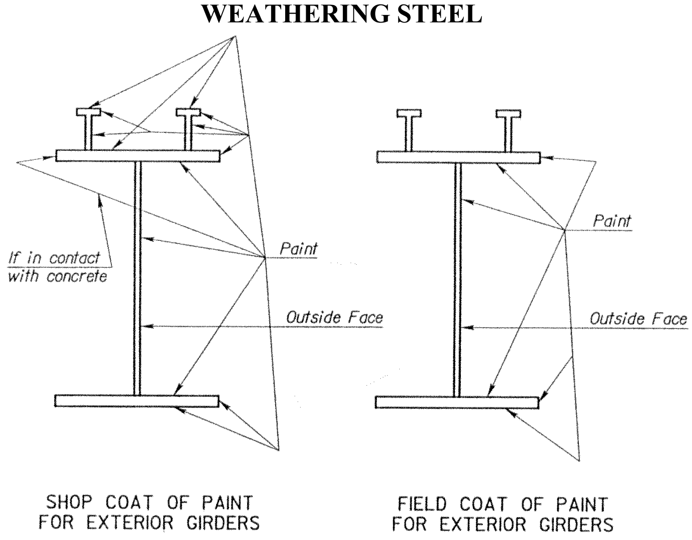
e. Field Painting New Weathering Steel. Apply a finish coat to all primed structural steel surfaces still exposed after the placement of superstructure concrete. The surface preparation of the top surface of the top flange (field applied welded stud shear connectors), and the application of the prime coat (including the top of the top flange after welded shear stud connectors have been applied in the field) and the finish coat in the field shall comply with the general requirements for painting structural steel and the field painting of new, non-weathering structural steel, with these additions and exceptions:

Unless noted otherwise in the Contract Documents, use a waterborne acrylic, brown finish coat color equivalent to Federal Standard No. 595a, Color No. 30045 (Carboline No. 2248).

If drainage is allowed over the side of the deck on a plate girder bridge, and the entire length of the exterior girder is to be painted, apply a finish coat to the exterior girders according to **FIGURE 714-1**.

Unless shown otherwise in the Contract Documents, blast clean the entire exterior facia of the unpainted exterior girders after erection to meet SSPC-SP6, Commercial Blast Cleaning.

FIGURE 714-1
WEATHERING STEEL



f. Painting Galvanized Steel. Follow ASTM D 6386 to prepare galvanized surfaces that are to be painted, then apply a primer tiecoat prior to application of the topcoat. Use a tiecoat that is compatible with the topcoat and approved by the Engineer. Follow the manufacturer's recommendations for application, including dry film thickness and cure time of the primer tiecoat.

g. Repainting Steel Bridges - Change Paint System. Repaint the steel bridges. Comply with the general requirements for painting structural steel, with these additions and exceptions:

Remove the existing paint system and repaint the bridge with a paint system of organic zinc or inorganic zinc prime coat and acrylic or polyurethane finish coat.

Clean and prepare the steel surfaces, including iron or steel casings and metal railings previously painted that are accessible for field painting. Do not paint tops of expansion guard plates, bars or angles across the roadway at joints between adjacent spans on which vehicular traffic comes in direct contact, and pipes or ducts owned by utility companies.

If lower chords, braces of truss spans or other members are separated by tie plates or fills, clean the spaces between backs of angles or channels (equal to the thickness of the tie plates or fills) of all rust and loose paint. Tight paint found between splice plates, beneath rivet heads and in other such narrow openings may be left intact. Take special care to remove the rust often found along the edges of the top flanges of I-beams at their line of contact with a concrete deck.

Apply the type of prime coat specified in the Contract Documents with 3 to 6 mils dry film thickness of the prime coat on flat areas. More thickness will be allowed in fillet areas if there is no evidence of mud cracking, and if the coating is tight.

After the prime coat is dry, give the inorganic zinc prime coat a thorough spray of clean water a minimum of 24 hours before the finish coat is applied. Organic zinc paint does not require a water spray.

Spray painting may be waived in those places where it is not possible to blast clean. Clean these areas by hand as well as possible, and apply a heavy coat of organic zinc primer with a brush or dauber.

Apply 1 finish coat with 3 to 6 mills dry film thickness on flat areas. A thickness in excess of 6 mils is allowed in fillet areas if there is no evidence of mud cracking, and if the coating is tight. If bubbles form, allow them to collapse and apply an approximate 1 mil of the finish coat to the area where the bubbling occurred.

h. Repainting Steel Bridges - Painting In Kind (Bridges with either organic zinc or inorganic zinc prime coat and acrylic or polyurethane finish coat paint systems). Repaint the steel bridges. Comply with the general requirements for painting structural steel, with these additions and exceptions:

Prepare the metal surfaces and repaint the bridge with the same paint system as existing.

Clean and prepare the steel surfaces, including iron or steel casings and metal railings previously painted that are accessible for field painting. Do not paint tops of expansion guard plates, bars or angles across the roadway at joints between adjacent spans on which vehicular traffic comes in direct contact, and pipes or ducts owned by utility companies.

If lower chords, braces of truss spans or other members are separated by tie plates or fills, clean the spaces between backs of angles or channels (equal to the thickness of the tie plates or fills) of all rust and loose paint. Tight paint found between splice plates, beneath rivet heads and in other such narrow openings may be left intact. Take special care to remove the rust often found along the edges of the top flanges of I-beams at their line of contact with a concrete deck.

Blast clean the steel surfaces to remove any defective coating. Hand clean widely spaced damaged spots (3/16 inch or less in diameter) on an otherwise tight existing coating. Remove oil and grease using a non-flammable solvent approved by the Engineer.

Clean areas according to SSPC-SP6, Commercial Blast Cleaning to produce a height of profile of 1 to 3 mils.

Apply 1 coat of organic zinc (minimum dry film thickness of 3 mils) to bare metal. Cover the bare metal and overlap the existing finish coat by 1 inch.

Spray painting may be waived in those places where it is not possible to blast clean. Clean these areas by hand as well as possible, and apply a heavy coat of organic zinc primer with a brush or dauber.

Use the type of finish coat specified in the Contract Documents. Apply 1 finish coat with 3 to 6 mils dry film thickness on flat areas. A thickness in excess of 6 mils is allowed in fillet areas if there is no evidence of mud cracking, and if the coating is tight. If bubbles form, allow them to collapse and apply an approximate 1 mil of the finish coat to the area where the bubbling occurred.

714.4 ENVIRONMENTAL PROTECTION (Existing Lead-based Paint Systems)

Provide environmental protection on a structure whether partially or completely removing an existing paint system that is defined as hazardous per federal Resource Conservation and Recovery Act (RCRA) Disposal

Regulations (40 CFR 261). The removal of existing lead-based paint may result in creation of waste subject to the above hazardous waste regulations.

a. Structure Classification. The bridge classification will be included in the Contract Documents, prior to letting.

For the purpose of this specification, bridges are classified as:

(1) Class A: A bridge in which any part is within 300 feet of:

- a residence, a school, a public use area, a commercial/industrial property, agricultural buildings;
- or a protected natural area property.

(2) Class B: Any bridge that is not Class A.

b. Health and Environmental Sampling.

(1) The Environmental Services Section (ESS) of the Bureau of Design will conduct a bridge Site Review and Field Survey (SRFS) to document the details of the project and the environmental concerns in the vicinity.

(2) Soil samples will be collected by the ESS prior to and at the conclusion of paint removal operations. While conducting the SRFS, soil samples will be collected within KDOT right-of-way from a minimum of 1 test site 10 to 100 feet away from the structure in each of 4 directions. The specific location of each site will be documented. Each test site shall consist of a 1 square foot area. A composite sample will be obtained by collecting soil ¾ inch in diameter and ½ inch in depth at the center of the square and at each of the 4 corners.

At the conclusion of the project, soil samples will be collected by the ESS in the same manner at a 1 square foot area within a radius of 5 feet of the original sample location. The pre-job and post-job samples will be analyzed for total lead at a Kansas Department of Health and Environment (KDHE) certified laboratory.

(3) The air sampling equipment shall be provided by the Contractor and will remain the property of the Contractor. Collect air samples, unless stated otherwise in the Contract Documents, on all Class A bridges. Collect the samples following the procedures specified in the Code of Federal Regulations (CFR), 40 CFR 58, Appendix G and the quality assurance procedures as specified in 40 CFR 58, Appendix B and 40 CFR 58.20. Employ high volume air samplers to assess the effects of blasting operations on ambient air quality outside the containment structure. Collect air samples each day paint is blasted from the structure. Place the air samplers on KDOT right-of-way in the upwind and downwind position to the prevailing wind at locations expected to experience maximum impact. Locations for air sampling will be approved by the Engineer. Remove and replace the sample filters each day. Store the used filters in air-tight bags, properly identified with date, sample location and KDOT project number.

Submit the air sample filters to a KDHE certified laboratory a minimum of once every 5 working days, where they will be analyzed for total lead. Lead concentrations in ambient air must be in compliance with 40 CFR 50, which allows a maximum of 0.05 mil/cubic yard (See Guide 6, Section 5.5.4). The laboratory analyses must be accelerated in order to have analytical results to the Engineer within 5 working days of the original transmittal to the laboratory. Identify the analytical results by the date of collection, type and location of sample, and KDOT project number.

If ambient air concentrations exceed regulatory limits, halt blasting operations until containment design controls have been implemented to reduce emissions to a satisfactory level.

(4) Collect surface water samples on all bridges located over any perennial stream, river or body of water. Sediment samples may also be required, at the discretion of the Engineer, where stream flow is extremely low, where containment has obviously failed or when paint removal operations exceed 30 calendar days. At the direction of the Engineer, a minimum of 1 sample shall be collected upgradient of the structure and 1 in the down gradient position of the structure during blasting operations. The samples will be representative of the project's potential impact to the water body and will be collected in the presence of the Engineer. If visible waste or paint chips are observed on the surface of the waterway, halt blasting operations until the containment has been modified to eliminate debris contact with the water surface. This determination will be made by the Engineer. Identify water samples by date, type and location of sample, and KDOT project number. Submit the water samples to a KDHE certified Laboratory for the analysis of total lead within 1 week from the time of collection. Submit the analytical results to the Engineer upon receipt from the laboratory. Identify the analytical results by date of collection, type of sample, Chain of Custody forms, and KDOT project number.

(5) Failure to submit analytical data for air and water samples on a timely basis as described above may result in work on the project being suspended by the Engineer until submittals are in compliance. Temporary suspension of work on the project due to non-compliance by the Contractor will not alter or waive the charging of working days for the project.

(6) Submit all documentation relative to air and water sample collection and analyses to the ESS within 30 days of completion of the paint removal process. If documentation is not submitted, the Engineer may stop work on the project until such documentation has been received by the Engineer and ESS.

c. Notifications and Record Keeping. The ESS will submit a SRFS report to the Bureau of Waste Management (BWM), KDHE, Forbes Field, Topeka, Kansas 66620-0001 a maximum of 60 days before beginning work on the bridges. At the same time, a copy will also be provided to the Bridge Management Section and the appropriate KDOT District Office. The District Office will provide a copy of the Site Review and Field Survey report to the Contractor.

At the conclusion of the blasting operations, the ESS will submit a report to the BWM, which includes the results of all air, soil, and surface water samples obtained during the project. A copy of this report will also be provided to the appropriate District Office. The Contractor may receive a copy of this report upon request to the Engineer or ESS.

d. Lead Base Paint Removal. The Contractor engaged in lead base paint removal operations must carry a pollution liability (access liability) policy with a minimum coverage of $1,000,000. Maintain this policy in force until the Secretary releases the Contractor from all obligations under the contract. The insurance contract must cover claims for such length of time as said claims are permitted by law. Provide a copy of this insurance certificate to the Engineer prior to beginning lead base paint removal operations.

Use best industry practices to protect the environment, persons and adjacent property from contamination due to blasting of the existing structure. When "Power Wash" is shown as a bid item, clean the existing steel before initiating the blasting operations. Use a power washer with pressure in the range of 700 to 1000 pounds per square inch to clean the structure, at a maximum rate of 4 gallons per minute, using potable water. Comply with all applicable regulations contained in K.A.R. 28-16-28 (b) through (f) for protection of water quality, K.A.R. 28-29-1 through 28-29-27 for disposal of solid waste and K.A.R. 28-31-1 through 28-31-14 for disposal of hazardous waste. In addition, comply with all applicable Occupational Safety and Health Administration standards including those found in 29 CFR 1910.1025 covering the occupational exposure to lead and 29 CFR 1926.62 outlining the requirements for the removal of lead-based paint from bridge repair and rehabilitation activities.

Contain paint chips, corrosion residues and spent abrasives, referred to as waste materials, resulting from blasting and other cleaning operations. The containment requirements are covered in **subsection 714.4e**. Use special containment methods or removal procedures over power lines, communication lines, railways or roadways not closed to traffic. Obtain the permits and permission from the line owner on the containment methods and removal procedures. The proposed containment method or removal procedures must be sealed by a licensed Professional Engineer, and submitted to the Engineer before commencing paint removal operations.

Clearing of the work area for containment purposes is the responsibility of the Contractor. Clearing may not extend beyond right-of-way. Burning on the right-of-way is prohibited. The area to be cleared and the clearing method must be approved by the Engineer before starting the clearing operation. Provide locations, approved by the Engineer, and dispose of all the debris at said locations.

e. Removal and Containment Requirements.

(1) Class A Bridges. On all Class A bridges, provide a KDHE certified Lead Abatement Supervisor for oversight of all paint removal, storage and disposal operation. These operations shall adhere to work practices established in K.A.R. 28-72-18(g) and K.A.R. 28-72-18d(a). The Lead Abatement Supervisor must have available at the job-site a telephone number for the nearest Local Emergency Planning Commission (LEPC), or if none can be found within a 50 mile radius, the nearest Haz-Mat Response Contractor.

Dry abrasive blasting or any other approved method which meets the paint specification may be used to remove the lead paint from the bridge. Use the containment methods shown below to maximize pollution control.

(a) Power Tools: Use containment unless the power tools are vacuum equipped and all parts of the vacuum equipment are in a condition that prevents emissions of waste material. This determination will be made by the Engineer.

(b) Dry Abrasive Blasting: Use 100% air impenetrable walls with rigid or flexible framing, fully sealed joints, airlock or resealable entryways, and negative air achieved by forced or natural air flow (verified by instrument or visual monitoring) and exhaust air filtration (See SSPC – Guide 6, Paragraph 4.2.2.1).

Design the containment to withstand the effects of negative air pressure equal to the combined volume of all blast nozzles inside the enclosure plus 4 air changes of the enclosure per hour. The method of attaching and the effects of dead load caused by the installation of the enclosure to the bridge shall be sealed by a licensed Professional Engineer. Provide a copy of such plans to the Engineer for approval before commencing paint removal operations.

Recyclable or non-recyclable abrasive may be used. Use recyclable abrasives with a classifier system rated to remove a minimum of 98% of the non-abrasive material, and free of oil substances.

Do not allow the waste material to contact the ground or water surface. Plywood or other impermeable material may be used, subject to approval by the Engineer. When the roadway beneath the structure is closed, the hard surfaces such as asphalt and concrete roadway, sidewalks and sloped paving may be left uncovered if they have an unbroken surface, and can be cleaned by sweeping or vacuuming as described in **subsection 714.4f.(1)**. If the roadway surface is used for waste material collection, cover the storm drains.

(c) Visible emissions are permitted at given frequencies or durations provided they do not extend beyond KDOT right-of-way. Permissible visible emissions for Class A bridges are defined as random emissions of a cumulative duration of a maximum of 1% of the work day, equivalent to 5 minutes in an 8 hour period (See SSPC-Guide 6, Paragraph 5.5.1.1). The Engineer will determine if visible emissions limitations are being exceeded. Temporary suspension of work on the project may be ordered by the Engineer if visible emissions exceed limitations. The ordering of a temporary suspension for exceeding emissions limitations will not alter or waive the charging of working days for the project.

(2) Class B Bridges. Dry abrasive blasting or any other approved method which meets the paint specification may be used to remove the lead paint from the bridge. Use the containment methods shown below to maximize pollution control.

(a) Power Tools: The Contractor is subject to the limitations for Class A Bridges as described in **subsection 714.4e.(1)(a)**.

(b) Dry Abrasive Blasting: Use 100% impermeable tarpaulins or heavy plastic (6 mil minimum thickness) to prevent disposition of waste material on the soil or water surface. Plywood or other impermeable material may be used subject to approval by the Engineer. Overlap the ground cover a minimum of 1 ½ feet and weight them as needed to prevent separation. Cover all bare soil and vegetated areas inside the curtains required by items below, and extend a minimum of 20 feet beyond in all directions except at abutments. When the roadway beneath the structure is closed, the hard surfaces such as asphalt and concrete roadway, sidewalks and sloped paving may be left uncovered if they have an unbroken surface, and can be cleaned by sweeping or vacuuming as described in **subsection 714.4f.(1)**. If the roadway surface is used for waste material collection, cover the storm drains.

- Curtains: Use curtains in the form of rigid or flexible walls, rated by the manufacturer at a minimum of 85% impermeable to contain lead paint particles and dust generated from the blasting operation. Use curtains with adequate strength to withstand wind velocity. Plywood or other impermeable material may be used, subject to approval by the Engineer. Attach and overlap the edges of the walls a minimum of 3 feet, unless the edges are completely joined.
- Girders and Deck Trusses: Rigid or flexible walls may be suspended from the bridge deck to the ground so that the work area is contained on all 4 sides. Attach and overlap the edges of the walls a minimum of 3 feet, unless the edges are completely joined. Extend the wall up between the girders to seal this space. Extend the walls to the ground, and anchor or weight at the bottom. An exhaust fan with an adequate filter system may be required to protect the personnel within the confinement.
- Thru and Overhead Trusses: If the roadway is open to traffic, suspend rigid or flexible 85% impermeable walls both inside and outside of the truss from a height greater than the point to be removed, with the inside edge resting on the deck and secured by weights, and the bottom outside edges fastened within the lower walls attached to the bridge deck in the manner required for girders.

  If the roadway is closed to traffic, suspend rigid or flexible 85% impermeable walls outside from a height greater than the point of paint removal with the lower edges fastened within the lower walls attached to the bridge deck in a manner required for girders; or suspend a rigid barrier outside the truss with the bottom edge resting on or directly above the roadway and inclined at an angle of 45° with the truss to deposit waste material on the closed roadway.

The height must be at a minimum, equal to the height of the truss, and with the space between the end of the barrier and truss closed with impermeable material. Suspend rigid or flexible walls across the bridge deck between the opposite trussed at both ends of the area to be blasted. On truss bridges provide a document sealed by a licensed Professional Engineer noting the amount of work area allowed for containment.

- Over a Body of Water: If a project site is located within 0.5 mile upstream of any public water supply intake, the ESS will notify the applicable public entity of project activity within 30 days of commencing paint removal operations.

  Rigid or flexible 100% impermeable material may be suspended horizontally beneath the bridge deck to contain the waste material; or suspend scaffolding that supports a platform beneath the bridge deck lined with impermeable material to contain the waste material; or for bridge decks within 50 feet of the water surface, anchor a barge beneath the bridge and use impermeable material to direct waste material to the barge; or for bridge decks that are within 50 feet of a frozen water surface, collect and remove waste material from the ice surface with ground cover as required in **subsection 714.4e.(2)(b)**. Extend the distance of ground cover in a downwind direction to a distance greater than the highest point of the paint removal. Extend the material used to contain the girders and trusses from outside the paint surfaces to inside of the containment walls, the platform, inside the barge or inside the containers on the barge.

  Over a narrow body of water, the following methods may be used as an alternate to the methods shown above. Cover a platform above the water surface with 100% impermeable material that overlaps the ground covers; or suspend an impermeable material across the underside of the bridge deck at a point more than halfway across the water body to direct paint particles to the farther bank. Anchor the containment at the bank so that it overlaps the ground covers, and seal the space above the containment in between the beams. Repeat the procedure in the opposite direction. The rigid or flexible walls used to contain the material from the girders or the trusses shall extend from outside the painted surfaces to the platform or inside the horizontal containment material.

  In addition, employ floating booms down gradient of the structure if any waste material is detected floating on the water surface. Use a skimmer or wet vacuum to capture any waste material or paint chips.

(3) Wind Speed Limitations: Do not conduct paint removal operations whenever wind speed or other weather conditions render the containment ineffective or unsafe. If excessive visible emissions of particulate matter occur in the air or in visible deposits on the ground or water surface due to adverse weather conditions, either halt operations until the weather and/or wind speed is at a workable level, or increase design controls to adequately accommodate weather related conditions. The Engineer shall make this determination.

(4) Alternative Method of Removal: Alternate methods of removal may be proposed. Submit the alternate proposal to the State Bridge Engineer a minimum of 30 days in advance of use. Include site-specific design and engineering controls appropriate for the proposed alternative method. The alternate method must be approved by KDHE and KDOT before initiation.

f. Waste Material Cleanup, Storage and Treatment.

(1) Cleanup of Waste Material: Clean up all visible deposits of waste materials at the end of each work day and store them in secured containers above normal high water elevation, within KDOT right-of-way as describe in further detail in item **subsection 714.4f.(3)**. Recover this material by manual means or by vacuum with filtration. Do not use an air pressure or a water stream which redistributes, but does not remove the waste material. Collect material from the roadway and from floating booms as needed, and at a minimum at the end of each day.

(2) Storage of Waste Material: Consider generated waste material to be a hazardous waste until representative analytical results have been received by the ESS and the Engineer, indicating that the waste is non-hazardous, pursuant to 40 CFR 261 and the KDHE.

(a) While classified as a hazardous waste, store the waste material according to the requirements of K.A.R. 28-31(g) or (h). In addition to K.A.R. 28-31(g) or (h), in the plan for storage of waste material, include the following:

- Store the waste material in secured drums, bulk hoppers, bins or rolloffs. Clearly mark the containers with the words "Hazardous Waste", the KDOT project number and the date upon which the period of accumulation began for each container;

- Store the waste containers on an impermeable surface that accommodates sweeping or vacuuming;
- Do not accumulate hazardous waste for more than 90 days. If an extension of time is needed, seek approval from the ESS; and
- The Engineer is designated the "Emergency Response Coordinator" and is responsible for coordinating all emergency response measures outlined in K.A.R. 28-31-40(h).

(b) In order to classify generated waste as non-hazardous for on site storage, obtain a minimum of 2 composite samples at the direction of and in the presence of the Engineer. The sample must be representative of the total volume of waste generated through that point in time, as determined by the Engineer. Submit the samples to a KDHE certified laboratory and test for lead according to the TCLP Method SW 1311/7420, pursuant to 40 CFR 261, Appendix II. Maintain proper Chain of Custody forms at all times. The Contractor shall bear the costs of all sampling and analyses.

- If the sample analyses indicate the waste to be non-hazardous, less than 5 mg/L, the analytical results serve as representative documentation for the remainder of the waste generated on that project site, provided changes are not made to the method of paint removal, the type of blast media or any other portion of the paint removal operation that would render the samples non-representative of the total volume of waste. These criteria will be evaluated at the discretion of the Engineer;
- KDOT reserves the right to conduct random sampling at any time to assure that paint removal operations have not been altered in such a way as to compromise the representative nature of the original samples. KDOT will bear the cost of any random sampling ordered unless said sample analyses determines the waste to be hazardous, whereupon the Contractor will be responsible for the cost of sample analyses. If the waste is found to be hazardous through random sampling, the entire volume of waste generated shall be considered hazardous;
- Store non-hazardous waste material in secured containers and place on an impermeable surface which accommodates sweeping or vacuuming; and
- Mark each storage container with the KDOT project number and date upon which the period of accumulation began.

(3) Sampling and Analysis of Waste Material.

- Collect representative composite samples of the waste material at the direction of and in the presence of the Engineer. Sampling and testing procedures and contaminant limits are described in **subsection 714.4f.(2)(b)**;
- A minimum of 2 samples are required and may be the same 2 samples described as initial waste characterization in **subsection 714.4f.(2)(b)**. Additional samples shall be required in order to total a minimum of 2 samples per ton of waste generated. The Contractor shall bear the cost of all sampling and analyses;
- All samples collected must fall below the 5 mg/L TCLP regulatory requirement in order to dispose of any of the waste as non-hazardous, pursuant to K.A.R. 28-29-109.

(4) Disposal of Waste Material.

(a) If all samples indicate a lead content below 5 mg/L, dispose of the entire volume of waste generated as follows:

- Provide documentation confirming the disposal of said waste at a KDHE permitted landfill to the Engineer within 15 business days of the disposal. If documentation is not submitted, the Engineer may stop work on the project until such documentation has been received by the Engineer and ESS; or
- Recycle according to **subsection 714.4f.(4)(b)**;
- DO NOT DISPOSE OF THIS MATERIAL AS A HAZARDOUS WASTE.

(b) If any sample indicates a lead content at or above 5 mg/L, recycle the entire volume of waste generated as follows.

- Recycle waste material through an EPA approved lead recycling facility, pursuant to 40 CFR 261.1. For the purposes of transport, the waste may be designated as "recyclable";

- Prior to commencement of the project, provide the Engineer documentation confirming the pre-acceptance of the recyclable materials by the recycling facility;
- Provide the Engineer documentation identifying the volume of waste transported from the project site; and
- Within 15 business days of acceptance by the EPA approved recycling facility, provide the Engineer and ESS documentation confirming the acceptance of the waste and the volume as delineated above. If documentation is not submitted, the Engineer may stop work on the project until such documentation has been received by the Engineer and ESS.
- DO NOT DISPOSE OF THIS MATERIAL AS A HAZARDOUS WASTE.

g. Inspection Staff. KDOT will not inspect the surfaces from which the paint has been removed by abrasive blasting until the air quality inside the enclosure is below the Permissible Exposure Limit (PEL), and preferably below the Action Level (AL). This inspection will occur before any paint is applied to the surface.

Provide the necessary facility for removal of and disposal of protective clothing. Provide a location and facility for the Inspector to wash exposed body areas.

h. General Site Cleanup. The Contractor is responsible for general cleanup of the job site after paint removal and painting operations have been completed. This includes but is not limited to cleanup of all debris associated with paint removal and painting operations, trash generated by Contractor personnel, as well as any excess blast media and/or paint chips. Cleanup will also include re-establishment of any vegetative cover disturbed by abatement activities, including damage caused by storing equipment and traffic at the site. Clean up lead-bearing waste according to **subsection 714.4f**. This determination will be made by the Engineer.

714.5 MEASUREMENT AND PAYMENT

The Engineer will not measure painting of new structural steel for payment. Payment for painting new structural steel is included in the payment for the structural steel.

The Engineer will measure bridge painting, environmental protection and power washing, of existing steel by the lump sum.

Payment for "Bridge Painting", "Environmental Protection" and "Power Wash" at the contract unit prices is full compensation for the specified work.

SECTION 715

PRESTRESSED CONCRETE MEMBERS

715.1 DESCRIPTION

Manufacture, cure, handle and install prestressed concrete bridge beams and panels to the dimensions specified on the Contract Documents. Manufacture and cure concrete piling to the dimensions specified on the Contract Documents.

BID ITEMS	**UNITS**
Prestressed Concrete Beams (*)(**)	Linear Foot
Prestressed Concrete Panels	Square Foot

*Type
**Size

715.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete .... **SECTIONS 401 & 404**
Reinforcing Steel .... **DIVISION 1600**
Bearings and Pads For Structures .... **DIVISION 1700**
Steel Strand .... **DIVISION 1600**
Welded Steel Wire Fabric .... **DIVISION 1600**

Provide a copy of mill certifications for reinforcing bar and wire mesh, as required in **DIVISION 1600**, to the Inspector prior to concrete placement.

Steel strand mill certifications and KDOT test reports are required prior to concrete placement. Due to variations in the modulus of elasticity, only one source of strand will be allowed in any unit. No more than 1 broken wire will be permitted in a bed.

Bearing plate mill certification is required. Coating for the plate will be tested for the requirements of ASTM A 123 or **SECTION 714** for painting.

Mill certifications and KDOT test reports are required for miscellaneous items, such as bolts, etc.

715.3 MANUFACTURE OF CONCRETE BRIDGE BEAMS, PILING AND PANELS

a. General. A minimum of 2 weeks before starting the production of prestressed concrete units, submit shop drawings according to **SECTION 105**. With the exception of prestressed piles, which do not require drawings, do not perform any production until the approved shop drawings are in the hands of the Inspector and producer, and the Engineer has authorized production. Changes to approved shop drawings are subject to the approval of the Engineer. Do not revise the number or location of coil inserts or other connection devices shown on approved drawings without the approval of the Engineer. Submit revised sheets of the same size as the shop drawings originally approved. Include information covering the following items in the shop drawings.

- The method of forming, placing and securing the reinforcement.
- The plan for prestressing the units, including the type, number, size and location of the prestressing elements.
- The method of releasing units with draped strands.
- Descriptions and allowable loads for hardware items (e.g. hold down devices, threaded inserts, etc.).
- Identify the proposed concrete mix, including the slump desired at point of delivery.
- The casting length center to center of bearings and the calculated prestress shortening.

Manufacture units within the tolerances in **TABLE 715-1**, unless shown otherwise on the Contract Documents.

TABLE 715-1: DIMENSIONAL TOLERANCES

DOUBLE TEE AND INVERTED BEAM

Unit Feature	Tolerance
Length	± ½ in.
Width (overall)	± ¼ in.
Depth	± ¼ in.
Stem Thickness	± ⅛ in.
Flange Thickness	+ ¼ in., - ⅛ in.
Position of Block-out	± ½ in.
Horizontal Alignment (Deviation from straight line parallel to centerline of the member.)	¼ in. (up to 40 ft. lengths) ⅜ in. (40 ft. to 60 ft. lengths) ½ in. (greater than 60 ft. lengths)
Camber deviation from design camber	± ¼ in. per 10 ft, but not greater than ¾ in.
Differential camber between adjacent members of the same design	¼ in. per 10 ft, but not greater than ¾ in.
Tendon position	± ¼ in. in c.g. of strand group
Tolerance between tendons	± ⅛ in.
Position of handling devices	± 6 in.
Position of deflection points for deflected strands	± 6 in.
Stem to edge of top flange	± ⅛ in.
Distance between stems	± ⅛ in.
Position of weld plates	± 1 in.
Squareness of ends (vertical and horizontal alignment)	± ¼ in.
Stirrup bar spacing (individual or accumulative)	± 1 in.
Stirrup bar height	± ½ in.

SINGLE TEE BEAM

Unit Feature	Tolerance
Length	± ¾ in.
Width (overall)	+ ⅜ in., - ¼ in
Depth	± ¼ in.
Width (stem)	+ ⅜ in., - ¼ in
Thickness (flanges and fillets)	+ ¼ in., - ⅛ in.
Position of block-outs	± ½ in.
Side inserts (center to center and center to end)	± ½ in.
Bearing area deviation from plane	± ⅛ in.
Bearing plate (center to end of beam)	± ¼ in.
Horizontal Alignment (Deviation from straight line parallel to centerline of the member.)	¼ in. (up to 40 ft. lengths) ⅜ in. (40 ft. to 60 ft. lengths) ½ in. (greater than 60 ft. lengths)
Camber deviation from design camber	± ¼ in. per 10 ft., but not greater than ±¾ in.
Differential camber between adjacent beams	¼ in. per 10 ft., but not greater than ¾ in.
Tendon position	± ¼ in. in c.g. of strand group
Tolerance between tendons	± ⅛ in.
Position of handling devices	± 6 in.
Position of deflection points for deflected strands	± 6 in.
Position of weld plates	± 1 in.
Squareness of ends (vertical and horizontal alignment)	± ½ in.
Stirrup bar spacing (individual or accumulative)	± 1 in.
Stirrup bar height	± ½ in.

TABLE 715-1 (continued)

BRIDGE I-BEAM

Unit Feature	Tolerance
Length	± ¾ in.
Width (flanges and fillets)	+ ⅜ in., - ¼ in.
Depth (overall)	+ ½ in., - ¼ in.
Width (web)	+ ⅜ in., - ¼ in.
Depth (flanges and fillets)	± ¼ in.
Bearing plates (center to center)	± ⅛ in. per 10 ft., but not greater than ± ¾ in.
Horizontal Alignment (Deviation from straight line parallel to centerline of the member.)	⅛ in. per 10 ft. of span, but not greater than 1 in.
Camber deviation from design camber	± ⅛ in. per 10 ft. of span, but not greater than ± ½ in.
Differential camber between adjacent members	1 in. maximum
Stirrup Bars (projection above top of beam)	± ¾ in.
Tendon position	± ¼ in. in c.g. of strand group
Tolerance between tendons	± ⅛ in.
Position of handling devices	± 6 in.
Position of deflection points for deflected strands	± 6 in.
Exposed beam ends (deviation from square or designated skew)	Horizontal: ± ¼ in. Vertical: ± ⅛ in. per 1 ft. of beam depth
Bearing plates (center to end of beam)	± ¼ in.
Side Inserts (center to center and center to end)	± ½ in.
Bearing area deviation from plane	± ⅛ in.
Stirrup bar spacing (individual or accumulative)	± 1 in.
Stirrup bar height	± ¾ in.
Position of post tensioning duct	± ¼ in.
Position of weld plates	± 1 in.

PRESTRESSED PILE

Unit Feature	Tolerance
Length	± 1 in.
Width or diameter	± ⅜ in., - ¼ in.
Head out of square	⅛ in. per 1 ft. of width
Horizontal alignment (deviation from straight line parallel to centerline of pile)	⅛ in. per 10 ft. of pile
Position of void	± ¼ in.
Position of stirrup bars and spirals	± ¾ in.
Position of tendons	± ¼ in.
Position of handling devices	± 6 in.
Position of steel driving tips	½ in.

PRESTRESSED PANELS

Unit Feature	Tolerance
Length	± ¼ in.
Width	± ¼ in.
Thickness	+ ¼ in., - ⅛ in.
Square ends (deviation from square)	± ¼ in.
Deviation from straightness of mating edge	+ ⅛ in.
Position of strands	± ⅛ in. vertical, ± ½ in. horizontal

Notify the Engineer a minimum of 2 business days for in-state production and 5 business days for out-of-state production, in advance of the date when casting is to begin to afford an opportunity for inspection of the casting beds and forms, the equipment for placement and tensioning of the strands, the equipment for proportioning, mixing, placing and consolidating the concrete, and the equipment for handling the units.

b. Equipment.

(1) Condition. Repair or replace unsafe or inadequately operating equipment.

(2) Concrete Mixers. Mix concrete in truck mixers or in a central mixing plant that comply with **SECTION 154**. When concrete is mixed in a central mixing plant and can not be adequately mixed according to **SECTION 401**, conduct tests, as required by the Engineer, to determine the minimum mixing time to achieve uniformity of the concrete mixture. For air-entrained concrete, the maximum mixing time may not exceed the mixing time established from uniformity tests by more than 60 seconds.

(3) Casting Beds. Portable casting beds are prohibited. The supporting foundations for casting beds must be such that no settlement will occur during the casting and curing of the units.

(4) Forms. Use forms that are true to line, mortar tight and provide access for placement of the reinforcement and concrete.

(5) Stressing Jacks. For stress application, use jacks equipped with hydraulic gauges or other approved stress measuring devices as a check against the applied load as measured by elongation. Recalibrate gauges when directed by the Engineer.

(6) Curing Enclosures. Use steam curing enclosures reasonably free from steam leakage and providing adequate circulation of steam. Arrange steam jets so that the steam shall not play directly on the forms or the concrete as it enters the enclosure. If non-waterproof tarpaulins are used for the enclosure, use a minimum of 2 layers. Use only waterproof tarpaulins or plastic sheeting for enclosures when prestressed concrete units are cured by radiant heat.

(7) Instruments. When accelerated curing is used, install instruments during the curing period for measuring and recording temperature and humidity inside curing enclosures and for measuring and recording temperature in the concrete for each 200 feet of casting bed. Provide a minimum of 2 instrument installations of each type for each enclosure. The location of each instrument must be approved by the Engineer. Humidity level indicators may be waived by the Engineer.

c. Manufacturing Requirements.

(1) General. Except as modified by the Contract Documents or approved by the Engineer, follow the latest edition of the Prestressed Concrete Institute's, "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products".

(2) Reinforcement. Install reinforcing bars as shown in the Contract Documents, and rigidly secure them to prevent movement during placement of the concrete. Welding of reinforcing steel bars is prohibited.

Substituting deformed welded steel wire fabric in prestressed beams for reinforcing bars is acceptable, provided the spacing of the wires is less than or equal to the spacing shown in the plans, and the area of steel per foot is equivalent or greater than the reinforcing bars shown in the plans. Use the table shown in the plans for area of steel equivalences. Higher yield strength welded steel wire fabric is allowed, but will not change the equivalences. Post production welding of wire fabric is prohibited.

Accurately position steel strand within the tolerances specified in the Contract Documents. Rigidly secure the strand so it shall be retained in the specified locations. The minimum horizontal spacing, center to center of strands at the ends, is 2 inches. Install supports to prevent dead load sag. The roller size on the holddown device must match the strand size used. Provide strand supports as shown in the Contract Documents that consist of a device with freely turning rollers a minimum of ⅞ inch in diameter at each deflection point. A yoke type device may be used for top depressing of strands when approved by the Engineer. The prestress force and center of gravity must be as shown in the Contract Documents.

Perform tensioning and elongation according to the Contract Documents. No tensioning of strands or placement of concrete will be permitted when the ambient air temperature is below 20ºF. At the option of the Engineer, strand shall be brought to within 25°F of the concrete at placement in lieu of corrections in elongation due to temperature. The Engineer may use suitable equipment to determine if the strand tension is proper throughout the entire bed length. Make corrections as required.

(3) Concrete. Handle and place the concrete by methods that shall produce a dense, uniform product, free from sand streaks and honeycomb areas. The presence of any deleterious substance such as “bag paper” is cause for rejection. Deliver concrete to the producer’s site of the work and complete placement within the time limits specified in **SECTION 401**. Deliver and place successive batches at a constant rate and before the preceding batch has been perceptibly hardened or dried, or is no longer pliable, and in no case may the interval between successive batches in a unit exceed 20 minutes, or if the concrete mix or environmental conditions require otherwise, a period established by the Engineer. Do not add water to temper deposited concrete.

Place concrete during cold weather according to **SECTION 401**. In addition, the form temperature shall be a minimum of 40ºF before the concrete may be placed. When necessary, continue heating the forms during the placement and finishing of the concrete.

Provide concrete units meeting the tolerances specified in **TABLE 715-1**, unless shown otherwise in the Contract Documents.

(4) Surface Finish. Make all surfaces of the units reasonably straight and true to lines and grades, and free from fins or other projections. Form joint marks will be permitted. Give top surfaces of beams a wire brush or stiff broom finish applied transverse to the length of the beam. Rake the top surfaces of the panels, perpendicular to the prestressing strand, making depressions of approximately ¼ inch. Do not pull out the coarse aggregate when raking.

(5) Cracks. Produce concrete units free from cracks of sufficient width to impair the unit’s strength and durability.

(6) Curing. Curing may be accomplished by either the moist curing method or accelerated curing with low pressure steam or radiant heat.

(a) Moist Curing Method (Normal Curing Temperatures). As soon as possible after the units have been cast, cover them with a minimum of 2 layers of burlap and keep wet until the side forms are removed. After the side forms are removed, protect the units with wet burlap or a vapor proof cover until they have attained the strength requirement for release shown in the Contract Documents.

If repairs to the concrete surface are required or to give the units a surface finish, remove the protective covering and complete the surface work, but keep the surfaces of the unit moist during the entire time that the protective covering is removed.

(b) Accelerated Curing with Low Pressure Steam or Radiant Heat. Perform low pressure steam curing or radiant heat curing under an enclosure to contain the live steam or the heat. Allow the initial set of the concrete to take place by delaying the initial application of steam or heat from 2 to 4 hours after the final placement of concrete. If retarders are used, increase the waiting period before application of the steam or radiant heat to 4 to 6 hours. If the time of initial set is determined by the standard method of test for "Time of Setting of Concrete Mixtures by Penetration Resistance", ASTM C 403, the time limits described above may be waived.

Do not apply live steam directly on the concrete forms causing localized high temperatures.

Radiant heat may be applied by means of pipes circulating steam, hot oil or hot water, or by electric heating elements. Perform radiant heat curing under a suitable waterproof enclosure to contain both heat and moisture. Minimize moisture loss by covering all exposed concrete surfaces with 2 layers of wet burlap.

While waiting for the initial set, the minimum temperature within the curing chamber shall be 50ºF. During this time, live steam or radiant heat may only be used to maintain the curing chamber at the minimum temperature.

During the initial application of live steam or radiant heat, increase the ambient air temperature within the curing enclosure at a maximum average rate of 40ºF per hour. The maximum curing temperature within the enclosure is 160ºF, while the maximum internal concrete temperature shall be limited to 180°F. Hold the maximum temperature until the concrete has reached the desired strength. Immediately after the steam or heat curing has been discontinued, accomplish release. Additional curing is not required after release.

Do not allow the temperature of the concrete to drop below 50ºF at any time.

Provide recording thermometers showing the time-temperature relationship throughout the curing period from placing concrete to transfer of prestress. All temperature records will be retained by the Engineer as part of the curing records. Missing or incomplete time-temperature records shall be cause for rejection of the corresponding prestressed units.

Temperature limits and use of recording thermometers are the same when curing with steam or radiant heat. Due to the slow rise of ambient temperatures with radiant heat, application of heat cycles may be accelerated to meet climatic conditions, however, do not increase the ambient air temperature within the curing enclosure by more than 40ºF per hour. In all cases, the curing procedure to be used must be well established and carefully controlled.

(7) Releasing Prestressed Units with Draped Strands. Units may be de-tensioned as soon as they have attained the strength requirements shown in Contract Documents. If the units have been cured by accelerated curing methods, transfer the stressing force to the concrete as soon as the release strength of the concrete has been reached, and while the concrete is still warm.

d. Inspection and Testing.

(1) General. Provide the Engineer free access to the manufacturing plant at all times for inspecting materials, plant facilities, manufacturing and curing procedures. Inform the Engineer of the planned concrete placement and curing schedule in advance of the start of any work. The Engineer will require time for testing of materials, inspection of equipment and reviewing of procedures that will be used in casting units, prior to beginning casting.

(2) Testing Equipment.

(a) Cylinder Molds. Provide an ample supply of cylinder molds for the casting of test cylinders. All molds are subject to approval of the Engineer. Use 6"∅ x 12" cylinders. The Engineer may approve the use of 4"∅ x 8" cylinders, provided reliable correction factors have been developed and submitted, along with supporting data, for review and acceptance.

(b) Compression Machine. Provide a machine capable of measuring the compressive strengths of concrete cylinders cast during the manufacturing of the units. All testing machines must be calibrated and approved by the Engineer.

(3) Test Cylinders.

(a) Casting and Curing. All test cylinders are the responsibility of the Contractor. With the exception of 28 day cylinders, cure all cylinders under the same conditions (environment) as the concrete they represent. Initially store then cure 28 day cylinders as per KT-22.

For the testing purposes described below, the “total volume of concrete placed” is defined as each 40 cubic yards of concrete or fraction thereof placed in each line, within each curing enclosure, between bulkheads, during a continuous working period.

Make 1 group of 3 or more cylinders for each third of the total volume of concrete to be placed. Note the limits of the concrete in the beds represented by each of the groups of cylinders. Mark and identify all cylinders groups as 1, 2 and 3 with marked group 1 representing the first third of the total volume of concrete placed, marked group 2 representing the second third of the total concrete placed, and marked group 3 representing the final third of the total concrete placed. To facilitate the testing of multiple sets of cylinders for release or shipping, each group may contain more than 3 cylinders. Mark cylinders within a group as xA, xB, xC, xD, xE where “x” is the group number (always 1, 2, or 3) and A through E are the unique cylinder identifying marks within the group. Letters D and E, etc., are optional additional cylinders which allow more than one set of test cylinders for release or shipping. Identify which cylinders will be used for 28 day testing (i.e. 1E, 2E, 3E). Store and cure these three cylinders as per KT-22.

Follow the procedure of making sets of cylinders from early, middle and late placement, during normal production operations. When operations are interrupted or changed (i.e. equipment break-down, very small placements, etc.), adjust the cylinder fabrication schedule to match the production, and provide adequate cylinders for later release and shipping strength testing. Coordinate this revised schedule with the Engineer on the production site.

(b) Testing. With the Engineer observing, test cylinders to measure the release and shipping strength at the producer’s plant.

(i) Release Strength. Test 3 cylinders, 1 cylinder from each of the 3 groups of cylinders (i.e. 1A, 2A, 3A) prior to strand release to determine if the specified (design) release strength shown in the Contract Documents has been reached. Release strength is attained when the average compressive strength of the 3 tested cylinders equals or exceeds the design release strength and no more than 1 cylinder in the tested set has a compressive strength which is below the design release strength by no more than 100 psi. If the above conditions are not met, a minimum of 1 hour must pass before a second cylinder from each of the same 3 groups is tested (i.e. 1B, 2B, 3B).

(ii) Shipping Strength. Before reaching 28 days of age, the Contractor, may test 3 cylinders, 1 cylinder from each of 3 groups of cylinders (i.e. 1C, 2C, 3C) to determine if the specified 28 day strength shown in the Contract Documents has been reached. Shipping strength is attained when all 3 tested cylinders meet or exceed the specified minimum 28 day strength. If this requirement is met, the products represented by these cylinders are accepted for strength requirements and may be shipped 1 day (approximately 24 hours) after meeting the compressive strength requirement and 5 days (approximately 120 hours) after concrete placement, whichever is greater. If the above condition is not met, a minimum of 2 hours must pass before a second cylinder from each of the same 3 groups is tested (i.e. 1D, 2D, 3D). If a cylinder from each of the 3 groups is not available for testing, then early shipping will not be allowed. Cylinders earmarked for 28 day testing cannot be tested for shipping.

(iii) 28 Day Strength. A previously identified set of 3 cylinders, 1 cylinder from each group of cylinders (i.e. 1E, 2E, 3E) shall be stored and moist cured as per KT-22 and then tested when the concrete has reached an actual age of 28 days. Testing will take place at a location chosen by the Engineer while being observed by the Engineer. When the early shipping requirements described above have not been met, the average strength of these 3 cylinders must meet or exceed the specified minimum 28 day strength. In addition, only 1 of the cylinders in the tested set may be below the minimum specified 28 day strength by no more than 5%.

The average strength of 1 set of 3 cylinders may be less than the specified minimum 28 day strength by no more than 5% or 300 psi, whichever is less, provided that the previous 9 consecutive sets of 28 day cylinders manufactured for the same KDOT project and using the same mix design complied with the 28 day strength criteria described above.

(iv) Coring. When either (but not both) of the following occur:

- the 28 day strength of an individual cylinder is less than the 5% criteria described above or
- a second of any 10 consecutive manufactured cylinder sets attains an average compressive strength below the specified minimum 28 day strength by no more than 5% or 300 psi, whichever is less.

The Contractor may, with the approval of the Engineer, core the unit (or units) represented by such cylinder (or cylinders) and have them tested. The location of the cores must be approved by the Engineer. Follow AASHTO T 24 when obtaining, preparing, testing and calculating the strength of drilled cores.

If the adjusted compressive strengths of any of the cores are below the specified minimum 28 day compressive strength, the represented units will be rejected. Coring is not allowed on product represented by more than 1 out of any 10 consecutively manufactured cylinder sets, regardless of reason, and can only take place after the concrete has reached an age of 28 days.

e. Handling, Storage and Transportation.

(1) Handling. Do not lift or strain the units in any way before the stress application strength has developed. While lifting and handling, support the units only at points designated in the Contract Documents.

(2) Storage. When units are stacked for storage, support each unit at designated bearing points.

(3) Transportation. The units may be shipped 1 day (approximately 24 hours) after test cylinders have reached the specified 28 day compressive strength, and the units have attained a minimum age of 5 days (approximately 120 hours), whichever is greater. Support beams in an upright position. The required points of support and direction of reactions with respect to the beam are approximately the same during transportation as when the beam is in its final position in the structure. Transport piling and panels with the points of support approximately below the lifting points designated in the Contract Documents.

If during transportation, units are supported at points so that a portion of the unit is cantilevered past the points designated above, the unit must be adequately reinforced or the overhanging portion adequately supported to prevent damage.

(4) Damage. Units damaged in shipment or placement may be accepted provided the damage does not impair the structural qualities of the unit, and such damage can be repaired at the work site to the satisfaction of the Engineer.

f. Field Construction. Do not place concrete on prestressed bridge beam units until they have reached a minimum age of 28 days, or as noted in the Contract Documents. Install bridge beams as shown in the Contract Documents.

g. Piling. Do not place piling before the specified 28 day strength has been attained. See **SECTION 704** for placing piling.

715.4 MEASUREMENT AND PAYMENT

The Engineer will measure the length of prestressed concrete beams by the linear foot.

The Engineer will measure the area of prestressed concrete panels by the square foot.

Payment for "Prestressed Concrete Beams" and "Prestressed Concrete Panels" at the contract unit prices is full compensation for the specified work.

SECTION 716

POST-TENSIONING
(Haunched Slab Bridges)

716.1 DESCRIPTION

Provide and install all post-tensioning system components as shown in the Contract Documents to construct a post-tensioned haunched slab bridge.

BID ITEM	UNITS
Post-Tensioning for Slab Bridge	Pound

716.2 MATERIALS

Comply with all material requirements in the Contract Documents in addition to **subsection 716.2**.

a. Prestressing Steel. Provide uncoated, 7 wire, Grade 270 (1860), low-relaxation strands for prestressed concrete complying with AASHTO M 203 (ASTM A 416). Provide strands with a minimum ultimate strength of 270 ksi. Fabricate the tendons with sufficient length beyond the anchor bearing plates to allow for stressing and anchorage device installation.

The Engineer will accept the strands based on **subsection 716.2h**. Protect all strands against physical damage and rust or other results of corrosion at all times, from manufacture to grouting or encasing in concrete. Reject strands that have sustained physical damage at any time. Use wire that is bright and uniformly colored, having no foreign matter or surface pitting.

Package the strands in containers or forms to protect against damage and corrosion during shipping and storage. Provide an inhibitor carrier type packaging material complying with the provisions of Federal Specifications MIL-P-3420F-87. Place a rust preventative corrosion inhibitor or other corrosion inhibiting material in the package, incorporate a corrosion inhibitor carrier type packaging material or apply directly to the steel when approved by the Engineer. Use a corrosion inhibitor that has no deleterious effect on the strands or grout or bond strength of strands to grout.

Clearly mark the shipping package or forms with a statement that the package contains high-strength prestressing steel strands, the care to be used in handling, the type, kind and amount of corrosion inhibitor used, including the date when placed, safety orders and instructions for use.

b. Post-Tensioning System. Use an approved post-tensioning system of proper size and type to construct tendons as shown on the Contract Documents. Do not substitute components of the approved post-tensioning system. Do not use tendon couplers. Use only post-tensioning systems that utilize tendons fully encapsulated in anchorages, ducts and fully filled with approved grout.

Systems which transfer prestress force by bonding the prestress steel strand directly to concrete are prohibited.

c. Post-Tensioning Anchorage. Provide anchorages meeting or exceeding:

- Article 5.10.9 of the AASHTO LRFD Bridge Design Specifications, latest edition and interims; and
- Article 10.3.2 of the AASHTO LRFD Bridge Construction Specifications, latest edition and interims.

The Post-Tension Manufacturer shall supply the special reinforcement, such as spirals or grids, for the longitudinal and transverse tendons. Such reinforcement is required in the concrete end-zones of anchors. All anchorage devices shall develop 96% of the actual ultimate strength of the prestressing steel, when tested in an unbonded state, without exceeding anticipated set. The design of the end anchorages and end-zone reinforcing is the sole responsibility of the Post-Tension Manufacturer.

Galvanize the body of the anchorages according to ASTM 123. Other components of the anchorage including wedges, wedge plate and local zone reinforcement are not required to be galvanized. Construct the bearing surface and wedge plate from ferrous metal. Equip all anchorages with a permanent fiber reinforced plastic grout cap that encloses the whole wedge plate. Vent grout caps and bolt to the anchorage.

d. Post-Tensioning Ducts. Provide semi-rigid, mortar-tight plastic ducts, including connection joints, capable of withstanding concrete pressures without deforming or permitting the intrusion of cement paste during the placement of concrete. Use all duct material complying with AASHTO and the Post Tensioning Institute (PTI) for bonded tendons. Do not use ducts manufactured from recycled materials. Provide ducts for multi-strand tendons with an inside area a minimum of 2 ½ times the net area of the tendons. Provide ducts that do not cause electrolytic action or deterioration of the concrete or the duct. Provide ducts that will bend without crimping or flattening, and with sufficient strength to maintain their correct alignment during the placement of the concrete.

Provide corrugated plastic ducts for both the longitudinal and transverse ducts. Provide the proper fasteners for the ducts. Use an approved plastic on all parts of the clamps. Construct the ducts from either polyethylene or polypropylene. The minimum acceptable radius of curvature shall be established by the duct supplier according to standard testing methods. The material thickness of ducts is 0.08 inches ± 0.01 inch. Fabricate polyethylene ducts from resins complying with ASTM D 3350 with a cell classification of 345464A. Fabricate polypropylene ducts from resins complying with ASTM D 4101 with a cell classification of PP0340B44544 or PP0340B65884.

e. Inlets and Outlets. Use inlets for injecting grout into the duct. Use outlets to allow the escape of air, water, bleed water and grout. Provide inlets and outlets at locations shown in the Contract Documents. Provide ¾ inches minimum internal diameter plastic pipe for inlets and outlets made of ASTM A 240 Type 316 stainless steel, nylon or polyolefin materials. If nylon inlets/outlets are used, a cell class of S-PA0141 (weather resistant) is required. Only use polyolefin products which contain antioxidant(s) with a minimum Oxidation Induction Time (OIT) according to ASTM D 3895 a minimum of 20 minutes. Test the remolded finished polyolefin material for stress crack resistance using ASTM F 2136 at an applied stress of 350 psi, resulting in a minimum failure time of 3 hours. Provide pipes that are mortar-tight. Provide plastic components that do not react with concrete or enhance corrosion of the strands, and are free of water soluble chlorides.

Provide the proper plastic connectors and fasteners to attach the pipes to the ducts. Provide positive mechanical shut-off valves for all inlets for a minimum pressure rating of 100 psi. Provide cap, valves or other devices capable of withstanding the pumping pressures for all outlets. No tape is allowed at any connection.

f. End Anchorages Permanent Grout Cap. Use permanent grout caps made from fiber reinforced polymer or ASTM A 240 Type 316L stainless steel. Use nylon, Acrylonitrite Butadiene Styrene (ABS) or polyester resins in the fiber reinforced polymer. For products made from nylon, a cell class of S-PA0141 (weather resistance) is required. Seal the cap with "O" ring seals or precision fitted flat gaskets placed against the bearing plate. Equip the grout cap with a top grout vent. Use grout caps rated for a minimum pressure of 100 psi. Use ASTM A 240 type 316L stainless steel bolts to secure the cap to the anchorage. When stainless steel grout caps are supplied, provide certified test reports documenting the chemical analysis of the steel.

g. Grout. Provide grout that complies with **DIVISION 1700**. Use only one supplier for any single structure.

h. Testing Requirements. Provide all materials for testing. Conduct all tests according to the applicable AASHTO and ASTM specifications.

(1) Testing by the Engineer. Provide 3 samples of prestressing strand of sufficient length to provide 5 feet measured between fittings for each size strand from each heat, reel or coil.

Provide the Engineer with a certification stating the manufacturer's minimum guaranteed ultimate strength of the strand for each size supplied from each lot.

(2) Testing by the Contractor. Provide the Engineer with a certificate of test performance from the manufacturer of the strand for each size from each heat, reel or coil to determine the modulus of elasticity prior to stressing the initial tendon in the bridge. Re-evaluate the theoretical elongations shown on the post-tensioning working drawings using the results of the tests and correct as required. Submit revisions of the theoretical elongations to the Engineer for approval.

716.3 CONSTRUCTION REQUIREMENTS

a. Post-Tensioning Designs. Use 0.6 inch diameter strands longitudinal and transverse post-tensioning systems as shown in the Contract Documents.

b. Qualification of the Post-Tensioning System Manufacturer (System Manufacturer). Select a system manufacturer with experience (in the United States) in post-tensioning concrete haunched slab or concrete box girder bridges that were designed and constructed according to AASHTO LRFD Construction specifications.

Before materials are provided and any post-tensioning operations begin, the system manufacturer must be approved by the State Bridge Office (SBO). If the system manufacturer has not been previously approved, provide the SBO with the necessary information to consider their qualifications. Provide the SBO with:

- Certificate of compliance with OSHA and other applicable industry standards for safety;
- In-house capability to design end anchorage assemblies, local zone and general zone design according to AASHTO specifications, sealed by a Professional Engineer licensed in the state of Kansas;
- Certificate of compliance with AASHTO LRFD Construction specifications for testing of the end anchorage assemblies, performed by an independent testing laboratory, and sealed by a Professional Engineer licensed in the state of Kansas;
- In-house QC/QA implementation for manufacturing, assembling, storage, delivery, installation, stressing and grouting supervision;
- Names, qualification and experience of the field personnel to be assigned to assist the Contractor to supervise installation, stressing and grouting;
- The technician that supervises all grouting operations must be a valid American Segmental Bridge Institute (ASBI) Certified Grouting Technician. Provide the SBO with verification of the technician's ASBI Certification;
- Proof of continuous post-tensioning operations. Firms with less than 10 years of experience may be approved if sufficient related project experience is demonstrated, but in any event a minimum of 7 years of experience is required;
- List of post-tensioned haunched slab bridges completed within the past 5 years including owner and identifying bridge information; and
- List any unfavorable claims within the last 10 years.

The SBO will approve (or disapprove) the system manufacturer within 5 working days of receiving the required information.

A system manufacturer may submit the necessary information to be considered for qualification at any time. The SBO will maintain a list of approved system manufacturers. Any change in a system manufacturer's system or evidence of poor performance will require re-approval.

c. Shop Drawings. Submit shop drawings from the system manufacturer to the State Bridge Office (SBO) for all work related to post-tensioning according to **SECTION 105**. The shop drawings must be sealed by a Professional Engineer licensed in the state of Kansas. The shop drawings must be approved by the SBO before beginning fabrication.

As a minimum, include in the shop drawings:

- A Post-Tensioning System that meets the requirements in the Contract Documents;
- Tendon geometry and layouts;
- Distance from the bottom of slab to bottom of duct;
- Duct support detail and spacing according to the Contract Documents;
- The locations of grout ports and grout vents;
- Connection details such as duct coupler, anchorage to duct and grout ports/ vents to duct;
- Anchorage local-zone reinforcement;
- Permanent grout cap details, concrete recess, pour backs and temporary protection;
- Jacking forces and initial forces;
- Anchor set;
- Stressing operation and equipment data;
- All material specifications (e.g. strands, ducts and grout);
- Grouting operation and equipment data;
- Safety procedures;
- Elongation calculations and tolerances;
- All required computations;

- If duct sizes different from the sizes shown in the Contract Documents are approved, modify the spacer frame details shown in the Contract Documents; and
- Computations and a typical tendon force diagram (for all types of tendons), after friction and anchor set losses, based on an expected actual friction coefficient for the system to be used.

d. Installation. Install the hardware including ducts, tendons, end anchorage assemblies and special reinforcing according to the Contract Documents and the instructions of the system manufacturer.

Provide a qualified on-site representative of the system manufacturer, who is skilled and thoroughly experienced in the use of the system to supervise or provide appropriate guidance of the work. The system manufacturer's representative will provide the Engineer pertinent information as required. The system manufacturer's representative must be available full-time during post-tensioning hardware installation for inspecting and approving all installation prior to concrete placement, stressing, anchoring all tendons and grouting operations.

As a minimum, the following items require inspection and approval by the system manufacturer's representative:

- Installation of all hardware;
- Instructions to the Contractor regarding concrete placement around the ducts, end-anchorage assemblies and other appurtenances; and
- Supervision of stressing procedures, record keeping, certification of stressing results and grouting operations

The representative of the system manufacturer that supervises all grouting operations must be a valid American Segmental Bridge Institute (ASBI) Certified Grouting Technician.

Do not place any concrete in the bridge abutments and superstructure until the hardware installation is approved by the Engineer and the system manufacturer's representative.

Reject all unidentified strands or anchorage assemblies.

Provide all ducts or anchorage assemblies with inlet/outlet pipes.

Provide concrete test cylinders at both abutments. Do not begin stressing until testing of concrete cylinders verifies minimum bridge concrete strength for jacking has been obtained.

Do not begin the stressing before the concrete strength has reached the f'_{ci} shown in the Contract Documents and a minimum of 72 hours after completing the slab pour. Complete the stressing within 7 days after completing the slab pour.

Vibrate the concrete slab, as required, to obtain proper consolidation and compaction of the concrete specified in the Contract Documents.

Proper vibration at the abutments and around the end anchorage assemblies is especially critical and should be considered a "confined" area. Exercise care to obtain concrete consolidation around the end anchorages without disturbing the reinforcing or post-tensioning assemblies.

e. Stressing Tendons.

(1) Stresses. Tension all strands using hydraulic jacks. The minimum force of the strands is the value shown on the approved shop drawings. Do not allow the maximum temporary tensile stress (jacking stress) in the strands to exceed 80% of the specified minimum ultimate tensile strength. Anchor the strands at stresses (initial stresses) that shall result in the ultimate retention of permanent forces of not less than those shown in the Contract Documents. After seating, do not exceed 70% of the specified minimum ultimate tensile strength at the anchorages locations and 74% of the specified minimum ultimate tensile strength in the span.

Consider permanent force and permanent stress as the force and stress remaining in the strands after all losses, including creep, shrinkage, elastic shortening of concrete, relaxation of steel, post-tensioning losses due to the sequence of stressing, friction, take-up of anchorages and any other losses due to the method or system of post-tensioning. Complete stressing of the strands to within -0 to +5% of the forces shown in the Contract Documents.

(2) Stressing Jacks. Apply post-tensioning forces only after the concrete has attained the specified compressive strength as determined by the cylinder tests and within the time requirements in **subsection 716.3d**. Equip each jack used to stress tendons with a pressure gauge (a minimum of 6 inches in diameter) for determining the jacking pressure. Calibrate each jack and its pressure gauge as a unit with the cylinder extension in the approximate position that it will be at final jacking force. As a minimum, provide 2 jacks at each site to guard against breakdowns. Provide certified calibration charts (by an independent laboratory) with each jack, hydraulic system and pressure gauge used on the project. Perform the calibration while the jack is in the identical configuration as will be used on the site (e.g., the same length hydraulic lines).

Provide a calibrated master gauge at each job site. Supply the master gauge in a protective waterproof container capable of protecting the calibration of the master gauge during shipment to a laboratory. Provide a quick-attach coupler on the calibrated master gauge to verify the permanent gauge readings. Calibrate and provide the Engineer with the master gauge for the duration of the project. Any repair of the jacks, such as replacing the seals or changing the length of the hydraulic lines, will be cause for re-calibration of the jack with a load cell. Conduct hydraulic jack calibration a minimum of every 6 months.

(3) Elongations. Conduct the tensioning process so that the tension being applied and the resulting elongation of the strands may be measured at all times. Keep a permanent record of gauge pressures and elongations, and submit it to the Engineer. Using only a rigid metal ruler, measure elongations to the nearest ⅛ inch.

Preload tendons to 20% of their total jacking force. Inspect dead end anchors for adequacy before completing the post-tensioning of the tendon.

If a tendon's measurable elongation is greater by more than 7% of the calculated measurable elongation, the tendon will be evaluated by the Engineer in conjunction with the State Bridge Office (SBO) and subject to rejection.

If a tendon's measurable elongation is less than the calculated measurable elongation by more than 7%, overstress the tendon to 80% of its ultimate strength from either end. If this yields an elongation within 7% of the calculated measurable elongation, the tendon will be accepted; otherwise it will be evaluated and subject to rejection.

Evaluation of out of tolerance elongations procedure:

It is of primary importance that the evaluation be performed as soon as the potential failure happens, since completion of the entire process is time critical.

In the event of a failure to meet the 7% requirements above, a tendon evaluation is required, and will consist of one or all of the following procedures as determined by the Engineer in conjunction with the SBO:

- Modification of the friction and wobble coefficient: Perform in-place friction tests or modify the K-factor by using the data from the tendon in question.
- Verification of the tendon modulus of elasticity: Perform additional bench tests.
- Re-calibration of the stressing jack: Verify elongation through jack or extension if used.
- Perform lift-off at dead end.

Submit to the Engineer and SBO for approval, a proposal of a tendon evaluation sealed by a Professional Engineer licensed in the State of Kansas, representing the system manufacturer.

Submit to the Engineer and SBO the results of the tendon evaluation.

Should the evaluation fail to justify the discrepancy between the actual and calculated measurable elongation, the tendons will be rejected.

(4) Record of the Post-Tensioning Operation. Keep a record of the following post-tensioning operations for each tendon installed:

- Date strands installed;
- Date strands stressed;
- Date grouted;
- Supervisor's and Inspector's names;
- Coil number for strands installed or heat number for bars installed;
- Jacking ends;
- The theoretical and actual elongation;
- The theoretical and actual anchor set;
- Actual tendon lengths;
- Gauge pressure and forces (initial, intermediate intervals, and before anchor set);
- Accepted or number of items rejected; and
- Comments as to problems.

Upon completion of the post-tensioning, submit to the Engineer for approval a record of gauge pressures and tendon elongations. The records submitted must be sealed by a Professional Engineer (licensed in the state of Kansas) representing the system manufacturer.

Do not cut off stressing tails of tendons until the stressing records have been approved by the Engineer. Do not torch cut strands or bars at any time.

f. Grout. Provide the Engineer with a minimum of 3 days advance notice of the beginning of the grouting operations to allow adequate time for ASBI-certified KDOT inspection staff to get to the job site.

Grout the annular space between the duct and the tendons after the tensioning of all tendons has been completed and the strands have been anchored.

Weather permitting, begin grouting immediately or within 72 hours after stressing all tendons within an independent unit.

(1) Equipment. Provide a grouting mixer capable of continuous mechanical mixing which shall produce grout free of lumps and undispersed cement. Batch all materials using batching equipment which provides accurate solid and liquid measures. Provide grout equipment capable of continuously grouting the longest tendon on the project within a maximum of 20 minutes.

Use grouting equipment utilizing gravity feed to the pump inlet from a hopper attached to and directly over it. Keep the grout hopper at least partially full of grout at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct.

Use positive displacement type pumps, capable of producing the outlet pressure required by the grout manufacturer. Use a pump with seals, adequate to prevent introduction of oil, air or other foreign substance into the grout, and to prevent loss of grout or water. Place a pressure gauge at some point in the grouting line between the pumping outlet and the duct inlet, and having a full scale reading of a maximum of 300 psi. Use grouting equipment containing a screen having clear openings of ⅛ inch maximum size to screen the grout prior to its introduction into the grout pump.

(2) Mixing. Mix the grout according to the manufacturer's directions. The pumpability of the grout may be determined by the Engineer according to ASTM C 939. When this method is used, do not exceed 11 seconds for the efflux time of the grout sample immediately after mixing. Do not use the flow cone to test grout which incorporates a thixotropic additive.

(3) Grout Operations. Keep all grout inlets and high point outlets open when the grouting operation begins. Allow grout to flow from the first outlet past the inlet until any residual flushing water or entrapped air has been removed, at which time close the outlet. Close remaining outlets in the same manner and in the order shown on the plans.

Perform normal grout pumping operations at 75 psi. Do not exceed 250 psi for pumping pressure at the inlet. Pump the grout through the duct and continuously waste at the outlets until there is no evidence of water or air being ejected.

If the actual grouting pressure exceeds the maximum recommended pumping pressure, inject grout at any outlet that has been, or is ready to be closed as long as a one-way flow of grout is maintained. If this procedure is used, fit the outlet that is to be used for injection with a positive shutoff. When one-way flow of grout can not be maintained as outlined above, flush the grout immediately out of the duct with water.

To keep the tendon filled with grout under pressure, close the outlets and inlets in the order shown on the plans, when the tendon duct section at the outlet and inlet is completely filled with grout. Do not remove or open positive shutoffs required at the inlets and outlets until the grout has set.

In temperatures below 32°F, keep ducts free of water to avoid damage due to freezing. Maintain the temperature of the concrete slab between 35 and 85°F from the time grouting begins until jobsite cured 4 inch diameter cylinders of grout reach a minimum compressive strength of 800 psi, when tested according to AASHTO T22. The maximum grout temperature is 90°F, during mixing or pumping. When required, cool the mixing water.

Remove ends of inlets and outlets a minimum of 1 ½ inches below the concrete surface after the grout has set and fill the recess in the concrete with an approved epoxy grout.

Grout all anchorages, before the winter shut down.

g. Protection of End Anchorages. Clean exposed end anchorages, strands and other metal accessories of rust, misplaced mortar, grout and other such materials as soon as possible after tensioning and grouting is completed. Immediately following the cleaning operation, apply a coat of zinc-rich epoxy paint, minimum thickness of 4 mils.

h. Recess Pocket Filling. Fill all longitudinal and transverse end anchorage recess pockets as shown in the Contract Documents. Apply an approved epoxy resin bonding agent according to the manufacturer' prior to placing an approved non-shrink, non-metallic grout. Apply grout according to the grout manufacturer's instructions. Finish the outside exposed surfaces of the recess pockets smooth and flush with the surrounding concrete surface. Select grout to match the color of the surrounding concrete slab.

716.4 MEASUREMENT AND PAYMENT

The Engineer will compute the weight of the longitudinal post-tensioning tendons in pounds by measuring the theoretical plan length from end to end of wearing surface and for transverse post-tension tensions by measuring out-to-out of the bridge deck.

Use a unit weight of 0.74 pounds per foot for 0.6 inch diameter strand.

Payment for "Post-Tensioning for Slab Bridge" at the contract unit price is full compensation for the specified work.

SECTION 717

BRIDGE OVERLAYS

717.1 DESCRIPTION

Construct the portland cement concrete overlay as shown on the Contract Documents.

When Bridge Deck Grooving is a bid item in the contract, perform the grooving as shown in the Contract Documents.

BID ITEMS	**UNITS**
Portland Cement Concrete Overlay (*)	Square Yard
Material for Portland Cement Concrete Overlay (Set Price)	Cubic Yard
Bridge Deck Grooving	Square Yard
* Thickness	

717.2 MATERIALS

Provide materials that comply with the applicable requirements.

Grade 4.0 (AE) Concrete+	**SECTIONS 401 & 402**
Aggregate for Concrete Not On Grade	**DIVISION 1102**
Precure/Finishing Aid Material++	**DIVISION 1400**
Concrete Curing Materials	**DIVISION 1400**
Concrete Masonry Coating	**DIVISION 1700**

+Use concrete that meets requirements for low permeability concrete (LPC) as specified in **DIVISION 400**.

++When silica fume is used as an SCM, the use of Precure/Finish Aid may be used according to the manufacturer's instructions.

For overlays use Supplemental Cementitious Materials at allowable substitution rates as listed in **TABLE 401-2**.

717.3 CONSTRUCTION REQUIREMENTS

a. Equipment. Use a finishing machine consisting of a mechanical strike-off capable of providing a uniform thickness of concrete slightly above finish grade in front of an oscillating screed or screeds. The finishing machine will be inspected and approved by the Engineer before work is started on each project.

Use a minimum of 1 oscillating screed capable of consolidating the concrete by vibration to 100% of the vibrated unit weight with the following features:

- Install identical vibrators so a minimum of 1 vibrator is provided for each 5 feet of screed length;
- Bottom face a minimum of 5 inches wide with a turned up or rounded leading edge;
- Effective weight a minimum of 75 pounds for each square foot bottom face area;
- Positive control of vertical position, the angle of tilt and the shape of the crown;
- Design together with appurtenant equipment to obtain positive machine screeding of the plastic concrete as close as practical to the face of the existing curb line;
- Length sufficient to uniformly strike-off and consolidate the width of the lane to be paved;
- Forward and reverse motion under positive control;
- Supporting rails which are fully adjustable (not shimmed) to obtain the correct profile, unless otherwise approved by the Engineer. Provide supports which are sufficiently rigid and do not deflect under the weight of the machine. Anchor the supporting rails to provide horizontal and vertical stability; and
- Equip to travel on the completed lane when placing concrete in a lane abutting a previously completed lane.

Manufacturer's specifications or certification may be used as verification of the oscillating screed requirements.

A drum roller equipped to perform all functions outlined for the oscillating screed above, may be used for finishing the overlay concrete in lieu of an oscillating screed. Equip the drum roller to vibrate by either a factory or field adaptation. The drum roller must be able to compact the concrete to a minimum of 100% of the consolidated unit weight.

Provide an overall combination of labor and equipment with the capability for proportioning, mixing, placing and finishing new concrete at the following minimum rates shown in **TABLE 717-1**.

TABLE 717-1: PORTLAND CEMENT CONCRETE OVERLAY PRODUCTION REQUIREMENTS

Total Placed Surface Area per Bridge (Square Yards)	Minimum Cubic Yards per Hour
0-328	1.0
329-492	1.5
493-656	2.0
Over 656	2.5

b. Preparation of Surface. Prior to placement of concrete, sand or shot blast the surface followed by an air blast to the bottom 3 inches of hubguard, and edges against which concrete is to be placed to remove all dirt, oil, pavement marking and other foreign material, as well as any unsound concrete, laitance and curing material from the surface. Wet sand blasting may be used only with approval of the Engineer. It is desired that the surface be roughened by the sand or shot blast to provide satisfactory bond with the surfacing concrete. Protect metal deck drains and areas of the curb or railing above the proposed surface from the sand or shot blast.

Check the finish machine clearance above the prepared surface before concrete is placed to obtain the thickness specified in the Contract Documents.

A minimum of 2 hours before the placing of the concrete overlay, use clean water to thoroughly wet any concrete surfaces to which the concrete is to bond against. Blow or broom away all free water immediately ahead of the placing operation. Bonding surfaces should be maintained in a damp condition with no free water.

c. Placing Concrete. Place and fasten the screed rails in position to obtain finished concrete at the required profile. Place the supporting rails upon which the finishing machine travels outside the area to be concreted. A hold-down device shot into concrete is prohibited, unless the concrete is to be subsequently overlaid. Hold-down devices of other types leaving holes in exposed areas will be approved provided the holes remaining are grouted full. Methods for anchoring and supporting the rails and the concrete placing procedure require approval by the Engineer.

Locate longitudinal joints along lane lines, or as approved by the Engineer. Keep the joints clear of wheel paths as much as practical.

Placing of the overlay is prohibited when conditions on the bridge deck are such that the evaporation rate is estimated to equal or exceed 0.2 pounds per square foot per hour, or is predicted to exceed that rate during the course of the placement, unless corrective measures listed in **subsection 710.3b.** are taken to reduce the evaporation rate to below 0.2 pounds per square foot per hour.

Fogging may be necessary during placement of the overlay. Accomplish fogging according to **subsection 710.3b**.

The evaporation rate will be rechecked with the measures in place, using the procedures outlined above.

The elapsed time between depositing the concrete on the deck and final screeding may not exceed 15 minutes, unless otherwise authorized by the Engineer.

Manipulate and mechanically consolidate new concrete to a minimum of 98% of the consolidated unit weight and screed to final grade. In irregular areas or along the curb where the finishing screed does not reach, hand tamp with a 6-inch by 6-inch metal plate device to assist in consolidation and bonding of the concrete. When concrete for partial depth patches is placed with the overlay, apply additional vibration or hand tamping in the patch areas to assist in consolidation and bonding of the concrete.

d. Finishing. Strike off overlays with a self-propelled finishing machine. The screed on the finish machine must be self-oscillating, and operate or finish from a position either on the skew or transverse to the bridge roadway centerline.

On overlays skewed greater than 10º, operate the finishing machine on the same skew as the bridge, unless approved otherwise by the State Bridge Office.

Irregular sections may be finished by other methods approved by the Engineer. Float and straightedge the wearing surface so the finished surface is at the cross-section shown in the Contract Documents. Do not add water to the surface of concrete, unless approved by the Engineer, and when approved apply as a fog spray.

Secure a smooth riding bridge deck, correcting surface variations exceeding ⅛ inch in 10 feet by use of an approved profiling device, or other method approved by the Engineer.

For decks without the bid item Bridge Deck Grooving, finish the deck with the rough burlap drag.

For decks with the bid item Bridge Deck Grooving, see **subsection 710.3f.** for grooving requirements.

e. Curing and Protection. Cure and protect according to **subsection 710.3e**.

f. Weather Limitations. See **SECTION 401**. Also, discontinue concreting operations when a descending air temperature in the shade and away from artificial heat falls below 45ºF except with written approval from the Engineer. Do not start or resume operations until an ascending air temperature reaches 40ºF, or if night time temperatures are expected to fall below 35ºF.

g. Limitations of Operations. When a new deck is involved, do not commence work on the wearing surface until the lower course meets the time requirements of **SECTION 710**, unless specified otherwise.

Do not place concrete adjacent to a surface course, less than 36 hours old. This restriction does not apply to a continuation of placement in a lane or strip beyond a transverse joint in the same lane or strip.

In areas where there is no traffic, preparation of the area may be started in a lane or strip adjacent to newly placed surface the day following its placement. If this work is started before the end of the 7-day curing period, restrict the work as follows:

- Sawing or other operations may interfere with the curing process in the immediate work area for the minimum practical time only;
- Resume the curing promptly upon completion of the work;
- Keep the exposed areas damp until such time as curing media is replaced; and
- Do not use power driven tools heavier than a 15-pound chipping hammer.

h. Construction Joints. Make construction joints (either longitudinal or transverse) by placing and finishing the overlay approximately 6 inches beyond the desired location of the construction joint. After the overlay is cured, make a vertical saw cut at the location of the construction joint and chip away the excess overlay.

i. Sealing Vertical Faces of the Overlay. Seal all construction joints and vertical faces (such as the edge at the curb line) of the overlay. Sand or shot blast the construction joints and vertical faces, and apply a concrete masonry coating to the cleaned vertical surfaces according to **SECTION 726**. This work is subsidiary to the overlay.

j. Correction of Unbonded Areas. If during construction of the project, newly overlain areas are discovered to be unbonded by tapping or chaining, outline the concrete from such areas by sawing, remove it with small air tools (15-pound maximum) and replace it at no additional compensation.

717.4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The Engineer will measure portland cement concrete overlay by the square yard.

The Engineer will measure material for portland cement concrete overlay by the cubic yard according to the following:

(1) When approved by District on repair of existing bridges, this pay item will be used to compensate the Contractor for the additional overlay material that will be required to fill the areas greater than the thickness of overlay shown in the Contract Documents. The Contractor is responsible for maintaining adequate quality control of the demolition process to minimize deviations from the plan grades.

(2) The Engineer will keep a running account of the volume of overlay material that is produced and delivered to the deck. When approved, the Contractor will be paid, at the set price per cubic yard, for all overlay material in excess of 110% of the theoretical volume to cover the deck area with the thickness of overlay shown in the Contract Documents.

When shown as a bid item in the contract, the Engineer will measure for payment bridge deck grooving by the square yard.

Payment for "Portland Cement Concrete Overlay" and "Bridge Deck Grooving" at the contract unit price and "Material for Portland Cement Concrete Overlay (Set Price)" at the contract set unit price (when approved by the District Engineer) is full compensation for the specified work.

SECTION 718

ELASTOMERIC CONCRETE

718.1 DESCRIPTION

Construct elastomeric concrete according to the Contract Documents.

718.2 MATERIALS

Provide materials that comply with **DIVISION 1500**.

718.3 CONSTRUCTION REQUIREMENTS

Provide the Engineer with a copy of the product manufacturer's instructions for use of this material.

Mix, transport, place and cure the elastomeric concrete as recommended by the material manufacturer.

Provide a technical representative of the material manufacturer at the jobsite during the initial placement of the elastomeric concrete. The manufacturer's representative shall provide technical expertise regarding the mixing, transporting, placement, and curing of the elastomeric concrete. This requirement may be waived for experienced contractors. Submit request for waving a technical representative, along with a list of successfully completed elastomeric concrete projects, to the Engineer.

718.4 MEASUREMENT AND PAYMENT

The Engineer will not measure the elastomeric concrete separately; it will be subsidiary to other items of the contract.

SECTION 719

EXPANSION JOINTS

719.1 DESCRIPTION

Install expansion joints as designated in the Contract Documents. Do not substitute joint material without approval of the State Bridge Office.

BID ITEM	**UNITS**
Expansion Joint (*)	Linear Foot

*Strip Seal Assembly, Preformed Elastomeric Neoprene, Preformed Elastomeric Compression, Membrane Sealant** or other
**Type

719.2 MATERIALS

a. General. Provide the type of expansion joint system designated in the Contract Documents that complies with **DIVISION 1500**. When specified in the Contract Documents, use rapid set concrete patching material according to **SECTION 1716**.

b. Strip Seal Assembly. Provide strip seal assemblies and preformed pressurized elastomeric neoprene and compression joint seals that comply with **DIVISION 1500**.

Fabricate the strip seal assembly and armoring and support systems according to **DIVISION 700**.

c. Preformed Elastomeric Neoprene. Provide preformed elastomeric neoprene joints that comply with **DIVISION 1500**.

d. Preformed Elastomeric Compression. Fabricate the preformed elastomeric compression joint seals to extend across the roadway in 1 piece. The material may be trimmed at the ends.

e. Membrane Sealant. Provide membrane sealant that complies with **DIVISION 1500**.

719.3 CONSTRUCTION REQUIREMENTS

a. Strip Seal Assembly. Submit shop drawings according to **SECTION 105** for each location, type and model of strip seal assembly used, according to **DIVISION 700**. The Contractor is responsible for preparing shop drawings and coordinating the fabrication of the strip seal assemblies that require structural steel protection angles with the fabricator of the structural steel angles.

Install the strip seal assemblies according to the Contract Documents and the manufacturer's recommendations. Provide a technical representative of the material manufacturer at the jobsite during installation.

Place either a butt joint at each break in the pavement cross slope, or bend a unit of the device to comply closely to the break in cross slope. Do not field cut the device without approval of the Engineer.

If the assembly is installed in sections, show the sequence of unit installation on the shop drawings. Install the first unit and adjust it so that the anchor bolts shall center in the mounting slots. Install washers and tighten bolts to the torque recommended by the manufacturer. Wire brush both ends of the successive units, and butt them tightly against installed units. Do not apply the sealant until the unit is ready to be bolted down. Cut the corner at the face of curb, and grind to match normal curb dimensions. Tighten all bolts and scrape excess sealant off the surface.

If the assembly is installed in one continuous length with no field splices, proceed with the installation in a uniform manner to maintain continuity of the seal.

Complete final sealing of the finished expansion joint as soon as possible after installation. Fill all bolts, exposed ends, joints between units and other areas of possible leakage with sealant. Scrape excess sealant away before it has set.

b. Preformed Elastomeric Neoprene and Compression Joint Seals. When constructing the concrete forms for the ends of the bridge deck and adjacent abutment backwalls, form block-outs for the preformed elastomeric compression joint seals, according to the Contract Documents. The block-outs in the poured concrete must be uniform in depth and width, and free of irregularities.

Before installing the elastomeric joint seals, thoroughly clean the surfaces of the indentation formed for the elastomeric joint material, and swab it with a uniform coating of the lubricant-adhesive as recommended by the manufacturer.

Install the elastomeric joint material according to the manufacturer's recommendations. Use equipment capable of placing the strips at the specified depth without increasing or decreasing the length as taken from the roll or box by more than 5%.

Recess the top of the installed joint material a minimum of ⅛ inch, and a maximum of ⅜ inch below the top of the roadway deck adjacent to the joint material.

c. Membrane Sealant.

- Provide a technical representative from the material manufacturer at the jobsite during installation. Installation will not begin unless representative is present.
- Verify the joint opening size is correct based on the ambient temperature, correct as required.
- The minimum ambient air temperature during the installation and curing process is 40^{o} F.
- Just prior to the sealant being applied, clean the faces of the joint by sand blasting each joint face followed by an air blast to clean incompressibles from the joint. Solvent clean bridge or approach joint surfaces. To obtain complete bonding with the adhesive, the concrete must be surface dry.
- Apply the epoxy adhesive to the prepared concrete joint surfaces according to the manufacturer recommendations.
- Install the membrane sealant material into the joint, positioning it either flush with, or with a maximum recess of ½ inch from the top surface of the joint, however recommended by the manufacturer.
- Apply the manufacturer recommended splice adhesive liberally to both mitered ends of the 2 sections of membrane sealant material that will meet in the joint as the final step before installation. Install successive lengths of membrane sealant material by maintaining pressure toward the previously installed section while positioning the length being installed. Do not stretch the membrane sealant material.

Provide an air supply that is proven to be oil free prior to blast cleaning and air blasting. This is done by covering the end of the air hose farthest from the compressor with a white rage and discharging air for 10 seconds in the presence of the Engineer.

d. Other Expansion Joints. Provide a qualified representative of the expansion joint system manufacturer to instruct the Contractor and KDOT personnel in the correct installation procedures for the expansion joint system used.

Prepare the expansion gap area and install the expansion joint system according to the manufacturer's recommendations. Allow the expansion joint system to cure as recommended by the manufacturer before permitting traffic on the joint.

The Engineer will inspect the expansion gap area for the proper depth, width and alignment, as shown in the Contract Documents.

719.4 MEASUREMENT AND PAYMENT

The Engineer will measure expansion joints by the linear foot, measured along the centerline of the expansion joint.

Payment for "Expansion Joint (*)" at the contract unit price is full compensation for the specified work.

SECTION 720

SLIPFORMING CONCRETE BARRIER FOR BRIDGES

720.1 DESCRIPTION

At the Contractor's option, slipform the concrete barrier for the bridge.

720.2 MATERIALS

Provide Grade XX (AE)(SA) concrete for the bridge barrier that complies with **SECTIONS 401 & 402** and **SECTION 1102** with these exceptions:

- Determine the percent air using Kansas Test Method (KT-19); and
- The maximum slump allowed is ½ inch.

Provide set retarder admixture and liquid membrane forming compound Type 1-D, clear or translucent with fugitive dye that complies with **DIVISION 1400**.

720.3 CONSTRUCTION REQUIREMENTS

Form the ends of the bridge barrier. Brace all formed sections. Include bolt holes in the pattern and location required for installing guardrail. Form barrier sections with bridge name plates, deck drain boxes, light standards and expansion devices a minimum of 4 feet on each side of these locations.

Before placing concrete, check the clearance between the slipform machine and the reinforcing steel throughout the length of the barrier. While placing the concrete barrier, monitor the reinforcing steel at the entrance to the slipform machine to verify location and clearance. Brace reinforcing steel to prevent racking.

Place concrete in the uphill direction when slipforming concrete barriers on bridges with grades exceeding 2%.

See **DIVISION 700** for curing times required for the deck before using construction equipment or concrete delivery on new bridge decks.

If using trucks to deliver concrete to the slipform machine, limit the quantity of concrete each truck is allowed to haul to the load carrying capacity of the bridge, or 75% of the truck's rated capacity, whichever is less. Control the speed of vehicles entering or leaving the deck in order to limit deck movement. Except for vehicles necessary for the concrete placement operations, limit heavy vehicles on the bridge deck for 24 hours following the concrete placement of the barrier.

Construct a test section approximately 100 feet long to demonstrate the acceptability of the slipforming method. Repair or replace the test section, and form the remaining barrier in the conventional manner if the Engineer rejects the test section.

Correct surface irregularities and other defects. With the Engineer's approval of the methods, repair or remove and replace unacceptable portions of the barrier.

Following the slipforming, lightly broom both sides of the barrier vertically. Broom the top of the barrier perpendicular to the longitudinal axis of the barrier.

Cut contraction joints as shown in the Contract Documents without spalling, just prior to initial set.

Apply 2 coats of curing compound immediately after the brooming operation. The minimum application rate is 1 gallon per 250 square feet of barrier for both applications. Apply the second application immediately after the first application, and at right angles to the first application.

720.4 MEASUREMENT AND PAYMENT

Slipforming of concrete barrier is not measured for payment.

SECTION 721

HANDRAIL FOR BRIDGES AND OTHER USES

721.1 DESCRIPTION

Fabricate and erect the metal handrails according to the Contract Documents.

BID ITEMS	UNITS
Bridge Handrail (*) (**)	Linear Foot
Handrail (*) (**)	Linear Foot

* Type
** Size

721.2 MATERIALS

Provide materials that comply with **DIVISION 1600**.

721.3 CONSTRUCTION REQUIREMENTS

a. General. Fabricate, weld, paint and erect the metal handrails according to **DIVISION 700**.

Before ordering or fabricating the materials, submit shop drawings to the State Bridge Office for approval (**SECTION 105**).

Store handrail materials above ground on platforms or skids, with spacer blocks to keep the members separated. Protect the stored materials from contaminants and moisture.

Before placing concrete, protect the portion of the anchor bolts above the finished concrete line with wrappings or coatings of a release material. Use a template to verify the correct spacing and alignment of the anchor bolts. Remove the wrappings or coatings before erecting the handrails.

Before erecting the handrail posts, true the concrete surfaces where the posts will rest. Grind the concrete surfaces for proper seating, when required.

Erect the handrail by groups of posts corresponding to the length of each rail piece. Fully support handrail by posts at the time it is placed. The maximum deviation allowed from the correct alignment is ⅛ inch. Abrupt breaks in alignment must be corrected. Drifting of holes during assembly is permitted only to bring the parts into position. Do not enlarge the holes or distort the metal. Use beveled washers on beveled surfaces to give full bearing to both the head and nut. After the handrail is erected, align it and tighten the nuts on the anchor bolts.

b. Steel Handrail. Erect the handrail to line and grade using surveying instruments. Shim the handrail posts as required. For shims ⅛ inch or greater, use either steel or sheet lead shims. Only use 1 shim per post.

Unless the handrail is galvanized, apply 1 shop coat of paint after fabrication and one finish coat of paint after erection. Apply 2 shop coats of paint to surfaces that are inaccessible after assembly or erection. See **SECTION 714** for painting requirements.

c. Aluminum Handrail. Erect the handrail to line and grade using surveying instruments. Shim the handrail posts between the post and concrete surfaces, or between the post and base plate, as required. Use aluminum shims. If the shims are in contact with another metal or the concrete surfaces, coat the shims with caulking compound, or paint the shims with paint specifically used on aluminum, or use a synthetic rubber gasket.

721.4 MEASUREMENT AND PAYMENT

The Engineer will measure handrail from the center of end post to center of end post by the linear foot.

Payment for the "Bridge Handrail" or "Handrail" at the contract unit prices is full compensation for the specified work.

SECTION 722

SIGN STRUCTURES AND BRIDGE MOUNTED SIGN ATTACHMENTS

722.1 DESCRIPTION

Fabricate and erect bridge mounted sign attachments and sign structures to support signs over or adjacent to highways and streets as designated in the Contract Documents. The structures consist of:

- footings, including electrical grounding and conduit sleeves, when applicable;
- vertical support poles;
- vertical end support units;
- overhead trusses;
- structural attachment assembly;
- truss type arm; and
- maintenance walkway.

Remove, modify and reset the existing sign structures as designated in the Contract Documents.

BID ITEMS	UNITS
Bridge Mounted Sign Attachment (*)(**)	Each
Butterfly Overhead Sign Structure (*)(**)	Each
Cantilever Sign Structure (*)(**)	Each
Overhead Sign Structure (*)(**)	Each
Overhead Sign Structure (Mast Arm Type) (*)(**)	Each
Overhead Sign Structure (Single Tapered Tube) (*)(**)	Each
Remove and Reset Sign Structure (***)	Each
Reset Sign Structure (***)	Each
Sign Structure Modification (***)	Each

* Size or Size Group
** Type of Material

722.2 MATERIALS

Provide materials that comply with the applicable requirements.

Grade 4.0 Concrete	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTION 1102**
Cementitious Grout	**DIVISION 1700**
Castings	**DIVISION 1600**
Structural Steel	**DIVISION 1600**
Reinforcing Steel	**DIVISION 1600**
Steel Fasteners	**DIVISION 1600**

a. General. Provide new, unweathered materials of the type, and complying with the sizes, dimensions and tolerances shown in the Contract Documents.

Submit shop drawings according **SECTION 105**. Include a "cutting list" or "shop bill" that provides the piece mark length, outside diameter and wall thickness of each piece used in the fabrication of the structure. Provide an erection sketch, detailing the location of each piece in the final assembly. Do not perform any fabrication until the approved shop drawings are in the hands of the Inspector and fabricator, and the Engineer has authorized fabrication. Any purchase of materials before fabrication authorization is at the Contractor's risk. Changes to approved shop drawings are subject to the approval of the Engineer. Submit revised sheets of the same size as those originally approved.

Mark each bundle or package of material with letters, numbers or a combination of letters and numbers that are identified in the test report for that material. Mark each piece of material with letters, numbers or a combination of letters and numbers that are identified in the shop drawings. The marking must be legible, but not noticeable after erection of the structure.

b. Fabrication.

(1) Shop Welding. Perform welding and repairs in accordance with **SECTION 744**.

(2) Test Loading. Test loading of fabricated trusses is required only when inspection indicates the fabrication to be of doubtful or unacceptable quality requiring repairs before acceptance. Test load the structure to demonstrate the adequacy of the repair. The Contractor will bear the cost of test loading.

c. Electrical Equipment and Materials. Provide the electrical equipment and materials shown in the Contract Documents.

Submit to the Engineer for approval a schedule of electrical equipment and materials proposed for installation before beginning construction. Include catalog cuts, diagrams, drawings and other descriptive data required by the Engineer.

722.3 CONSTRUCTION REQUIREMENTS

a. General. Do not damage the existing cables and conduits. If necessary, relocate the existing cables and conduits to clear the footing locations. Repair or replace existing cables and conduits damaged during construction of the footings.

If temporary signs interfere with the erection of the permanent signs, relocate the temporary signs to the locations determined by the Engineer.

When "Contractor Construction Staking" is not shown as a bid item, the Engineer will stake the locations of sign structure footings. For each footing location, the Engineer will provide the Contractor with the vertical measurement from the crown grade of the pavement to the top of the footing.

Erect the bridge mounted sign attachments and sign structures according the Contract Documents.

If removing, modifying or resetting sign structures, do not damage the existing sign structures. Repair or replace, as directed by the Engineer, sign structures damaged through the negligence of the Contractor.

b. Concrete Footings. Construct the concrete footings according to the Contract Documents. When placing the concrete, consolidate the concrete in the footings by rodding and vibrating. Allow the concrete footings to cure a minimum of 4 days before attaching the sign structures.

c. Sign Structures.

(1) Bolted Joint Connections. Before assembling the sign structures, use a soft wire brush to clean the contact surfaces of the bolted connections. Remove all corrosion and coatings, except galvanizing. Wipe the cleaned contact surfaces with rags soaked with acetone, syol or toluol. Remove excess solvent from the contact surfaces using clean, dry rags.

Assemble the sign structures according to the Contract Documents. Seal all bolted joints immediately, using a sealant intended for this purpose, and applied according to the sealant manufacturer's recommendations.

(2) Attachment to Anchor Bolts. Place the sign structure with anchor plate on the anchor bolts. After all signs are mounted on the structure, and the sign pole (or bridge support) is plumb, proceed with anchor bolt tightening procedures. Fill the gap between the top of the footing and the bottom of the anchor plate with concrete grout according to the details in the Contract Documents.

(3) All Sign Structures.

- Do not use a pipe wrench to tighten nuts on Sign Structures;
- Use only a box end or socket wrench to snug tighten nuts;
- Maintain a minimum dimension of 6 inches from the top of foundation to finished grade;
- With approval of the Engineer, repair any marring of the galvanizing caused while lifting the structure into place;
- Submit specifications for the hydraulic wrench to the Construction Engineer (who will contact the Signing and Lighting Engineer) for approval; and
- If the four refusal maximum is exceeded on any DTI, discontinue tightening and contact the State Bridge Office;
- Grade the surrounding area to drain away from the structure.

(4) Existing Sign Structures. Verify the existing anchors will extend a minimum of one thread above the top tightened nut in the final condition. Do not damage the existing anchors during the removal of the existing hardware. Clean the threads of all rust and lubricate with an approved wax, prior to placing the new hardware.

Install DTIs on each anchor. Install a hardened washer on each anchor, if required. Use new hardware galvanized according to **SECTION 1616**. Verify the assembly (leveling nut, hardened washer(s), tower base plate, DTI, top nut) is in a snug tight condition before final tightening begins. Using the approved hydraulic wrench, tighten each nut to achieve a minimum of three refusals of the 0.005 gauge. Do not exceed four refusals of the 0.005 gauge. After tightening, score the remaining threads.

(5) New Sign Structures. Construct the elements of the structure according to the Contract Documents. Threads of the anchors shall be plumb and free of any construction debris.

Install DTIs on each anchor. Install a hardened washer on each anchor, if required. Use hardware galvanized according to **SECTION 1616**. Verify the assembly (leveling nut, hardened washer(s), tower base plate, DTI, top nut) is in a snug tight condition before final tightening begins. Using the approved hydraulic wrench tighten each nut to achieve a minimum of three refusals of the 0.005 gauge. Do not exceed four refusals of the 0.005 gauge. After tightening, score the remaining threads.

(6) Overhead Truss. In erection of the truss, allow the dead load deflection to take place before fully tightening all the connectors. Fully tighten the vertical portion which clamps the column in all corners, but tighten only the top of 1 end of the horizontal portion of the truss-to-end-support connector while the truss is fully suspended from the crane. The rest of the truss-to-end supports shall be fully tightened after the dead load of the truss is being supported by the connectors, but still attached to the crane with a slack line. Erect the signs within 24 hours of erecting the truss.

(7) Dissimilar Materials. Whenever dissimilar materials are to be in permanent contact, provide an insulating barrier of alkali resistant asphalt paint or equivalent.

d. Electrical Work. Comply with all Local, State and Federal ordinances.

(1) Conduit. Install conduit entrances through the concrete footing as indicated in the Contract Documents. Place temporary screwed caps on the conduit ends.

(2) Grounding. Ground all structures and sign bridges as detailed in the Contract Documents. Measure the resistance of the installed grounding system; the Engineer will observe the testing. The grounding system must have less than 25 Ω resistance to ground.

722.4 MEASUREMENT AND PAYMENT

The Engineer will measure each sign structure, bridge mounted sign attachment, removal and resetting of a sign structure and modification of a sign structure.

Payment for each "Bridge Mounted Sign Attachment", "Butterfly Overhead Sign Structure", "Cantilever Sign Structure", "Overhead Sign Structure", "Overhead Sign Structure (Mast Arm Type)", "Overhead Sign Structure (Single Tapered Tube)", "Remove and Reset Sign Structure", "Reset Sign Structure" and "Sign Structure Modification" at the contract unit prices is full compensation for the specified work.

SECTION 723

SUBSTRUCTURE WATERPROOFING MEMBRANE

723.1 DESCRIPTION

Apply an epoxy primer or an epoxy system to areas of the substructure as specified in the Contract Documents.

BID ITEM	UNITS
Substructure Waterproofing Membrane	Square Yard

723.2 MATERIALS

Provide materials that comply with **DIVISION 1700**.

723.3 CONSTRUCTION REQUIREMENT

Clean all surfaces that are to be waterproofed.

Apply the waterproofing membrane according to the manufacturer's recommendations.

Apply the membrane to a minimum 40 mils dry film thickness on the bridge seat as shown in the Contract Documents. Apply waterproofing membrane to promote drainage of the bridge seats, and to fill any low areas that may retain moisture. The average coverage should be approximately 3 ¾ gallons per 100 square feet.

723.4 MEASUREMENT AND PAYMENT

The Engineer will measure the substructure waterproofing membrane by the square yard to the limits shown in the Contract Documents.

Payment for the "Substructure Waterproofing Membrane" at the contract unit price will be full compensation for the specified work.

SECTION 724

BRIDGE BACKWALL PROTECTION SYSTEM

724.1 DESCRIPTION

Prepare the concrete surface and apply a bridge backwall protection system to the face of the concrete abutment and or the top surface of box culverts as specified in the Contract Documents.

BID ITEM	UNITS
Bridge Backwall Protection System	Square Yard

724.2 MATERIALS

Provide materials for bridge backwall protection systems that comply with **DIVISION 1700**.

724.3 CONSTRUCTION REQUIREMENTS

Provide the Engineer with a copy of the manufacturer's recommendations for application. If approved by the Engineer, apply the bridge backwall protection system as recommended by the manufacturer.

724.4 MEASUREMENT AND PAYMENT

The Engineer will measure the bridge backwall protection system by the square yard to the limits shown in the Contract Documents.

Payment for the "Bridge Backwall Protection System" at the contract unit price will be full compensation for the specified work.

SECTION 725

ABUTMENT DRAINAGE SYSTEMS

725.1 DESCRIPTION

Install the abutment drainage system specified in the Contract Documents.

For an abutment strip drain, install a geocomposite drainage system consisting of a prefabricated abutment strip drain, and perforated and non-perforated underdrain pipes, as designated in the Contract Documents.

For an abutment aggregate drain, install a geocomposite drainage system consisting of geotextile enclosed aggregate materials layered with base coarse reinforcement and perforated and non-perforated underdrain pipes, as designated in the Contract Documents.

BID ITEMS	UNITS
Abutment Strip Drain	Square Yard
Abutment Aggregate Drain	Cubic Yard

725.2 MATERIALS

Provide materials that comply with the applicable requirements.

Abutment Strip Drain .... **DIVISION 1700**
Geotextile Fabric………………………………………………………………….**DIVISION 1700**
Perforated Pipe for Underdrains .... **DIVISION 1900**
Non-Perforated Pipe for Underdrains .... **DIVISION 1900**
Geosynthetics (Class 2 Subsurface Drainage) .... **DIVISION 1700**
Geosynthetics (Base Course Reinforcement) .... **DIVISION 1700**
Geofoam .... **DIVISION 1700**
Aggregate for Structures and Pipe Backfill* .... **DIVISION 1100**
*Specified in the Contract Documents

725.3 CONSTRUCTION

a. General. Construct abutment drainage systems according to the Contract Documents.

b. Abutment Strip Drain. Clean the surfaces against which the geocomposite drains will be placed. Remove all soil, debris and irregularities that will prevent intimate contact between the surface and the drain.

Install the geocomposite drains either vertically or horizontally, according to the Contract Documents. Secure the geocomposite drains using metal stick clips or adhesives. When a waterproofing membrane is included in the Contract Documents, do not use nails to attach the geocomposite drain, unless the waterproofing membrane is self-healing.

Form all joints and splices according to the manufacturer's recommendations.

Cover all exposed edges of the geocomposite drainage core with geotextile filter fabric. Tuck and secure a minimum of 4 inches of fabric behind the core. This may be done by utilizing the excess fabric at the ends, or using a 12-inch strip of fabric in the same manner, taping it to the exposed fabric 8 inches in from the edge with a continuous strip of 3-inch, waterproof plastic tape and folding the remaining 4 inches over and tucking behind the core edge.

If the fabric is torn, perforated or ripped, patch it with a second layer of fabric having a 4-inch overlap, and secure the edges with 3-inch waterproof plastic tape. Replace damaged core sections.

Place the underdrain pipes as shown on the Contract Documents. Separate the fabric from the core. Wrap it around the circumference of the perforated underdrain pipe and tuck it behind the core.

c. Abutment Aggregate Drain.

- If the abutment area was over-excavated, replace the over-excavated area with aggregate for structures and pipe backfill to the limits of the excavation shown in the Contract Documents. Compact aggregate to Type B compaction, **SECTION 205**. This work will be performed at no additional cost to KDOT.

- After installing the Bridge Backwall Protection System (constructed and paid for according to **SECTION 724**), grade, shape and compact the cohesive soils to the dimensions shown in the plans.
- Shape and secure the geofoam to the previously placed Bridge Backwall Protection System without damaging the geofoam. Protect the geofoam from damage due to hydrocarbons (gas, diesel, solvents, etc.) and sunlight.
- Place the Class 2 Subsurface Drainage geosynthetic between the geofoam and the limits of the excavation with enough material to fully enclose and overlap at the top 3.0 feet and to fold and enclose the ends. Secure folds, any seams or splices and overlaps by sewing or manufacture's approved methods.
- Place the perforated 4-inch pipe as shown in the plans. Verify that any couplers are secured, that the slope is correct and in the intended direction.
- Place the first lift of aggregate so that there is 8 inches of aggregate above the pipe, level the aggregate and compact to Type B compaction, **SECTION 205**, using a hand operated plate compactor or other means approved by the Engineer. If the granular material cannot be shaped and compacted, as shown in the plans, then wrap 3.0 feet of the ends of each lift with Class 2 Subsurface Drainage Geosynthetic.
- Place the Base Coarse Reinforcement geosynthetic on compacted aggregate without gaps or sags and to the limits shown in the plans. Using the same methods above, successively place aggregate and Base Coarse Reinforcement geosynthetic in 12 inch lifts to the dimensions shown on the plans.
- Overlap the Class 2 Subsurface Drainage Geosynthetic a minimum of 3 feet on the top of the completed fill. Fold ends of the Class 2 Subsurface Drainage geosynthetic to enclose the fill and cut an opening, at the correct elevation, allowing the 4-inch pipe to exit the contained fill, but not the retained aggregate. Secure the lap, folds or any splices by sewing or by other methods approved by the manufacturer.
- Place Class 2 Subsurface Drainage geosynthetic over geofoam and enclosed aggregate as shown in the plans. Place and compact to soil cap material to the limits shown in the Contract Documents. Use material with a Unified Soil Classification of ML or CL. Compact to Type A compaction, MR-90, **SECTION 205**.

When shown on the plans, taper the contained aggregate, Base Course Reinforcement geosynthetic, and Class 2 Subsurface Drainage geosynthetic at the edge of the roadway. Fold, wrap and secure to create shape shown on the plans. Terminate the geofoam at limits shown in the plans. Perform work outside these limits shown on the plans according to the Contract Documents.

d. Backfill. Do not damage the abutment drainage system when backfilling the structure. Use backfill soils with a liquid limit of less than 50.

725.4 MEASUREMENT AND PAYMENT

The Engineer will measure abutment strip drains by the square yard to the limits shown in the Contract Documents.

The Engineer will measure abutment aggregate drains by the cubic yard to the limits shown in the Contract Documents.

Payment for "Abutment Strip Drain" and "Abutment Aggregate Drain" at the contract unit price is full compensation for the specified work. All other associated work is subsidiary.

SECTION 726

CONCRETE MASONRY COATING

726.1 DESCRIPTION

Prepare the concrete surfaces and apply a concrete masonry coating to the concrete surfaces designated in the Contract Documents.

BID ITEM	UNITS
Concrete Masonry Coating	Square Yard

726.2 MATERIALS

Provide concrete masonry coatings that comply with **DIVISION 1700**.

726.3 CONSTRUCTION REQUIREMENTS

Provide the Engineer with a copy of the coating manufacturer's recommendations for application.

Submit a sample panel exhibiting the color specified and the uniformity of the finish for approval by the Engineer.

Clean the concrete surfaces that will receive the coatings, before applying the concrete masonry coatings. Remove all projections and loose mortar particles from the concrete surfaces.

Store, mix, apply and cure the concrete masonry coating as recommended by the manufacturer.

726.4 MEASUREMENT AND PAYMENT

When shown is a bid item in the contract, the Engineer will measure concrete masonry coating by the square yard to the limits shown in the Contract Documents.

Payment for "Concrete Masonry Coating" at the contract unit price will be full compensation for the specified work.

SECTION 727

REPAIR (STRUCTURES)

727.1 DESCRIPTION

Perform the necessary procedures to repair the designated portion of the structure.

BID ITEMS	UNITS
Bridge Repair	Lump Sum
Jacking of Existing Structure	Lump Sum
Raise Expansion Device	Each
Remove and Reset Expansion Device	Each
Reset Existing Bearing	Each

727.2 MATERIALS

Provide the materials indicated in the Contract Documents. Provide the specified materials that comply with the materials' divisions (**DIVISIONS 1000 – 2500**).

727.3 CONSTRUCTION REQUIREMENTS

a. General. Repair the structure according to the Contract Documents and **DIVISION 700**.

If the Contract Documents require the superstructure be raised and supported on falsework while the repairs are made, allow the repaired areas to cure before resetting the structure.

Remove the old concrete to the limits shown in the Contract Documents. Dispose of the old concrete removed from the structure.

Do not damage the existing concrete that is to remain in place. Repair any damage to the existing structure caused by the Contractor.

Before any new concrete is placed, clean all reinforcing steel exposed during concrete removal. When specified, place new reinforcing steel as detailed in the Contract Documents.

When specified, apply an epoxy resin base bonding system to the adjacent concrete surfaces before placing the new concrete.

b. Jacking of Existing Structures. Use jacks, supported on falsework or by other methods, to raise the designated spans as units. When specified, move the spans as indicated in the Contract Documents.

c. Raise Expansion Device. Raise the expansion device as shown in the Contract Documents.

d. Remove and Reset Existing Expansion Devices. Relocate the existing expansion devices according to the Contract Documents and **DIVISION 700**.

e. Resetting Existing Bearing. Use jacks to raise and support the existing superstructure. Raise the existing superstructure no more than necessary to remove the load from the existing bearings.

Reset the existing bearing to the position shown in the Contract Documents.

Any welding required for the resetting of the existing bearing must comply with **DIVISION 700**.

Repaint areas damaged during the resetting of existing bearing according to the Contract Documents.

727.4 MEASUREMENT AND PAYMENT

The Engineer will measure jacking of existing structure by the lump sum. The Engineer will measure each raised or reset expansion device and reset bearing. The Engineer will measure the various types of structure repairs by the units shown in the Contract Documents.

Payment for "Bridge Repair", "Jacking of Existing Structure", "Raise Expansion Device", "Remove and Reset Expansion Device" and "Reset Existing Bearing" at the contract unit prices is full compensation for the specified work.

SECTION 728

BRIDGE CURB REPAIR

728.1 DESCRIPTION

Repair the bridge curb according to the Contract Documents. Use either the conventional method or the concrete surface repair-shotcrete method for placing the concrete.

BID ITEM	UNITS
Bridge Curb Repair	Linear Foot

728.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete (Conventional Method)	**SECTIONS 401 & 402**
Concrete Surface Repair-Shotcrete	**SECTION 826**
Aggregate for Concrete Not On Grade	**SECTION 1102**
Concrete Curing Materials	**DIVISION 1400**
Expansion Joint Materials	**DIVISION 1500**
Reinforcement Materials	**DIVISION 1600**
Epoxy Resin Base Bonding Systems	**DIVISION 1700**

728.3 CONSTRUCTION REQUIREMENTS

Remove and dispose of the unsound concrete to the limits shown in the Contract Documents.

Do not damage sound concrete that is to remain in-place. Repair any damage to the existing structure caused during removal.

Prior to placing any new concrete, clean all reinforcing steel exposed during the removal of the unsound concrete.

Apply an epoxy resin base bonding system to the adjacent concrete surfaces before placing any new concrete. If epoxy resin dries, reapply another coating.

If the new concrete is placed using conventional methods, construct and cure the bridge curb according to **DIVISION 700**.

If the new concrete is placed by the concrete surface repair-shotcrete method, apply the concrete according to **SECTION 826**.

728.4 MEASUREMENT AND PAYMENT

The Engineer will measure repaired bridge curb along the base of the curb by the linear foot.

Payment for "Bridge Curb Repair" at the contract unit price is full compensation for the specified work.

SECTION 729

MULTI-LAYER POLYMER CONCRETE OVERLAY

729.1 DESCRIPTION

Prepare the surface of the reinforced concrete bridge deck and construct a multi-layer polymer concrete overlay (overlay) as shown on the Contract Documents.

Provide an overall combination of labor and equipment with the capability of proportioning and mixing the polymer resin components and placing the primer and aggregate, in accordance with this specification and the manufacturer/supplier's recommendations.

BID ITEM	**UNITS**
Multi-Layer Polymer Concrete Overlay	Square Yard

729.2 MATERIALS

a. General.

(1) Proportion all polymer materials according to the manufacturer/supplier's recommendations.

(2) Provide the Engineer with a copy of the polymer materials manufacturer/supplier's mixing and application recommendations.

(3) If concrete bridge deck patching is specified, polymer concrete materials may be used for patching of the concrete bridge deck. See **SECTION 731**.

b. Epoxy. Provide a Type III epoxy resin as defined in **DIVISION 1700**.

c. Polyester. Provide a polyester resin as defined in **DIVISION 1700**.

d. Aggregate.

(1) Provide FA-C aggregate meeting **TABLE 1102-5** and **TABLE 1102-6**, or

(2) As provided by the polymer concrete overlay supplier in a prequalified system, **DIVISION 1700**.

729.3 CONSTRUCTION REQUIREMENTS

a. General. Wet cure concrete on new bridge decks for 14 days and allow the deck to dry for 21 days before applying the overlay.

Portland cement concrete patches require a minimum cure period of 28 days before application of the overlay.

At the preconstruction conference, discuss the patching material and the corresponding curing period. Submit changes, including a written statement from the polymer manufacturer/supplier recommending changes, to the Engineer for approval.

b. Equipment. Equipment is subject to approval of the Engineer and must comply with these requirements:

(1) Surface Preparation Equipment.

(a) Shot blasting equipment capable of producing a surface relief equal to the International Concrete Repair Institute (ICRI) Surface Preparation Level 6 to 7 or ASTM E 965 Pavement Macrotexture Depth of 0.04 to 0.08 inch. Final acceptance is based on testing procedures as outlined in KT-70, Part V.

(b) Shot/Sand blast equipment capable of producing the required surface relief on the deck adjacent to bridge rails and barriers and areas not accessible with shot blast equipment.

(c) Empty shot blasters and dispose of waste material a minimum of 50 feet from the prepared bridge deck. On long structures empty shot blasters on the unprepared surface a minimum of 50 feet from prepared surface to prevent contamination of the deck by return of dust to the prepared surface.

(d) The Engineer must approve the use of scarifiers, scrablers or milling machines.

(e) Wet sand blasting is prohibited.

(2) Mechanical Application Equipment.

(a) Polymer mixing and distribution system capable of accurate and complete mixing of the polymer resin and hardening agent, verification of the mix ratio and uniform and accurate distribution of the polymer materials at the specified rate on 100% of the work area.

(b) A self-propelled aggregate spreader (if required) capable of uniform and accurate application of the dry aggregate over 100 % of the work area.

(c) An air compressor capable of producing a sufficient amount of oil free and moisture free compressed air to remove all dust and loose material.

(d) Adequate additional hand tools to facilitate the placement of the polymer concrete overlay in accordance with this specification and the manufacturer/supplier's recommendations.

(3) Hand Application Equipment.

(a) Calibrated containers for accurate measurement of the polymer components.

(b) Paddle type mixer or other mixing device capable of accurate and complete mixing of the polymer resin and hardening agent.

(c) Notched squeegees and brooms capable of spreading the polymer material in accordance with this specification and the manufacturer/supplier's recommendations.

(d) Aggregate spreader capable of uniform and accurate application of the dry aggregate.

(e) Adequate additional hand tools to facilitate the placement of the polymer concrete overlay in accordance with this specification and the manufacturer/supplier's recommendations.

c. Preparation of Surface.

(1) When specified, perform any required repairs under **SECTION 731** and cure repairs, before preparation of the surface, unless placed with the overlay.

(2) Protect metal deck drains and areas of the curb or railing above the proposed surface from the shot blast.

(3) Close deck drains so the overlay materials will not pass through the drains.

(4) Remove any remaining contamination of the prepared deck surface or surface of subsequent courses. Sand blast or bush hammer contaminated areas to produce an acceptable surface for placement of the overlay.

(5) As the final preparation for the placement of the overlay, make a complete cleanup by shot blasting and/or other approved means, followed by an air blast with dry, oil free air or vacuum. Brooming is not acceptable. Remove all pavement marking, loose disintegrated concrete, dirt, paint, oil, asphalt, laitance carbonation and curing materials from patches and other foreign material from the surface of the deck.

(6) Produce a surface relief equal to the International Concrete Repair Institute (ICRI) Surface Preparation Level 6 to 7 or ASTM E 965 Pavement Macrotexture Depth of 0.04 to 0.08 inch.

(7) Place the first coat of the overlay within 24 hours of preparing the deck surface. Prepared surfaces exposed for more than 24 hours must be lightly sand blasted prior to application of the overlay.

d. Placing the Multi-Coat Polymer Concrete Overlay. Place the overlay to the grades, thickness and cross-sections as shown in the Contract Documents. Provide a technical representative of the polymer manufacturer/supplier on the job site during the placement of the overlay at no additional cost. The representative is to provide technical expertise to the Contractor and the Engineer regarding safe handling, placement and curing of the overlay.

(1) Visible moisture on the prepared deck at the time of placing the overlay is unacceptable. Identify moisture in the deck by taping a plastic sheet to the deck for a minimum of 2 hours (ASTM D 4263).

(2) Rain will not necessarily contaminate the surface. However, take care so no contamination has occurred. Traffic adjacent to the prepared surface during a rain will contaminate the surface.

(3) Follow all manufacturer/supplier suggested safety precautions while mixing and handling polymer components.

(4) Apply High Molecular Weight Methacrylate Primer, if required, at application rates shown in **TABLE 729-1**, or as directed by the material's manufacturer/supplier.

(5) Place the overlay in 2 separate courses at application rates shown in **TABLE 729-2** for the system being placed.

(6) Use notched squeegees or mechanical application equipment to place the prepared polymer on the deck immediately and uniformly at the prescribed rate.

(7) If mechanical application equipment is used, take 2 ounce samples for each 100 gallons of resin placed to verify mix ratios and curing times. Place samples on the bridge rail or deck and note time to cure.

(8) The bridge deck and all polymer and aggregate components must be at least 60°F at the time of application.

(9) Apply the dry broadcast aggregate to cover the polymer uniformly and completely within 10 minutes of application.

(10) Remove and replace any first course areas that do not receive enough aggregate before gelling of the polymer.

(11) Vacuum or broom excess aggregate from the first course after sufficiently cured. If damage or tearing occurs, stop brooming or vacuuming and allow additional curing time. See **TABLE 729-3** for curing guidelines.

(12) Do not open the first course to traffic.

(13) Place the polymer and aggregate for the second course at the prescribed rate and in the same manner as the first course. The second course can be placed immediately after brooming of the first course is completed.

(14) Recoat second course areas that do not receive enough aggregate before gelling of the polymer with additional polymer and aggregate.

(15) Locate any longitudinal joints along lane lines, or as approved by the Engineer. Keep the joints clear of wheel paths as much as practical.

(16) Produce and place the overlay within the specified limits in a continuous and uniform operation.

(17) Correct completed surface variations exceeding ⅛ inch in 10 feet, unless directed otherwise by the Engineer.

(18) Tape all construction joints to provide a clean straight edge for adjacent polymer concrete placement. This includes joints between previously placed overlay materials and at centerline.

(19) Finish the exposed edges at the ends of the bridge and at expansion joints to minimize bridge deck roughness.

(20) Apply a bond breaker to all expansion joints.

(21) Vacuum or broom excess aggregate from the bridge deck after the polymer is sufficiently cured. If damage or tearing occurs, stop brooming or vacuuming and allow additional curing time.

e. Face of Curbs, Barriers, and Corral Rail Posts. Use a paintbrush or roller to apply the polymer resin on the face of curbs, barriers, and corral rail posts.

- On bridges with a corral rail, apply the polymer resin to the front face and adjacent sides of all posts.
- On bridges with curbs apply the polymer resin to the top of the curb face.
- On bridges without curbs apply the polymer resin to the edge of the deck.
- On bridges with continuous concrete barrier rails, apply the polymer resin to the first break in the geometry of the barrier or a minimum of 6 inches, uniform. Protect areas above the break line (or minimum of 6 inches) from resin. Apply so the top threshold of the resin follows a uniform line along the rail.

This work is subsidiary to the bid item Multi-Layer Polymer Concrete Overlay.

Apply primer (if required) and polymer to the curb or barrier as each of the overlay applications are performed.

f. Application Rates. Place epoxy and polyester materials at the same rate.

Place primer (if required) at the application rate shown in **TABLE 729-1**.

Place the overlay in 2 separate courses at application rates shown in **TABLE 729-2**.

TABLE 729-1: HIGH MOLECULAR METHACRYLATE PRIMER APPLICATION RATES for MULTI-LAYER POLYMER CONCRETE OVERLAYS	
Primer	Each Coat Not Less Than 0.09 gal./sq yd

TABLE 729-2: APPLICATION RATES for MULTI-LAYER POLYMER CONCRETE OVERLAYS		
Course	**Polymer Rate**	**Aggregate Rate ***
1	Not Less Than 0.22 gal./sq yd	10 lbs./sq yd
2	Not Less Than 0.45 gal./sq yd	14.5 lbs./sq yd

*Apply enough aggregate to completely cover the polymer.

g. Curing.
(1) Epoxy. Minimum curing times are noted in **TABLE 729-3**.

TABLE 729-3: EPOXY CURE TIMES for MULTI-LAYER POLYMER CONCRETE OVERLAYS							
Course	**Average Temperature of Overlay Components, °F**						
	55-59	**60-64**	**65-69**	**70-74**	**75-79**	**80-85**	**85+**
	Minimum Cure Time (hours)						
1	5	4	3	2.5	2	1.5	1
2	6.5	6.5	5	4	3	3	3

Cure the second course for 8 hours if the air temperature falls below 55°F during the curing period before opening to traffic.

(2) Polyester. Proportion polyester courses so the cure times are between 30 and 120 minutes. Accelerators and inhibitors may be required to achieve proper set times. Proportion all materials as recommended by the material supplier.

(3) Plan and perform the work in such a way as to provide for the minimum curing times specified in this specification or as specified by the material manufacturer/supplier.

h. Testing. Perform Polymer Concrete Overlay Bond Evaluation as outlined in KT-70, Part V.

(1) Place a polymer concrete test patch of not less than 0.5 square yards per lane or planned completed day's work whichever is smaller. Submit a sequence plan to the Engineer. Test patches shall be full depth, placed by the normal construction sequence. Test patches should be representative of the work being performed.

(2) Perform a minimum of 4 pull-off tests on each patch as outlined in KT-70, Part V.

(3) Final acceptance will be based on the following results of the test outlined in KT-70, Part V:

- Type 1 – Failure in the concrete at a depth greater than or equal to ¼ inch over more than 50% of the test area for 3 out of 4 tests in the test patch.
- Type 2 – Failure in the concrete at a depth less than ¼ inch over more than 50% of the test area for 3 out of 4 tests in the test patch.
- Minimum Tensile Rupture Strength of 250 psi from an average of 3 out of 4 tests on a test patch regardless of depth of failure.

(4) If failure in the concrete is at a depth less than ¼ inch and the Minimum Tensile Rupture Strength is less than 250 psi, or the failure in the concrete is less than 50% of the test area, additional surface preparation is necessary.

(5) A failure in the concrete below 250 psi and greater than ¼ inch deep indicates weak concrete, not poor overlay bond. No additional surface preparation is required.

(6) Do not perform tensile adhesion tests when ambient or deck temperatures are above 85°F.

i. Correction of Unbonded or Damaged Areas. Repair new overlay areas discovered to be unbonded by tapping or chaining and areas where the overlay was damaged by the Contractor's operation. Saw cut the unbonded or damaged areas to the top of the deck surface, remove the overlay with small air tools (15-pound class maximum) or shot blasting. Aggressively sandblast or shot blast the concrete bridge deck surface at the unbonded area to remove contaminants. Replace the overlay according to standard placement procedures at no additional compensation.

j. Weather Limitations.
(1) Epoxy. Do not place the overlay if the air temperature is expected to drop below 55°F within 8 hours of placement.

(2) Polyester. Do not place any component of the overlay if the air or substrate temperature is at or expected to drop below 40°F during installation.

(3) General. Do not place the overlay when the deck temperature will exceed 90°F.

Do not place the overlay if gel time is less than 10 minutes.

The overlay may be placed outside the specified temperature ranges with the approval of the Engineer and the material manufacturer/supplier. Discuss changes to temperature limitations at the preconstruction conference.

Submit changes, including a written statement from the polymer manufacturer/supplier recommending the changes, to the Engineer for approval.

729.4 MEASUREMENT AND PAYMENT

The Engineer will measure multi-layer polymer concrete overlay by the square yard. The Engineer will measure the bridge roadway width and the bridge length from end of wearing surface to end of wearing surface.

Payment for "Multi-Layer Polymer Concrete Overlay" at the contract unit price is full compensation for the specified work.

SECTION 730

EPOXY RESIN CRACK REPAIR

730.1 DESCRIPTION

Repair cracks in the concrete by epoxy injection at the locations shown in the Contract Documents, or as designated by the Engineer.

BID ITEM	UNITS
Epoxy Resin Crack Repair	Linear Foot

730.2 MATERIALS

Provide a Type IV, Grade 1, Class B or C epoxy material for injection purposes that complies with **SECTION 1705** and is compatible with the concrete temperature at the time of repair.

For sealing surface cracks, provide either:

- Silicone Rubber Surface Crack Sealant (clear or gray) that complies with **SECTION 1724**.
- Type IV, Grade 3, epoxy material that complies with **SECTION 1705**.

730.3 CONSTRUCTION REQUIREMENTS

a. General. A representative of the Bureau of Research must approve the Contractor's equipment before work starts on the project.

Arrange to have a representative of the Bureau of Research present when the work begins. The KDOT representative will remain on the project until both the Contractor and Inspectors have an understanding of the proper procedures for this work.

Provide a log and record the following data as injection proceeds:

- The date the injection ports are set;
- The date the injection is performed;
- The length of the crack injected;
- The amount of epoxy used;
- The temperature of the concrete in which the injection is performed; and
- The air temperatures when injection is performed.

The Project Engineer must approve the injection log and verify the correctness of the recorded data. Upon completion of the project, provide the Project Engineer with the recorded data. The Project Engineer will forward this information to the Bureau of Structures and Geotechnical Services.

Make a representative of the material manufacturer available at the request of the Engineer.

Injected epoxy resin must be allowed to set a minimum of 4 hours before allowing traffic on the structure.

The materials, construction procedures, and the completed project will be inspected and approved by the Engineer.

b. Sealing Surface Cracks. Seal all visible surface cracks in the concrete. Before sealing the surface cracks, clean the surface to which the sealant will be applied.

Do not apply the sealant to wet surfaces. Apply the sealant with a minimum thickness of ⅛ inch, and a width of ¾ inch on both sides and ends of the crack.

If silicone rubber sealant is used, allow the sealant to cure a minimum of 24 hours. If an epoxy sealant is used, follow the epoxy manufacturer's recommendations for minimum cure time requirements based on substrate and ambient temperatures.

c. Epoxy Resin Crack Injection. Drilled ports or surface mount ports are acceptable. If drilled ports are used, vacuum drilling of the port holes is required. Place drilled injection ports at a depth recommended by the injection equipment manufacturer.

Space the epoxy injection ports as recommended by the material supplier and/or the epoxy injection equipment manufacturer.

Allow adhesive used to attach injection ports to cure for 24 hours before injecting the epoxy resin.

Begin injecting at the lowest part of the concrete and work upward as the cracks are filled. This will be evidenced by the presence of epoxy in the next port above. On horizontal cracks proceed with injection from one end of the crack and work toward the other.

Check for leaks in the surface sealed cracks during the epoxy injection operations. If leaks are found, repair the sealant with hot glue and tongue depressors or other methods approved by the Engineer.

On cracks of ⅛ inch or wider, limit the back pressure to a maximum of 30 psi. On all other cracks, maintain the back pressure between 80 and 100 psi.

After the injection is complete clean all surfaces of sealer and epoxy materials.

730.4 MEASUREMENT AND PAYMENT

The Engineer will measure epoxy resin crack repair by the linear foot.

Payment for "Epoxy Resin Crack Repair" at the contract unit price is full compensation for the specified work.

SECTION 731

AREA PREPARED FOR PATCHING (EXISTING CONCRETE BRIDGE DECKS)

731.1 DESCRIPTION

Perform all work necessary to remove all asphalt material and unsound concrete from the existing bridge or the designated area to the depth specified in the Contract Documents, or as designated by the Engineer.

BID ITEMS	UNITS
Area Prepared for Patching	Square Yard
Area Prepared for Patching (Full Depth)	Square Yard
Area Prepared for Patching (Poured with Overlay)	Square Yard
Area Prepared for Patching (Set Price)	Square Yard
Area Prepared for Patching (Full Depth) (Set Price)	Square Yard

731.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete .... **SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade .... **SECTION 1102**
Concrete Curing/Precure Materials .... **DIVISION 1400**
Reinforcing Steel .... **DIVISION 1600**
Epoxy Resin Base Bonding Systems .... **DIVISION 1700**
Rapid Set Concrete Patching Materials* .... **SECTION 1716**
***When specified in the Contract Documents.**

On bridge decks that do not receive a concrete overlay, use coarse aggregate complying with **SECTION 1102**, except grading must adhere to **TABLE 731-1**.

TABLE 731-1: AGGREGATE GRADATION	
Sieve Size	**Percentage Retained**
¾ "	0
½ "	0-10
⅜ "	15-50
#8	90-100

731.3 CONSTRUCTION REQUIREMENTS

a. General (All Decks). Remove asphalt material and unsound concrete as shown in the Contract Documents and as designated by the Engineer, to the depth required to reach sound concrete and rust free reinforcing steel. Dispose of removed material on sites approved by the Engineer.

Unless specifically noted in the Contract Documents, the Contractor may choose to remove unsound concrete by other means capable of removing the required concrete, without injury to the sound concrete and reinforcing steel.

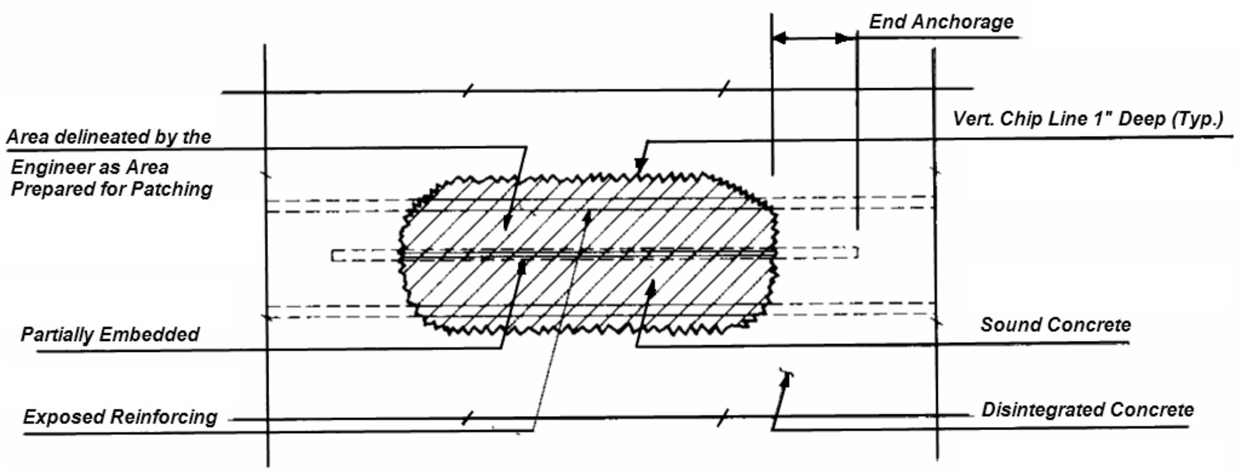
Unless specifically noted in the Contract Documents, the Contractor may **not** choose to remove unsound concrete by hydrodemolition. When hydrodemolition is allowed, remove the required concrete, without injury to the sound concrete and reinforcing steel. When hydrodemolition is allowed and used as the method of removal, the Engineer will determine the areas of unsound concrete after hydrodemolition.

Do not use jack hammers or chipping hammers heavier than the nominal 15-pound class on any partial depth concrete removal. Jack hammers up to the nominal 30-pound class may be used in areas of full depth patching to within 6 inches of the edges of the designated areas. Do not use chipping hammers heavier than a nominal 15-pound class to remove the 6-inch edge. Operate jack hammers and chipping hammers at an angle to prevent damage to the sound concrete.

731 - AREA PREPARED FOR PATCHING (EXISTING CONCRETE BRIDGE DECKS)

(1) Reinforcing. Remove all scale and heavy rust from steel bars. When concrete is removed by jack hammers, wet sandblasting is prohibited. If reinforcing is left exposed, and signs of rust appear, the Engineer may require that the cleaning be repeated. Do not cut, stretch or damage any exposed reinforcing steel. Do not break the bond between the reinforcing steel and concrete where bars are partially exposed yet remain anchored in sound concrete, near the ends or where more than half the bar is beneath the concrete removal line. See **FIGURE 731-1**.

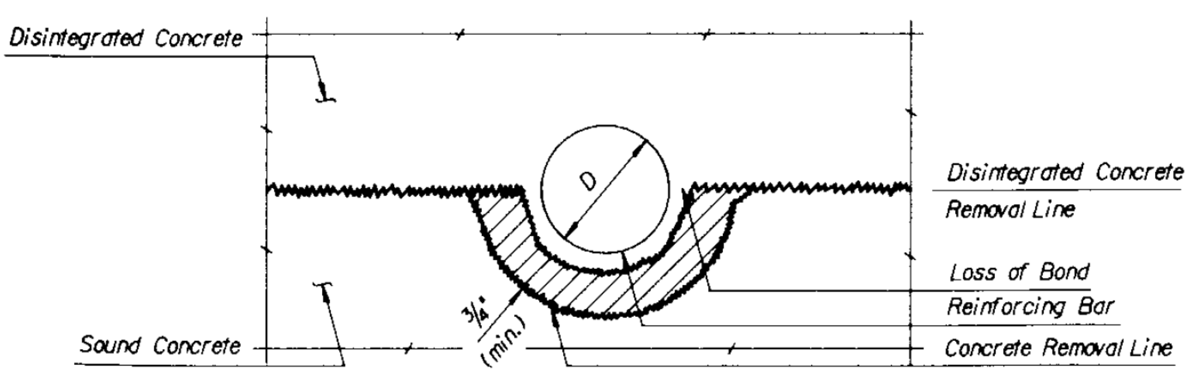
FIGURE 731-1



(2) Bonding of Reinforcing Steel.

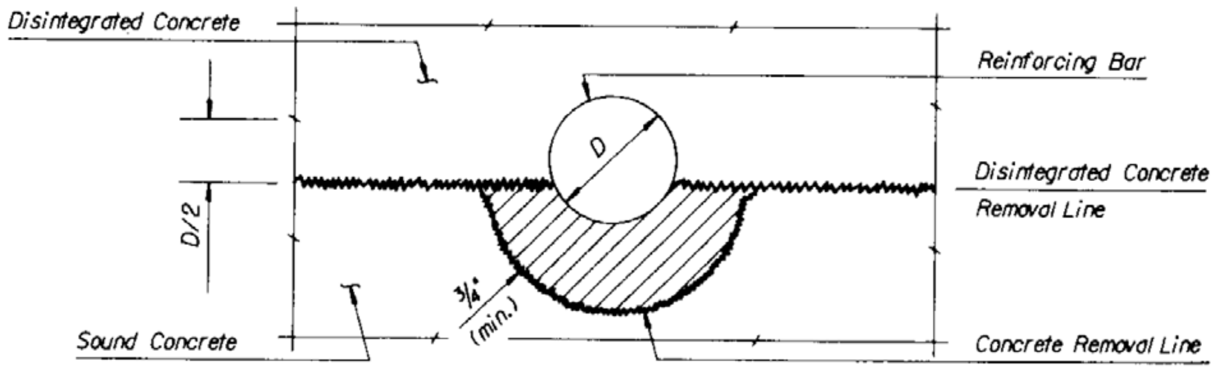
(a) Top Layer of Transverse Reinforcing Bars. Where the bond between existing concrete and the top layer of transverse reinforcing steel has been destroyed (**FIGURE 731-2**), remove the concrete adjacent to the bar to a depth that shall permit concrete to bond to the entire periphery of the bar with a minimum clearance of ¾ inch. A bar may be considered bonded by the Engineer even if less than ½ the bar depth is embedded in concrete.

FIGURE 731-2



(b) All Reinforcing Bars Other Than the Top Layer of Transverse Bars. Where more than ½ the diameter of the steel is exposed (**FIGURE 731-3**), or where the bond between existing concrete and reinforcing steel has been destroyed (**FIGURE 731-2**), remove the concrete adjacent to the bars to a depth that shall permit concrete to bond to the entire periphery of the bar with a minimum clearance of ¾ inch.

FIGURE 731-3



(3) Concrete Surface Preparation. Wet the surface with water, but prevent free standing water. No grout is required.

(4) Epoxy Resin Base Bonding Agent. Coat all abutting vertical edges in full depth patches with an epoxy resin bonding agent. Apply the adhesive material according to the manufacturer's recommendations, just prior to the placement of patching concrete. Provide good bond of the patch material at the edges of the patch area by applying additional vibration or hand tamping. If epoxy resin dries, reapply another coating.

(5) Concrete Placement. Place concrete according to **SECTION 710**.

(6) Segmental Construction. When large scale patches in the deck result in the debonding of the reinforcing steel, patch in segments to the size and spacing shown in the Contract Documents or as designated by the Engineer. After the initial segments have cured, if required, patch the areas between segments. Heavy equipment, such as volumetric mixing equipment, is prohibited on full depth patches for a minimum of 24 hours after the curing period has ended.

(7) Concreting in Hot Weather. Adhere to **subsection 710.3** when concreting in hot weather. A monomolecular film may be used to prevent rapid evaporation of water rising to the surface of the concrete. Do not use the film to work up grout as an aid to finishing operations. Use precure to prevent rapid evaporation between the initial strike off and brooming prior to covering with the curing media at ambient air temperatures above 70ºF, or when combinations of temperature, low humidity and wind create conditions which, in the judgment of the Engineer, require hot weather procedure. Apply 1 or more light applications of monomolecular film as required by weather and finishing conditions. Complete curing as noted in **subsection 731.3c.(4)**.

(8) Concreting in Cold Weather. Except by specific written authorization, concreting operations are prohibited when a descending air temperature falls below 45ºF. Do not start or resume concreting operations until the ascending ambient air temperature reaches 40ºF.

b. Bridge Decks That Are To Receive An Overlay. Use aggregate specified for Grade 4.0(AE) concrete. Use the course aggregate specified for wearing surface. Patching concrete slump must be 2 ½ to 3 ½ inches.

Cure a minimum of 24 hours prior to placing the new overlay.

On partial depth areas where there is no loss of bond with the reinforcing steel, fill patched with Grade 4.0(AE) concrete or with the type of concrete specified for the overlay. Place partial depth patches less than 1 inch thick along with the overlay. The remaining patches may be placed just before or as the overlay is placed, unless shown otherwise in the Contract Documents. Fill all prepoured patches to a level approximately ¼ inch below the top of the old existing deck. Cure the prepoured patches a minimum of 24 hours.

Adhere to **TABLE 731-2** for the minimum length of cure time after the placement of all full depth concrete patches and/or removal of adjacent concrete on segmental patching and prior to placing overlay.

TABLE 731-2: BRIDGE PATCHING CURING	
Minimum length of Cure Time*	**Ambient Air Temperature Range (ºF)**
48 hours	Above 60
72 hours	40 to 60
120 hours	32 to 40

*In special circumstances, longer cure times may be required by the Engineer.

Use wet burlap or polyethylene sheet for curing or cure according to **subsection 710.3e.** and **TABLE 710-1** for subdecks.

c. Bridge Decks That Do Not Receive An Overlay.

(1) Removal of Old Concrete. Remove unsound concrete to the limits designated in the Contract Documents or by the Engineer. Prior to removal, saw the perimeter of the patch, but do not saw into the reinforcing steel. Chip out the connecting edges below the sawed portion to nearly true lines. Do not damage sound concrete and dispose of the removed materials on sites approved by the Engineer. Perform final cleanup with a high pressure water jet with a minimum pressure of 3,500 psi or by sandblasting methods.

(2) Composition and Consistency of Concrete. Use Grade 4.0(AE) concrete with a slump between 2 ½ to 3 ½ inches at the point of placement.

(3) Placing, Consolidating and Finishing Concrete. Carefully place concrete to prevent segregation. Vibrate using a spud vibrator. Do not touch the old concrete underneath. Tamp the concrete in place using hand tamps with a maximum of 36 square inches of face. Strike off and finish the patch with wooden floats, followed by a light brooming for final finish.

(4) Curing. Apply the curing material after the finishing operation when marring the surface shall not occur. Cure the concrete surface using wet burlap and polyethylene sheets according to **subsection 710.3e.** and **TABLE 710-1** for bridge deck wearing surfaces. Keep the curing material in place for a minimum of 72 hours, unless designated otherwise by the Engineer. Keep burlap continuously wet during the curing period.

d. Bridge Decks That Receive a Multi-Layer, Single-Layer or Slurry Polymer Concrete Overlay.

(1) Polymer concrete materials may be used for patching of the concrete bridge deck.

For shallow patches, 3 inches maximum depth, polymer concrete overlay resin and FA-C aggregate, **TABLES 1102-3** and **1102-4,** may be used.

For deep patches, greater than 3 inches polymer concrete overlay resin with an approved MA-1 or MA-2 aggregate, **TABLE 1102-6,** may be used.

The slurry polymer concrete system may be used for shallow and deep patching with the manufacturer/supplier's recommendation.

Mix and cure all patching according to manufacturer/supplier's recommendations.

(2) A Rapid Set Concrete Patching Material, compatible with the overlay may be used for patching the concrete bridge deck.

(3) Strike off patches to a level approximately ¼ inch below the top of the original concrete deck.

731.4 MEASUREMENT AND PAYMENT

The Engineer will measure the area prepared for patching by the square yard after the designated thickness of surface has been removed. The measured pay quantity will be those areas sounded by the Engineer and marked as unsound or delaminated concrete.

The Engineer will measure full depth patching prior to placement of patching concrete.

The Engineer will measure areas of partial depth patching poured with the overlay before the overlay is placed. Pay quantity for partial depth patching will be the marked areas of unsound or delaminated concrete minus the sum of the partial depth patching poured with the overlay and the full depth patching.

Payment for "Area Prepared For Patching" and "Area Prepared For Patching (Full Depth)" at the contract unit prices and "Area Prepared For Patching (Set Price)" and "Area Prepared For Patching (Full Depth) (Set Price)" at the contract set prices are full compensation for the specified work when shown in the contract.

731 - AREA PREPARED FOR PATCHING (EXISTING CONCRETE BRIDGE DECKS)

When the contract items include both "Area Prepared for Patching" and "Area Prepared for Patching (Full Depth)", the price bid for "Area Prepared for Patching (Full Depth)" shall be a minimum of 1 ¼ times the price bid for "Area Prepared for Patching". Failure to comply with this requirement is cause for rejection of the bid.

"Area Prepared for Patching (Poured with Overlay)" will be paid at 70% of the contract unit price for "Area Prepared for Patching" and is full compensation for the specified work. Payments made for of "Area Prepared for Patching (Poured with Overlay)" will be shown as an added item to the contract. Concrete for the partial depth patching poured with the overlay will be paid for as provided in the overlay specification.

When no contract item is shown for "Area Prepared For Patching (Full Depth)" and upon approval of the Engineer, areas prepared for patching that are full depth requiring forming on the underside shall be paid for at a rate of 2 ¼ times the contract unit price per square yard of "Area Prepared For Patching".

Concrete used to fill patched areas shall be subsidiary to other items of the contract.

SECTION 732

MACHINE PREPARATION
(EXISTING CONCRETE BRIDGE DECKS)

732.1 DESCRIPTION

Prepare the bridge deck surface for a concrete bridge deck overlay by removing the existing concrete and asphaltic material from bridge deck and approaches as shown in the Contract Documents.

BID ITEM	UNITS
Machine Preparation (*)	Square Yard
*Thickness	

732.2 MATERIALS - None specified.

732.3 CONSTRUCTION REQUIREMENTS

Remove concrete and asphaltic materials from the existing surface to the specified depth over the area of the deck by means of milling or cutting procedure capable of removing the specified material without injury to the sound concrete.

When specified, mill the approaches according to the Contract Documents.

732.4 MEASUREMENT AND PAYMENT

The Engineer will measure machine preparation by the square yard. Milling of approaches is subsidiary to the machine preparation bid item.

Payment for "Machine Preparation" at the contract unit price is full compensation for the specified work.

SECTION 733

BRIDGE DRAINAGE SYSTEMS & DECK DRAIN EXTENSIONS

733.1 DESCRIPTION

Provide and install the bridge drainage system as shown in the Contract Documents.

Submit to the Engineer for approval shop drawings of the bridge drainage systems showing methods for accommodating thermal expansion, if necessary. Use 15 x 10^{-6} in/in / ºF as the coefficient of thermal expansion for fiberglass systems.

Include in the shop drawings the methods to be used to properly position the bridge drainage system for the temperature at the time of installation. Show the amount of adjustment required for temperature changes (in 10° increments). The mean temperature shall be assumed 60ºF.

Provide material for and install bridge deck drain extensions as shown in the Contract Documents.

BID ITEMS	UNITS
Bridge Drainage System (*)	**
Bridge Deck Drain Extension	Each

*Steel or Fiberglass
**Unit of Measure Shown in the Contract Documents

733.2 MATERIALS

Provide materials that comply with the applicable requirements.

Structural Steel Fabrication and Painting	**DIVISION 700**
Structural Steel	**DIVISION 1600**
Castings	**DIVISION 1600**
Steel Fasteners	**DIVISION 1600**
Anchor Bolts for Structural Uses	**DIVISION 1600**
Steel Fasteners	**DIVISION 1600**
PVC Pipe	**DIVISION 1900**
Fiberglass Pipes and Fittings	**DIVISION 1900**

Joint Adhesive. Bond adhesive joint will be a vinyl ester resin based product with silica filler, polyester pigment, and methyl ethyl ketone peroxide catalyst. The adhesive formulation will be certified proven suitable for the intended application. Certify the resin to have no additives that leach out, catalysts which remain active or other ingredients that could lead to deterioration.

733.3 CONSTRUCTION REQUIREMENTS

a. Bridge Drainage System (Steel). Install the steel bridge drainage system according to **SECTION 712** and the Contract Documents.

b. Bridge Drainage System (Fiberglass). Use "bell and spigot" type adhesive bonded joints.

Use a standard sling, clamp or clevis hanger as used in steel pipe applications.

Use a split fiberglass pipe protective sleeve bonded in place at all support locations of a length no less than the pipe diameter being supported.

Install according to the approved shop drawing, Contract Documents, and guidelines and procedures recommended by the manufacturer.

Install the fiberglass bridge drainage systems that will not restrict movements between the substructure and superstructure or causes damage to the drainage system during expected thermal movements.

The strap thickness will be 3/16 inch for all hangers, a minimum width of 1 ½-inch for 8-inch and 10-inch pipe and 2 inches for greater than 10 inches. The sling, clamp for clevis will be sized to accommodate the pipe protective sleeve. Use a double nut on all connectors to prevent over tightening and to lock the nuts against each other.

Use bonded rigid couplers. Insert pipes so that the ends are centered.

Sand spigot ends to remove glossy finish and expose fibers. Insert pipe so it bottoms out within the bell fitting to create a fully fitted joint. Mix and apply 2 layers of adhesive according to the manufactures recommendations. Secure the joint so it cannot move, do not twist the joint. Do not disturb the joint until it has gelled according to the manufactures recommendations. An electric heat gun or heating collar may be used to accelerate gelation of the joint.

c. Bridge Deck Drain Extensions. Install angles equally spaced around the perimeter of PVC pipe using two 1 ¾-inch long by ½ -inch diameter bolts with a flat washer and lock nut. Place the bolt head on the inside of the PVC pipe.

Anchor the steel angles to the bottom of the deck using a concrete hex nut sleeve anchor. Use a 5/8-inch diameter sleeve anchor with an effective anchor length of 2 ½ inches and a bolt with a ½-inch diameter. Embed all anchors a minimum of 2 inches into the bottom of the concrete. Drill and place the anchors in accordance with the anchor manufacturer's recommendations.

Plumb the completed drain extension and place the PVC pipe flush against the bottom of the concrete.

Use PVC pipe lengths that extend a minimum of 12 inches below the bottom of the beam, girder, chord or slab. If the beam, girder, chord or slab is not of uniform depth, vary the length of each extension to provide the 12-inch minimum.

733.4 MEASUREMENT AND PAYMENT

The Engineer will measure bridge drainage system by the units shown in the Contract Documents.

The Engineer will measure each bridge deck drain extension.

Payment for "Bridge Drainage System" and "Bridge Deck Drain Extension" at the contract unit prices is full compensation for the specified work.

SECTION 734

STRUCTURAL PLATE STRUCTURES

734.1 DESCRIPTION

Assemble and install the size and type of structural plate structure specified in the Contract Documents.

BID ITEMS	UNITS
(*) Structural Plate Pipe (**) (***)	Linear Foot
(*) Structural Plate Pipe Arch (**) (***)	Linear Foot
(*) Structural Plate Arch (**) (***)	Linear Foot

*Size, diameter or span and height
**Gauge
***Asphalt Coated

734.2 MATERIALS

Provide structural plate for pipe, pipe arches and arches that comply with **DIVISION 1900**.

734.3 CONSTRUCTION REQUIREMENTS

Submit the design to the Engineer for approval, before installing any structural plate structure.

Include a Load Rating Table on the working drawings and provide the SBO with a LFR and LRFR rating and support calculations for the structure. The load rating shall take into consideration varying fill depths and KDOT live load criteria. For LFR Load Rating, include HS-20-44, KDOT rating vehicles for Inventory and Operating rating factors. Rate the Heavy Equipment Transport (HET) vehicle for Operating rating factor. For LRFR, use HL-93 for Inventory and Operating. Submit a Load Rating Report along with the working drawings. Include in the Load Rating Report a summary rating table, assumptions used in the load rating, the depth of fill, material strengths and any other significant information required to load rate the precast culvert. The Load Rating will include all elements of the proposed system including, but not limited to stub-walls and connections.

If the Contract Documents require a concrete footing, construct the footing according to **DIVISION 700**.

Excavate for and form the bed for the structural plate structures according to **DIVISION 200**. If placing 2 or more structural plate structures adjacent to each other, separate them by a distance equal to ½ the diameter of the pipe for structural plate pipe, and by a distance of 2 feet for structural plate pipe arch.

Do not damage the plates during assembly and erection. Replace plates that are damaged during shipping or assembly. Repair any damaged coating after erection

Assemble the structural plate structure true to the dimensions shown in the Contract Documents, with all connections tight. When required by the Contract Documents, provide and erect strutting within the structure during construction, leaving it in place until the structure is backfilled.

Backfill the structure according to **DIVISION 200**.

734.4 MEASUREMENT AND PAYMENT

The Engineer will measure structural plate structure by the linear foot, along the centerline of the structure. The Engineer will measure structural plate structures with vertical ends from end to end. The Engineer will measure structural plate structures with sloping ends from the center point of the slope on one end to the center point of the slope on the opposite end.

Payment for the "Structural Plate Pipe", "Structural Plate Pipe Arch" and "Structural Plate Arch" at the contract unit prices is full compensation for the specified work.

SECTION 735

PRECAST REINFORCED CONCRETE BOX

735.1 DESCRIPTION

Install the specified sizes of precast reinforced concrete boxes at the locations designated in the Contract Documents.

Unless specified otherwise in the Contract Documents, the Contractor has the option to substitute precast reinforced concrete boxes for the cast-in-place reinforced concrete boxes shown in the Contract Documents.

Submit all working drawings according to **SECTION 105**.

BID ITEM	**UNITS**
Reinforced Concrete Box (*) (Precast)	Linear Foot
*Size	

DESIGN:

- Design the precast concrete box units in accordance with the AASHTO LRFD Bridge Design Specifications, latest version.
- Precast wings and headwalls are prohibited at stream crossings.
- Cast-in-place end sections shall conform to KDOT Standard BR031.

For fill heights less than or equal to 3 feet:

- Use epoxy coated reinforcing steel and air entrained concrete
- Use a distribution slab meeting the requirements of KDOT Standard BR031.
- Use an approved “non-coal tar” bridge backwall protection system to cover the middle 1/3 of the top of precast arch culverts, the complete top slab of precast rigid frame culverts and the uppermost 12 inches of the outside walls.
- Indicate on the shop drawings the limits of the bridge backwall protection system.

Prior to beginning foundation construction, submit complete design calculations, including loadings, for the Engineer’s review. Design calculations and loadings may be submitted prior to the working drawing submittal. Submit design calculations sealed by a Kansas licensed Professional Engineer.

Prior to fabrication, submit to the Engineer for review and approval, working drawings including the supplier’s manufacturing specifications, details of all phases of construction, including layout, joint details, lifting devices, casting methods, construction placement and details of any cast-in-place sections. Submit working drawings according to **SECTION 105**.

Designate proposed transportation methods, and submit over-height and overload permits, if required, with the working drawings.

When required, submit falsework plans and calculations sealed by a Kansas licensed Professional Engineer according to **SECTION 708**.

PRECAST CONCRETE BOX LOAD RATING:

Include a Load Rating Table on the working drawings and provide the State Bridge Office with a LFR and LRFR rating and support calculations for the structure. The load rating shall take into consideration varying fill depths and KDOT live load criteria. For LFR Load Rating, include HS-20-44, KDOT rating vehicles for Inventory and Operating rating factors. Rate the Heavy Equipment Transport (HET) vehicle for Operating rating factor. For LRFR, use HL-93 for Inventory and Operating. Submit a Load Rating Report along with the working drawings. Include in the Load Rating Report a summary rating table, assumptions used in the load rating, the depth of fill, material strengths and any other significant information required to load rate the precast culvert. The Load Rating will include all elements of the proposed system including, but not limited to stub-walls and connections.

735.2 MATERIALS

a. General. Use materials that comply with the applicable requirements:

Grade 4.0 and 4.0 (AE) Concrete .... **SECTIONS 401 & 402***
Commercial Grade Concrete for Seal Course .... **SECTIONS 401 & 402**

Aggregate for Concrete Not On Grade .... **SECTION 1102**
Reinforcing Steel (Grade 60) .... **DIVISION 1600**
Reinforcing Steel (Epoxy Coated) (Grade 60) .... **DIVISION 1600**
Welded Wire Fabric .... **DIVISION 1600**
Quality Control Program for Precast Concrete Products....................................... **DIVISION 1900**
Drilling and Grouting …………………………………………………………......**DIVISION 800**
Joint Seals…………………………………….…………………………………**DIVISION 1500**
Geotextile Fabric .... **DIVISION 1700**
Bridge Backwall Protection………….. ……………………………………….**DIVISION 1700**

*For precast reinforced concrete boxes constructed according to this specification, KT-73 testing is not required.

b. Precast Reinforced Concrete Box. Provide precast reinforced concrete box sections complying with ASTM C 1577 and this specification.

Exceptions and additions to the above requirements are:

(1) ASTM Section 11. PERMISSIBLE VARIATIONS. Revise the first sentence of subsection 11.1 to read: The internal dimensions may not vary more than 1% or ¾ inch, whichever is less, from the design dimensions.

(2) ASTM Section 11. PERMISSIBLE VARIATIONS. Add the following subsections:

(a) 11.8 Deviation from straightness of mating edge: ± ¼ inch.

(b) 11.9 Squareness of ends (vertical and horizontal): ± ¼ inch.

(c) 11.10 With any new production start-up or change in set-up, join a minimum of the first 5 production units at the fabrication plant for inspection of joint fit-up and alignment of boxes. Continue joining each unit until production is satisfactory. Check approximately 10% of the remaining production at random, using a minimum 3 unit assembly. The Engineer may order a 3 or more unit assembly at any time measurements or observations indicate a problem exists.

(3) Design multiple-cell precast reinforced concrete boxes according to the criteria used to develop the single-cell precast boxes.

(4) Member thickness shall be the thickness specified by ASTM C 1577, ¾ the thickness of the corresponding member of an equivalent KDOT Standard cast-in-place rigid frame box culvert, or six inches, whichever is larger. When calculating the minimum thickness of the bottom slab, deduct ½ inch from the cast-in-place thickness before factoring by ¾.

(5) Provide minimum clearances to reinforcing of 1¼ inches ± ¼ inch from all faces except when the depth of fill is less than 2 feet. In that case, make the clearance in the top of the top slab 2 ½ inches ± ¼ inch. Develop all reinforcement according to the AASHTO LRFD Bridge Design Specifications.

(6) For fill heights less than or equal to 2 feet, use either epoxy coated reinforcement in the top slab or an approved "non-coal tar" "Bridge Backwall Protection System" to cover the top slab and uppermost 12 inches of the outside walls. Indicate on the shop drawing which option was used.

(7) Provide a minimum of 0.06 square inches per foot of longitudinal reinforcing for shrinkage and temperature requirements in each face, except at the joint as shown in the Contract Documents.

(8) Provide minimum transverse steel areas in each face of 0.19 square inches per foot of barrel.

(9) The maximum shear reinforcement (in lip of joint) spacing in the longitudinal direction is 6 inches.

(10) Do not weld reinforcing bars or steel fabric, except the original welding required to manufacture the wire fabric.

(11) Air entrained concrete is not required for dry-cast units. Use air entrained concrete for wet-cast units where the depth of fill will be less than 2 feet, as shown in the Contract Documents.

(12) Minimum length of a precast section is 4 feet.

(13) A single-cell box of equivalent area may be substituted for a double-cell box with cell spans less than or equal to 6 feet. Do not modify the cell height shown on the Contract Documents, unless approved by the Engineer. Two single-cell boxes may be substituted for a double-cell box, when approved by the Engineer.

(14) Prior to fabrication, submit working drawings to the Engineer for approval (see **SECTION 105**). Detail all phases of construction including layout, joint details, lifting devices, casting methods, construction placement and details of any cast-in-place sections. Note the proposed transportation methods on the working drawings.

(15) Legibly mark this information on an inside face of each box section using waterproof paint or other approved means:

- Date of manufacture;
- Name or trademark, and location of the manufacturer;

- Weight of box section in tons; and
- The top of the box.

Allow the Engineer free access to the manufacturing plant at all times for the purpose of inspecting materials, plant facilities and manufacturing and curing procedures. Inform the Engineer of planned concrete placement and curing schedule 5 business days before work is started.

Precast reinforced concrete boxes will be accepted according to **SECTION 1902**, and when deemed necessary by the Engineer, satisfactory results of material tests performed by the Engineer, compliance with dimensional requirements and visual inspection at the point of production or usage.

c. Foundation Materials for Precast Boxes. Provide either crushed stone or concrete seal course for the foundation of the precast box.

Provide crushed stone free of soapstone, shale, shalelike or other easily disintegrated material. Provide crushed stone with adequate gradation to provide a uniform foundation. The Engineer will accept the crushed stone based on visual inspection at the point of usage.

For concrete seal course, provide commercial grade concrete, or use any other concrete acceptable for use on the project.

735.3 CONSTRUCTION REQUIREMENTS

a. Foundation Preparation. Excavate and prepare the foundation according to **DIVISION 200**. Construct a 6-inch (minimum) thickness of crushed stone, or 3 inches of concrete seal course of commercial grade concrete for the foundation of the precast box.

b. Installation of Precast Boxes. Install the precast reinforced concrete box culvert with the groove end of each section up-grade. Join the sections tightly.

c. Sealing Joints of Precast Boxes. Seal the joints using one of the options shown in the Contract Documents. Install the joint sealant according to the manufacturer's recommendations.

If geotextile is used to wrap the joint:

- Use only geotextile that has been properly stored;
- Limit the exposure to the elements (between placement and covering) of the geotextile to a maximum of 7 calendar days;
- Do not drop any D_{50} backfill larger than 6 inches onto the geotextile from a height greater than 1 foot;
- Do not drop any D_{50} backfill smaller than 6 inches onto the geotextile from a height greater than 3 feet; and
- Do not contaminate the geotextile with grease, mud or other foreign substances. Replace contaminated or damaged geotextile. If approved by the Engineer, repair damaged geotextile by placing a patch over the damaged area and sewing the patch to the geotextile. Extend the patch a minimum of 1 foot beyond the perimeter of the damaged area. Replace contaminated or damaged geotextile, or repair if approved, at the Contractor's expense.

Fill the lifting holes with precast plugs sealed with mastic or mortar.

d. Distribution Slab Requirements.

(1) Fill heights less than 2 feet require a distribution slab. Precast distribution slabs may be used for fill heights less than 2 feet but greater than 1 foot, otherwise use cast-in-place.

Construct or place the distribution slab to extend a minimum of 2 feet beyond the exterior walls of the barrel. Construct or place the distribution slab to the outside edge of the roadway shoulders.

Place a minimum of 3 inches of granular material between the box and a concrete distribution slab.

Cast-in-place distribution slabs require one of the following combinations of steel reinforcement:

- 1 layer of mesh and 1 layer of reinforcement bars, or
- 1 layer of reinforcement bars.

(2) Fill heights less than or equal to 1 foot.

Construct a cast-in-place distribution slab a minimum of 6 inches thick, reinforced with #4 bars spaced at 18 inches placed transverse to the centerline of the box, and #5 bars spaced at 12 inches placed parallel to the centerline of the box. Uniformly consolidate the concrete without voids. An equivalent welded wire fabric is acceptable.

(3) If the fill height is greater than 1 foot, but less than or equal to 2 feet.

- Use the cast-in-place criteria above.
- Use precast distribution slab sections constructed with the same criteria as the cast-in-place distribution slab above. Do not locate precast slab joints near precast box joints.
- Reinforced concrete pavement with reinforcement as specified for a cast-in-place slab mentioned above (minimum 6 inches thick) shall meet the requirements of a distribution slab.
- Asphalt pavement (minimum 6 inches thick) shall meet the requirements of a distribution slab with 6 inches of granular material provided between the asphalt and the precast box. Place a geogrid on top of the granular material.

(4) A special design is required for the distribution slab if the above options are not geometrically possible.

e. Cast-In-Place Construction. Unless otherwise approved by the Engineer, construct cast-in-place collars at horizontal and vertical changes in RCB alignment.

Construct the cast-in-place sections, end sections and wingwalls, according to **DIVISION 700**, and as detailed in the Contract Documents.

- Construct the cast-in-place box sections at a minimum to the member thicknesses and reinforcement shown in the Contract Documents. When the thicknesses between the cast-in-place and precast members are different, transition at a maximum rate of 4:1 without reducing the box opening size.
- Skewed precast structures with fill heights greater than 10 feet will not be attached to the cast-in-place end section(s).
- Do not drill and grout dowel bars in the field, but detail on the working drawings and install by the Fabricator.
- Use 16 foot minimum cast-in-place end section for structures where precast sections are not attached (unreinforced open joint) to the cast-in-place sections.
- For multiple precast sections placed on a skew, submit for approval by the Engineer, working drawings (sealed by a Kansas licensed Professional Engineer) with details of cast-in-place end sections.
- When the thicknesses between the cast-in-place and precast members are different, transition at a maximum rate of 4:1 without reducing the box opening size.

f. Top Slab Protection. When required by **subsection 735.2b.(6)**, cover the entire exterior face of the top slab and the uppermost 12 inches of the outside walls and both sides of the joint with a Bridge Backwall Protection System from the KDOT's prequalified list. Remove any dirt or latent concrete before applying the coating per the manufactures directions. Lap ends and stagger joints according to the manufacture's recommendation. Repair any flaws or damage to the coating before backfilling the structure.

735.4 MEASUREMENT AND PAYMENT

The Engineer will measure precast reinforced concrete boxes by the linear foot. Precast end sections, and cast-in-place end sections and wingwalls will not be measured for payment.

When shown as a bid item in the contract, foundation stabilization and concrete seal course will be measured and paid for according to **SECTION 204**. When not shown as a bid item in the contract, foundation stabilization and concrete seal course are subsidiary.

Payment for "Reinforced Concrete Box (Precast)" at the contract unit price is full compensation for the specified work.

When not shown as a bid item in the contract, the "Bridge Backwall Protection System" will be subsidiary to other bid items.

If constructed as an option to cast-in-place RCB's, the Engineer will not measure the precast reinforced concrete boxes for payment. The cast-in-place quantities are the basis of payment. Payment of the cast-in-place quantities at the contract unit prices is full compensation for the specified work.

736 – PRECAST CULVERTS

SECTION 736

PRECAST CULVERTS

736.1 DESCRIPTION

Design, provide and install precast culvert units as shown in the Contract Documents. Do not substitute Precast Culvert elements with cast-in-place culvert elements without approval from the State Bridge Office (SBO).

BID ITEMS	**UNITS**
Precast Arch Culvert	Linear Foot
Precast Rigid Frame Culvert	Linear Foot

DESIGN:

- Design the precast culvert units in accordance with the AASHTO LRFD Bridge Design Specifications, latest version.
- Precast wings and headwalls are prohibited at stream crossings.
- Cast-in-place end sections shall conform to KDOT Standard BR031.

For fill heights less than or equal to 3 feet:

- Use epoxy coated reinforcing steel and air entrained concrete
- Use a distribution slab meeting the requirements of KDOT Standard BR031.
- Use an approved "non-coal tar" bridge backwall protection system to cover the middle 1/3 of the top of precast arch culverts, the complete top slab of precast rigid frame culverts and the uppermost 12 inches of the outside walls.
- Indicate on the shop drawings the limits of the bridge backwall protection system.

Prior to beginning foundation construction, submit complete design calculations, including loadings, for the Engineer's review. Design calculations and loadings may be submitted prior to the working drawing submittal. Submit design calculations sealed by a Kansas licensed Professional Engineer.

Prior to fabrication, submit to the Engineer for review and approval, working drawings including the supplier's manufacturing specifications, details of all phases of construction, including layout, joint details, lifting devices, casting methods, construction placement and details of any cast-in-place sections. Submit working drawings according to **SECTION 105**.

Designate proposed transportation methods, and submit over-height and overload permits, if required, with the working drawings.

When required, submit falsework plans and calculations sealed by a Kansas licensed Professional Engineer according to **SECTION 708**.

PRECAST CULVERT LOAD RATING:

Include a Load Rating Table on the working drawings and provide the SBO with a LFR and LRFR rating and support calculations for the structure. The load rating shall take into consideration varying fill depths and KDOT live load criteria. For LFR Load Rating, include HS-20-44, KDOT rating vehicles for Inventory and Operating rating factors. Rate the Heavy Equipment Transport (HET) vehicle for Operating rating factor. For LRFR, use HL-93 for Inventory and Operating. Submit a Load Rating Report along with the working drawings. Include in the Load Rating Report a summary rating table, assumptions used in the load rating, the depth of fill, material strengths and any other significant information required to load rate the precast culvert. The Load Rating will include all elements of the proposed system including, but not limited to stub-walls and connections.

736.2 MATERIALS

a. General. Submit to the Engineer a list of sources of material or fabrication locations for items which may require sampling, inspection or certification before use. Provide the Engineer samples of all materials requiring testing and approval, once the materials become available.

Allow the Engineer free access to the manufacturing plant at all times for the purpose of inspecting materials, plant facilities and manufacturing and curing procedures. Inform the Engineer of planned concrete placement and curing schedule before work is started.

Use materials that comply with the applicable requirements:

Grade 4.0 and 4.0 (AE) Concrete	**SECTIONS 401 & 402***
Aggregates for Not On Grade Concrete	**SECTION 1102**
Reinforcing Steel (Grade 60)	**DIVISION 1600**
Reinforcing Steel (Epoxy Coated) (Grade 60)	**DIVISION 1600**
Welded Wire Fabric	**DIVISION 1600**
Bolts, Threaded Rods, Nuts	**DIVISION 1600**
Structural Steel	**DIVISION 1600**
Joint Seals	**DIVISION 1500**
Bridge Backwall Protection System	**DIVISION 1700**
Geotextile Fabric	**DIVISION 1700**
Aggregates for Backfill	**DIVISION 1100**

*For precast reinforced culverts constructed according to this specification, KT-73 testing is not required.

b. Precast Culvert.

(1) Calcium Chloride or admixtures containing Calcium Chloride are prohibited.

(2) Reinforcing Steel. Fabricate reinforcing steel for the precast elements and place in accordance with the detailed working drawings. Longitudinal distribution reinforcement may consist of welded wire fabric or deformed billet-steel bars. Welding is prohibited on reinforcing bars or wire fabric, except original welding required in manufacturing the wire fabric is acceptable.

(3) Hardware. Use the following:

- Structural steel anchors and plates to meet design, geometric and construction requirements.
- AISI type 304 stainless steel expanded coil inserts for detached headwall connections. Use AISI type 304 stainless steel coil rods and nuts in headwall connections. Use either AISI type 304 stainless steel plate washers or AASHTO M 270 (ASTM A709) Grade 36 plate washers hot dip galvanized as per AASHTO M 111 (ASTM A123) in connections.
- Dowel Bar Splicer System satisfying load requirements and geometric constraints.
- Provide corrosion protection coatings for all bolts, threaded rods, nut, fasteners, etc.
- Hook Bolts in the attached headwall connections per ASTM A307.
- All hardware shall either be AISI type 304 stainless steel or ASTM A 123 galvanized.

c. Materials for Sealing Joints of Precast Culverts. Provide Type III external sealing bands complying with ASTM C877. The basis of acceptance for external sealing bands will be a Type D Certification as specified in **SECTION 2600**.

d. Foundation Materials for Precast Culverts. Provide foundation materials to comply with the Contract Documents.

e. Markings. Legibly mark the following information on the outside face of each section with waterproof paint or other approved means:

- Date of manufacture;
- Name or trademark, and location of the manufacturer;
- Mass of culvert section in tons; and
- The top of the section.

f. Aggregates for Backfill. The backfill materials shall conform to SB-1, SB-2, or SCA-2, SCA-3 or SCA-5, **DIVISION 1100**.

g. Basis of Acceptance. Prequalification for the materials listed.

Precast culvert units will be accepted on the basis of satisfactory results of material tests performed by the Engineer, compliance with dimensional requirements, and visual inspection at the point of usage.

736.3 CONSTRUCTION REQUIREMENTS

a. Foundation Preparation. Excavate and prepare the foundation according to the Contract Documents.

b. Installation of Precast Culvert. Provide a manufacturer's representative at the job site during the installation or placement of the first 10% of the structure sections and the installation or placement of the final 10% of the structure sections. Install according to the approved detailed working drawings.

c. Sealing Joints of Precast Culverts. Seal the joints as shown in the Contract Documents. Install the butyl rubber, rope-form joint sealant in the chamfer groove between all precast sections, prior to installing connection plates or hardware.

Install a Type III external sealing band at each precast joint, or cast-in-place cold joint. Completely cover the surface area of closure joints and extend the sealing bands an additional 6 inches beyond the limits of closure joints. Overlap the bands to shed water. Overlap the bands a minimum of 6 inches along the axis of the band; overlap the bands a minimum of 2 inches transverse to the axis of the band. Place the bonding material to extend a minimum of 18 inches from the joint location.

If geotextile is used to wrap the joint:

- Use only geotextile that has been properly stored. Store rolls in a manner which protects them from the elements. If stored outdoors, elevate and protect with a waterproof cover;
- Limit the exposure to the elements (between placement and covering) of the geotextile to a maximum of 7 calendar days;
- Do not drop any D_{50} backfill larger than 6 inches onto the geotextile from a height greater than 1 foot;
- Do not drop any D_{50} backfill smaller than 6 inches onto the geotextile from a height greater than 3 feet; and
- Do not contaminate the geotextile with grease, mud or other foreign substances. Replace contaminated or damaged geotextile. If approved by the Engineer, repair damaged geotextile by placing a patch over the damaged area and sewing the patch to the geotextile. Extend the patch a minimum of 1 foot beyond the perimeter of the damaged area. Replace contaminated or damaged geotextile, or repair if approved, at the Contractor's expense.

d. Cast-In-Place Construction. Construct cast-in-place foundations, closure joint systems, culvert sections, wingwalls, end caps, headwalls and other concrete elements according to the Contract Documents. Use epoxy coated reinforcement for all closure joints when the fill height, measured at the shoulder line, is less than or equal to 3 feet. Install pavement waterproofing membrane to extend 18 inches beyond the limits of all closure joint concrete or grout. This membrane is subsidiary to the culvert.

e. Backfill Thickness and Material. Use a minimum of 2 feet of approved granular material to backfill the sides and top of the structure. When manufacturer's recommendations require more granular material, install at no additional cost to KDOT.

f. Field Welding. Perform all field welding by an approved certified welder, using approved weld procedures.

736.4 MEASUREMENT AND PAYMENT

The Engineer will measure precast arch culverts and precast rigid frame culverts by the linear foot. Precast and cast-in-place end caps, headwalls and wingwalls are subsidiary to the culvert.

When shown as a bid item in the contract, foundation stabilization and concrete seal course will be measured and paid for according to **SECTION 204**. When not shown as a bid item in the contract, foundation stabilization and concrete seal course are subsidiary to the culvert.

Payment for "Precast Arch Culvert" and "Precast Rigid Frame Culvert" at the contract unit prices is full compensation for the specified work. The pavement waterproofing membrane is subsidiary to the culvert. The specified granular backfill is subsidiary to the culvert. Any additional granular backfill required by the manufacturer will be done at no additional cost to KDOT.

SECTION 737

FIELD ERECTION

737.1 DESCRIPTION

Evaluate project characteristics and develop unique Field Erection Plans for each qualifying structure within the Contract Documents according to this specification.

For the purposes of this specification, erection is the process of transporting, handling and assembling the bridge components to result in a bridge structure that meets all the geometric and structural requirements of the Contract Documents.

737.2 ERECTION SUPERVISOR

The Erection Supervisor is the person responsible for all rigging and handling of bridge primary members. The Erection Supervisor shall be present at the erection site during the erection of all primary members of Category B & C Structures.

All Erection Supervisors must be pre-qualified. To become pre-qualified, provide proof of experience that the Erection Supervisor has a minimum of 5 years experience and at least 10 projects similar in scope, type and complexity.

KDOT will maintain a list of approved Erection Supervisors on a Pre-Qualified List.

At the pre-construction meeting, submit to the KDOT Field Engineer proof of pre-qualification for the scope, type and complexity of the structure to be constructed.

737.3 ERECTION PLANS

a. General. The Contract Documents will indicate the field erection category for each structure. Submit shop drawings according to **SECTION 105**.

KDOT will review the Erection Plan for all Categories, and either decline, or recommend for approval. The Engineer must approve the Erection Plan before work may begin. The level of review and the requirements for submittals by the Contractor to the Engineer are categorized by risk and complexity. **FIGURE 737-1** defines the 3 categories for field erection.

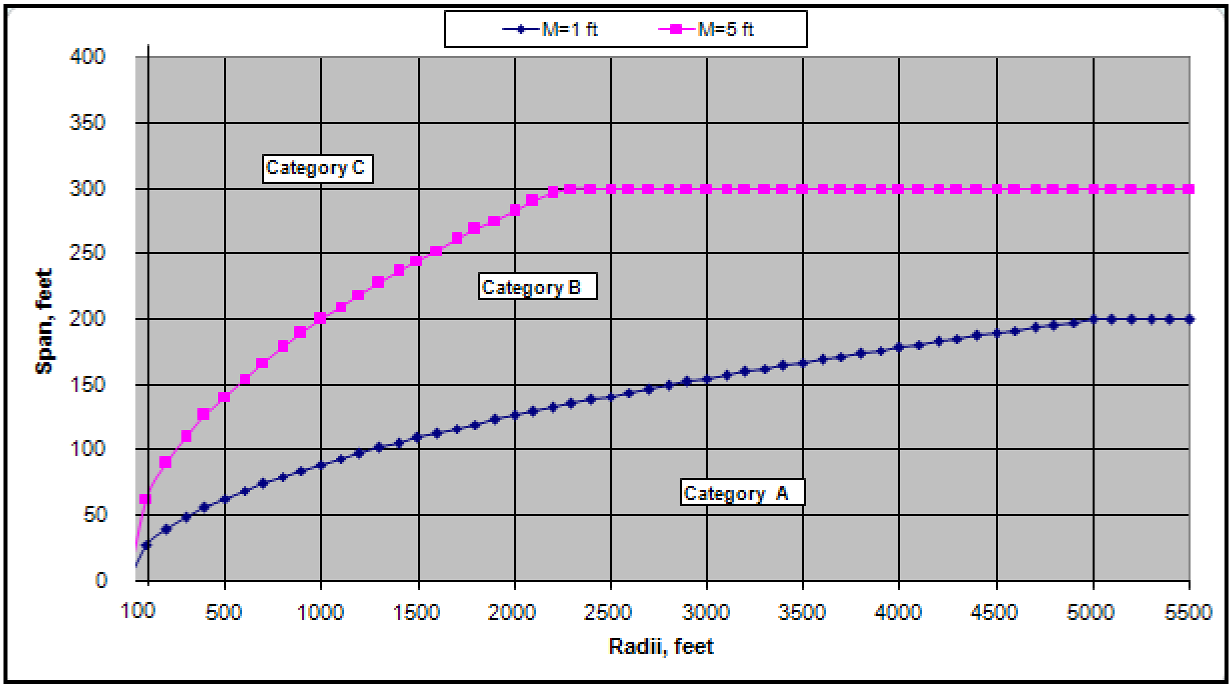


FIGURE 737-1

Special Requirements for Bridge Designers to Designate Erection Plan Categories

The initial Category is based on the chart which considers the length of the longest span, the curvature of the bridge and the skew angle.

If skew is greater than 30°, move up one Category (A to B or B to C).

If a structure crosses traffic or a railroad, require Category B as a minimum.

If the Contractor uses falsework bents or strong-backs for the field erection, Category C Erection Plans are required.

The designer may elevate a structure to the necessary Category based upon engineering judgment and unique circumstances.

b. Definitions and Submittals.

(1) Category A Erection Plan Requirements. Submit 1 copy of the detailed Field Erection Plans to the Field Engineer. At a minimum, include the following:

- Shop details, camber diagrams, list of field bolts, and shipping statements showing a list of parts and their respective weights
- Proposed methods of erection
  - A list of all equipment that will be used
  - Crane pick locations and loads
  - Falsework plans
  - Temporary bracing requirements
  - Blocking diagrams
- Specific details for structural erection shall be clearly defined
  - Spliced pieces
  - Multiple girders
  - Pick descriptions
  - Bolting locations
  - Number of fully tightened bolts at each splice
  - Cross-frames or diaphragms
  - Anchor bolts
  - Temporary bracing

(2) Category B Erection Plan Requirements. Meet the Category A Field Erection Plan Requirements in **subsection 737.3b.(1)** above. In addition, submit the detailed Field Erection Plans according to **SECTION 105** to the State Bridge Office (or Bureau of Local Projects) at least 4 weeks before beginning the erection process.

List on the Field Erection Plans the Erection Supervisor that shall be present at the site during the erection of all primary members.

Field Erection Plan development, authority, and responsibility fall under 3 separate Field Operations:

- **Traffic Control (Field Operation One):**
  This is site and structure specific control of traffic movements relative to the structural erection operations.
  - This portion of the operation is developed by the Contractor's personnel and will be reviewed and approved by KDOT's Field Engineer.
  - Field changes are under the authority of the Field Engineer.

- **Pick and Place (Field Operation Two):**
  This includes crane movements, rigging operations, storage, assembling, loading and unloading operations of primary, secondary and falsework members. This includes placing the assemblies into the structure.
  - This portion of the operation requires procedures, calculations and drawings and is developed by the Erection Supervisor.
  - All field operations and field changes are under the authority, and the responsibility, of the Contractor's Erection Supervisor.

- **Part of Permanent Structure (Field Operation Three)**:
  Defined as the point in time when the primary member becomes part of the structure. When the primary member is released from the rigging or when it rests solely on the bridge bent, bearing device or falsework bent as a part of the uncompleted structure, the primary member is considered to be part of the Permanent Structure.
  - This requires calculations, procedures and drawings to be developed and sealed by the Contractor's Professional Engineer.
  - Field changes must be approved and resealed by the Engineer who originally developed the plans before work begins. This work is under the authority of the Contractor's Professional Engineer.

(3) Category C Erection Plan Requirements. Meet the Category B Field Erection Plan Requirements in **subsection 737.3b.(2)** above. Additionally, there will be a pre-erection meeting before erection operations begin. The Erection Supervisor shall attend this pre-erection meeting to discuss any field concerns related to the erection procedures and to increase familiarity with each structure site.

c. Calculations.

The calculations, as a minimum, shall include the following information:

- Calculations to substantiate structural adequacy and stability for each stage of erection, accounting for the structures lack of completeness or complex structural geometry.
- Calculations to determine translations and rotations at intermediate erection conditions.
- Design calculations indicating and verifying the load capacity, the stability of all temporary supports, falsework bents, and bracing when used to allow traffic to travel under the incomplete structure.
- Calculations indicating structural redundancy of the incomplete structure shall be required at specific stages of erection. These calculations shall be required to account for unforeseen obstacles to the erection process that necessitate halting erection at an undesignated stopping point.

737.4 ERECTION INFORMATION

Submit a detailed Erection Procedure to the Owner for each bridge structural unit. In the Procedure, address all requirements for erection of the structure into the final designed configuration and satisfy all written Owner comments prior to the start of erection. As a minimum, include the following in the Erection Procedure:

a. The Contractor's Engineers shall provide the following information:

- Plan of the work area showing permanent support structures (piers and abutments), roads, railroad tracks, waterways (including navigational channel), overhead and underground utilities and other information pertinent to erection.
- Erection sequence for all members noting any temporary support conditions, such as holding crane positions, temporary supports, falsework, etc. Member reference marks, when reflected on the erection plan, should be the same as used on shop detail drawings.
- In the Field Erection Plans, describe the number, location and bolting requirements for the permanent cross-frames or diaphragms for each stage of construction.
- In the Field Erection Plans, address the expected condition of each bearing device for each stage of construction. State the minimum number of positive bearing connections or supplemental connections to each bent cap which will resist all potential destabilizing forces.
- In the Field Erection Plans, address traffic control and railroad issues.
- If falsework bents or strong-backs are used, the Field Erection Plans shall meet falsework requirements as defined in **SECTION 708**.

b. The Contractor's Erection Supervisor shall provide the following information:

- Location of each crane for primary picks showing all necessary information.
- Capacity chart for each crane configuration.
- Center of gravity, lift weight (including rigging) for all primary member picks.
- Primary member site delivery location and storage orientation.
- Details of any temporary lifting devices to be bolted/welded to or cast in to permanent members, including method and time (shop or field) of attachment, capacity and method, time and responsibility for removal.
- Temporary support details for bridge bearings.

c. The Owner's Inspector shall require the following:

- Requirements for bracing. At the end of the workday, remove the members not properly braced in compliance with the Field Erection Plan from the bridge substructure elements.
- All rigging must have capacity stamps, tags or be otherwise permanently marked on the device (per OSHA Standards)

737.5 CONSTRUCTION REQUIREMENTS

No erection work may begin without an approved Field Erection Plan. The Contractor is responsible for the erection, even though the Field Erection Plans have been approved by the Engineer. See **SECTION 105**. Keep the approved Field Erection Plans available on site at all times.

Before erection begins, resolve any questions that any party may have.

Prepare a Contingency Plan if the number of stable girder lines to be erected does not meet the Field Erection Plan number for a sequence proposed. (i.e. the plan says 6 girder lines and because of problems, 5 girder lines where erected before traffic delay penalties accrued).

It is required that all traffic must be stopped while overhead erection work involving the placement of primary members into the permanent structure is being performed. No members shall be suspended over highway traffic at any time during loading, unloading, moving, rigging or placing. In no case will KDOT allow highway/railroad traffic to travel under uncompleted structures without compliance of Field Operation Three above.

Erect the fabricated structure and perform all work required to complete the structure as specified in the Contract Documents. Provide all falsework, tools, machinery and appliances required to complete the work. After the structure is erected, remove all falsework, appliances and other obstructions or debris resulting from erection.

Provide the Engineer with safe means (such as scaffolding, safety lines, snoopers or hoist buckets) to inspect any portion of the structure during the erection operations. <u>The Engineer will refuse permission to proceed with erection work if the erection process is determined to be unsafe or substantially different than approved Field Erection Plans.</u>

737.6 MEASUREMENT AND PAYMENT

Erection is considered complete when all field connections are completed to the final design condition and falsework is removed. The Engineer will not measure Field Erection and Field Erection Plans for separate payment.

SECTION 738

HIGH MAST LIGHT TOWERS

738.1 DESCRIPTION

Construct new high mast light towers as shown in the Contract Documents.
Repair existing high mast light towers as shown in the Contract Documents.
See **SECTION 814**, for Electric Lighting System work.

BID ITEM	**UNITS**
High Mast Light Tower (*) (**)	Each
(*) Size	
(**) Foundation	

738.2 MATERIALS

Provide high mast light tower structures from the prequalified list of fabricators. Comply with all requirements and dimensions designated in the Contract Documents.

Use material for High Mast Light Tower structures that comply with the applicable requirements:

Structural Steel Tubing	**DIVISION 1600**
Grade 4.0(AE) Concrete	**SECTIONS 401 & 402**
Aggregate for Concrete Not On Grade	**SECTION 1102**
Concrete Admixtures	**DIVISION 1400**
Reinforcing Steel (Grade 60)	**DIVISION 1600**
Anchor Bolts	**DIVISION 1600**

738.3 CONSTRUCTION REQUIREMENTS

a. General. Provide and install all incidental parts which are necessary to complete the electrical system or modify existing systems as shown in the Contract Documents. See **SECTION 744** for fabrication requirements. All utility hookups are subsidiary, unless shown otherwise in the Contract Documents.

b. Removals and Excavations. Perform removals of existing structures and excavations to minimize damage to existing structures and right-of-way.

Remove the existing concrete foundations (including anchor bolts) to the elevation shown in the Contract Documents. Backfill the resulting holes according to **DIVISION 200**. Dispose of the removed foundations and anchor bolts.

Excavate and prepare the foundation according to **DIVISION 200**. Grade the area surrounding the completed structure in accordance with the Contract Documents.

c. Foundations. Form the foundations and place the concrete according to **DIVISION 700**. Hold conduit ends and anchor bolts securely in the proper position when the concrete is placed.

Cure the concrete foundations with wet burlap or polyethylene for a period of 72 hours. Prevent concrete temperatures from falling below 32ºF.

Do not attach poles until the concrete has cured for 14 days.

If a foundation can not be constructed as shown in the Contract Documents because of an obstruction, the Engineer will determine how to construct the foundation.

d. Repair/Replace Existing Structures. Verify the existing anchors will extend a minimum of one thread above the tightened nut in the final condition. Do not damage the existing anchors during the removal of the existing hardware. Clean the threads of all rust and lubricate with an approved wax, prior to placing the new hardware.

Install DTIs on each anchor. Install a hardened washer on each anchor, if required. Use new hardware galvanized according to ASTM A 123. Verify the assembly (leveling nut, hardened washer(s), tower base plate, DTI, top nut) is in a snug tight condition before final tightening begins. Using the approved air pneumatic torque/tension wrench, or a hydraulic wrench, tighten each nut to achieve a minimum of three refusals of the 0.005 gauge. Do not exceed four refusals of the 0.005 gauge. After tightening, score the remaining threads.

e. New Structures. Construct the elements of the structure according to the Contract Documents. Threads of the anchors shall be free of any construction debris.

Install DTIs on each anchor. Install a hardened washer on each anchor, if required. Use hardware galvanized according to **SECTION 1616**. Verify the assembly (leveling nut, hardened washer(s), tower base plate, DTI, top nut) is in a snug tight condition before final tightening begins. Using the approved air pneumatic torque/tension wrench or a hydraulic wrench tighten each nut to achieve a minimum of three refusals of the 0.005 gauge. Do not exceed four refusals of the 0.005 gauge. After tightening, score the remaining threads.

f. All Structures.

- Do not use a pipe wrench to tighten nuts on High Mast Light Tower structures;
- Use only a box end or socket wrench to snug tighten nuts;
- Maintain a minimum dimension of 6 inches from the top of foundation to finished grade;
- Repair any marring of the galvanizing caused while lifting the structure into place;
- Submit specifications for the air pneumatic torque/tension wrench or the hydraulic wrench to the Construction Engineer for approval;
- If the four refusal maximum is exceeded on any DTI, discontinue tightening and contact the State Bridge Office.

738.4 MEASUREMENT AND PAYMENT

The Engineer will measure each high mast light tower structure for payment.

Payment for "High Mast Light Tower" structures at the contract unit price is full compensation for the specified work.

SECTION 739

SLURRY POLYMER CONCRETE OVERLAY

739.1 DESCRIPTION

Prepare the surface of the reinforced concrete bridge deck and construct a slurry polymer concrete overlay (overlay) as shown on the Contract Documents.

Provide an overall combination of labor and equipment with the capability of proportioning and mixing the primer, polymer resin components, aggregate and seal coat, and placing the primer, slurry polymer overlay material, broadcast sand or aggregate, and seal coat in accordance with this specification and the manufacturer/supplier's recommendations.

BID ITEMS	UNITS
Slurry Polymer Concrete Overlay (*)	Square Yard
Material for Slurry Polymer Concrete Overlay (Set Price)	Cubic Yard
* Thickness	

739.2 MATERIALS

a. General.

(1) Proportion all polymer materials according to the manufacturer/supplier's recommendations.

(2) Provide the Engineer with a copy of the polymer material's manufacturer/supplier's mixing and application recommendations.

(3) If concrete bridge deck patching is specified, polymer concrete materials may be used for patching of the concrete bridge deck. See **SECTION 731**.

b. Epoxy. Provide a Type III epoxy resin as defined in **DIVISION 1700**.

c. Polyester. Provide a polyester resin as defined in **DIVISION 1700**.

d. Methyl Methacrylate. Provide a methyl methacrylate resin as defined in **DIVISION 1700.**

e. Broadcast Aggregate and Broadcast Sand.

(1) Provide FA-C aggregate meeting **TABLE 1102-5** and **TABLE 1102-6**, or

(2) Aggregate provided by the slurry polymer concrete overlay manufacturer/supplier in a prequalified system, **DIVISION 1700**.

(3) Provide clean dry silica broadcast sand meeting a commercial blast sand 20/40 gradation.

(4) The use of broadcast aggregate and/or broadcast sand is determined by the slurry polymer overlay manufacturer/supplier.

739.3 CONSTRUCTION REQUIREMENTS

a. General. Wet cure concrete on new bridge decks for 14 days and allow the deck to dry for 21 days before applying the overlay.

Portland cement concrete patches require a minimum cure period of 28 days before application of the overlay.

At the preconstruction conference, discuss the patching material and the corresponding curing period. Submit changes, including a written statement from the polymer manufacturer/supplier recommending changes, to the Engineer for approval.

Some overlay systems require the placement of a polymer primer coat and/or a polymer seal top coat, with or without broadcast sand or aggregate. In the following requirements, the polymer primer coat and polymer seal top coat will be referenced with the understanding they are system specific.

b. Equipment. Equipment is subject to approval of the Engineer and must comply with these requirements:

(1) Surface Preparation Equipment.

(a) Shot blasting equipment capable of producing a surface relief equal to the International Concrete Repair Institute (ICRI) Surface Preparation Level 6 to 7 or ASTM E 965 Pavement Macrotexture Depth of 0.04 to 0.08 inch. Final acceptance is based on testing procedures as outlined in KT-70, Part V.

(b) Shot/Sand blast equipment capable of producing the required surface relief on the deck adjacent to bridge rails and barriers and areas not accessible with shot blast equipment.

(c) Empty shot blasters and dispose of waste material a minimum of 50 feet from the prepared bridge deck. On long structures empty shot blasters on the unprepared surface a minimum of 50 feet from prepared surface to prevent contamination of the deck by return of dust to the prepared surface.

(d) The Engineer must approve the use of scarifiers, scrablers or milling machines.

(e) Wet sand blasting is prohibited for final cleanup and preparation.

(f) Any surface preparation equipment used must produce a constant uniform surface that can be shot blasted if necessary and prevent overrun of the quantities of overlay material.

(2) Mechanical Application Equipment.

(a) A mixing and distribution system capable of metered mixing and uniform distribution of primer and seal coat uniformly at the specific rate on 100% of the work area.

(b) A polymer mixing and distribution system capable of accurate and complete mixing of the polymer resin, hardening agent and aggregates, metered verification of the mix ratio and aggregate proportions and uniform and accurate distribution of the polymer materials at the specified rate or thickness on 100% of the work area.

(c) A self-propelled aggregate spreader capable of uniform and accurate application of the broadcast sand and/or broadcast aggregate over 100% of the work area.

(d) An air compressor capable of producing a sufficient amount of oil free and moisture free compressed air to remove all dust and loose material.

(e) Adequate additional hand tools to facilitate the placement of the overlay according to this specification and the manufacturer/supplier's recommendations.

(3) Hand Application Equipment.

(a) Calibrated containers for accurate measurement of the polymer components.

(b) Paddle type mixer or other mixing device capable of accurate and complete mixing of the polymer resin and hardening agent.

(c) Notched squeegees and brooms capable of spreading the polymer material in accordance with this specification and the manufacturer/supplier's recommendations.

(d) Gage rakes or manual/power screeds capable of placing the overlay according to this specification and the manufacturer/supplier's recommendations.

(e) Aggregate spreader capable of uniform and accurate application of the dry aggregate.

(f) Adequate additional hand tools to facilitate the placement of the polymer concrete overlay in accordance with this specification and the manufacturer/supplier's recommendations.

c. Preparation of Surface.

(1) When specified, perform any required repairs under **SECTION 731** and cure repairs, before preparation of the surface, unless placed with the overlay.

(2) Protect metal deck drains and areas of the curb or railing above the proposed surface from the shot blast.

(3) Close deck drains so the overlay materials will not pass through the drains.

(4) Remove any remaining contamination of the prepared deck surface or surface of subsequent courses. Sand blast or bush hammer contaminated areas to produce an acceptable surface for placement of the overlay.

(5) As the final preparation for the placement of the overlay, make a complete cleanup by shot blasting and/or other approved means, followed by an air blast with dry, oil free air or vacuum. Brooming is not acceptable. Remove all pavement marking, loose disintegrated concrete, dirt, paint, oil, asphalt, laitance, carbonation and curing materials from patches and other foreign material from the surface of the deck.

(6) Produce a surface relief equal to the International Concrete Repair Institute (ICRI) Surface Preparation Level 6 to 7 or ASTM E 965 Pavement Macrotexture Depth of 0.04 to 0.08 inch.

(7) Place the first coat of the overlay within 24 hours of preparing the deck surface. Prepared surfaces exposed for more than 24 hours must be lightly sand blasted prior to application of the overlay.

d. Placing the Slurry Polymer Concrete Overlay. Place the overlay to the grades, thickness and cross-sections as shown in the Contract Documents. Provide a technical representative of the polymer manufacturer/supplier on the job site during the placement of the overlay at no additional cost. The representative is to provide technical expertise to the Contractor and the Engineer regarding safe handling, placement and curing of the overlay.

(1) Visible moisture on the prepared deck at the time of placing the overlay is unacceptable. Identify moisture in the deck by taping a plastic sheet to the deck for a minimum of 2 hours (ASTM D 4263).

(2) Rain will not necessarily contaminate the surface. However, take care so no contamination has occurred. Traffic adjacent to the prepared surface during a rain will contaminate the surface.

(3) Follow all manufacturer/supplier suggested safety precautions while mixing and handling polymer components.

(4) Apply High Molecular Weight Methacrylate Primer and broadcast sand at application rates shown in **TABLE 739-1** or as directed by the materials manufacturer/supplier.

(5) Use gage rakes or mechanical application equipment to place the prepared slurry polymer concrete on the deck uniformly at the prescribed rate. Primers may require a cure time, **subsection 739.3g**.

(6) If mechanical application equipment is used, take 2 ounce samples for each 100 gallons of resin placed to verify resin and hardener mix ratios and curing times. Place samples on the bridge rail or deck and note time to cure.

(7) The bridge deck and all polymer and aggregate components must be at least 60°F at the time of application.

(8) Apply dry broadcast sand or broadcast aggregate, when required, to cover the polymer uniformly and completely within 10 minutes of application.

(9) Vacuum or broom excess sand/aggregate from the primer, the overlay and/or seal coats after sufficiently cured. If damage or tearing occurs, stop brooming or vacuuming and allow additional curing time. See **subsection 739.3g.** for curing guidelines.

(10) Recoat areas of primer, the overlay and/or seal coat that do not receive enough sand/aggregate before gelling of the polymer with additional polymer and sand/aggregate.

(11) Locate any longitudinal joints along lane lines, or as approved by the Engineer. Keep the joints clear of wheel paths as much as practical.

(12) Produce and place the overlay within the specified limits in a continuous and uniform operation.

(13) Correct completed surface variations exceeding ⅛ inch in 10 feet unless directed otherwise by the Engineer.

(14) Tape all construction joints to provide a clean straight edge for adjacent polymer concrete placement. This includes joints between previously placed overlay materials and at centerline.

(15) Finish the exposed edges at the ends of the bridge and at expansion joints to minimize bridge deck roughness.

(16) Apply a bond breaker to all expansion joints.

e. Face of Curbs, Barriers, and Corral Rail Posts. Use a paintbrush or roller to apply the polymer resin on the face of curbs, barriers, and corral rail posts.

- On bridges with a corral rail, apply the polymer resin to the front face and adjacent sides of all posts.
- On bridges with curbs, apply the polymer resin to the top of the curb face.
- On bridges without curbs, apply the polymer resin to the edge of the deck.
- On bridges with continuous concrete barrier rails, apply the polymer resin to the first break in the geometry of the barrier or a minimum of 6 inches, uniform. Protect areas above the break line (or minimum of 6 inches) from resin. Apply so the top threshold of the resin follows a uniform line along the rail.

This work is subsidiary to the bid item Slurry Polymer Concrete Overlay.
Apply polymer to the curb or barrier as each of the overlay applications are performed.

f. **Application Rates**. Place the overlay to the thickness and grades as shown in the Contract Documents. Place primer, broadcast sand and seal coat (if required) at the application rates shown in **TABLE 739-1**.

TABLE 739-1: PRIMER AND SEAL COAT APPLICATION RATE for SLURRY POLYMER CONCRETE OVERLAYS		
Course	**Material Rate**	**Broadcast Sand Rate ***
Primer	Not Less Than 0.09 gal./sq yd	Not Less Than 0.4 lbs./sq yd
Seal (one coat)	Not Less Than 0.23 gal./sq yd	N/A

*Apply enough broadcast sand to cover the primer coat uniformly and completely.

g. Curing.
(1) Epoxy. Minimum curing times are noted in **TABLE 739-2**.

TABLE 739-2: EPOXY CURE TIMES for SLURRY POLYMER CONCRETE OVERLAYS							
Course	**Average Temperature of Overlay Components, °F**						
	55-59	**60-64**	**65-69**	**70-74**	**75-79**	**80-85**	**85+**
	Minimum Cure Time (hours)						
Primer	5	4	3	2.5	2	1.5	1
Polymer Concrete	6.5	6.5	5	4	3	3	3

Cure the slurry polymer concrete for 8 hours if the air temperature falls below 55°F during the curing period before opening to traffic.

(2) Polyester. Polyester will be proportioned such that the cure times are between 30 and 120 minutes. Accelerators and inhibitors may be required to achieve proper set times. Proportion all materials as recommended by the material manufacturer/supplier.

(3) Methyl Methacrylate. Minimum curing times are noted in **TABLE 739-3**.

TABLE 739-3: METHYL METHACRYLATE CURE TIMES for SLURRY POLYMER CONCRETE OVERLAYS						
Course	**Ambient Temperature °F**					
	30-40	40-50	50-60	60-70	70-80	80-90
Primer	30	25	22	20	15	10
Polymer Concrete	50	40	35	30	25	20
Seal (one coat)	35	30	25	22	20	15

These times can be adjusted (longer or shorter) by changing the hardener in the mix as recommended by the manufacturer/supplier.

(4) Plan and perform the work in such a way as to provide for the minimum curing times specified in this specification or as specified by the material manufacturer/supplier.

h. Testing. Perform Polymer Concrete Overlay Bond Evaluation as outlined in KT-70, Part V.

(1) Place a polymer concrete test patch of not less than 0.5 square yards per lane or planned completed day's work whichever is smaller. Submit a sequence plan to the Engineer. Test patches shall be full depth, placed by the normal construction sequence. Test patches should be representative of the work being performed.

(2) Perform a minimum of 4 pull-off tests on each patch as outlined in KT-70, Part V.

(3) Final acceptance will be based on the following results of the test outlined in KT-70, Part V:

- Type 1 – Failure in the concrete at a depth greater than or equal to ¼ inch over more than 50% of the test area for 3 out of 4 tests in the test patch.
- Type 2 – Failure in the concrete at a depth less than ¼ inch over more than 50% of the test area for 3 out of 4 tests in the test patch.
- Minimum Tensile Rupture Strength of 250 psi from an average of 3 out of 4 tests on a test patch regardless of depth of failure.

(4) If failure in the concrete is at a depth less than ¼ inch and the Minimum Tensile Rupture Strength is less than 250 psi, or the failure in the concrete is less than 50% of the test area, additional surface preparation is necessary.

(5) A failure in the concrete below 250 psi and greater than ¼ inch deep indicates weak concrete, not poor overlay bond. No additional surface preparation is required.

(6) Do not perform tensile adhesion tests when ambient or deck temperatures are above 85°F.

i. Weather Limitations.

(1) Epoxy. Do not place the overlay if the air temperature is expected to drop below 55°F within 8 hours of placement.

(2) Polyester. Do not place any component of the overlay if the air or substrate temperature is at or expected to drop below 40°F during installation.

(3) Methyl Methacrylate. Do not place any component of the polymer concrete overlay if the air or substrate temperature is at or expected to drop below 40°F during installation without inclusion of cold temperature additive at the dosage specified by methacrylate manufacturer/supplier's mixing guide.

(4) General. Do not place the overlay when the deck temperature will exceed 90°F.

Do not place the overlay if gel time is less than 10 minutes.

The overlay may be placed outside the specified temperature ranges with the approval of the Engineer and the material manufacturer/supplier. Discuss changes to temperature limitations at the preconstruction conference. Submit changes, including a written statement from the polymer manufacturer/supplier recommending the changes, to the Engineer for approval.

j. Correction of Unbonded or Damaged Areas. Repair new overlay areas discovered to be unbonded by tapping or chaining and areas where the overlay was damaged by the Contractor's operation. Saw cut the unbonded or damaged areas to the top of the deck surface, remove the overlay with small air tools (15-pound class maximum) or shot blasting. Aggressively sandblast or shot blast the concrete bridge deck surface at the unbonded area to remove contaminants. Replace the overlay according to standard placement procedures at no additional compensation.

739.4 MEASUREMENT AND PAYMENT

The Engineer will measure slurry polymer concrete overlay by the square yard. The Engineer will measure the bridge roadway width and the bridge length from end of wearing surface to end of wearing surface.

The Engineer will measure material for slurry polymer concrete overlay by the cubic yard according to the following:

(1) When approved by District on repair of existing bridges, this pay item will be used to compensate the Contractor for the additional overlay material that will be required to fill the areas greater than the thickness of overlay shown in the Contract Documents. The Contractor is responsible for maintaining adequate quality control of the demolition process to minimize deviations from the plan grades.

(2) The Engineer will keep a running account of the volume of overlay material that is produced and delivered to the deck. When approved, the Contractor will be paid, at the set price per cubic yard, for all overlay material in excess of 110% of the theoretical volume to cover the deck area with the thickness of overlay shown in the Contract Documents.

Payment for "Slurry Polymer Concrete Overlay" at the contract unit price and "Material for Slurry Polymer Concrete Overlay (Set Price)" at the contract set price is full compensation for the specified work.

SECTION 740

POLYMER CONCRETE OVERLAY REPAIR

740.1 DESCRIPTION

Repair the existing polymer concrete overlay surface.

Provide an overall combination of labor and equipment with the capability of preparing the surface, proportioning and mixing the polymer components, and placing the polymer material and aggregate in accordance with this specification and the manufacturer/supplier's recommendations.

When specified, construct a single coat polymer concrete overlay according to this specification.

BID ITEMS	UNITS
Polymer Concrete Overlay Repair	Square Yard
Single-Layer Polymer Concrete Overlay	Square Yard

740.2 MATERIALS

a. Polymer.

(1) Provide material that is compatible with the existing polymer concrete overlay material and polymer concrete patch material.

(2) Proportion all polymer materials according to the manufacturer/supplier's recommendations.

(3) Provide the Engineer with a copy of the polymer materials manufacturer/supplier's mixing and application recommendations.

b. Epoxy. Provide a Type III epoxy resin as defined in **DIVISION 1700**.

c. Polyester. Provide a polyester resin as defined in **DIVISION 1700**.

d. Methyl Methacrylate. Provide a methyl methacrylate resin as defined in **DIVISION 1700**.

e. Aggregate.

(1) Provide FA-C aggregate meeting requirements of **TABLES 1102-5 and 1102-6**, or.

(2) As provided by the polymer concrete overlay supplier in a prequalified system, **DIVISION 1700**.

(3) Provide MA-6 aggregate meeting **TABLE 1102-3**.

(4) Provide clean dry silica broadcast sand meeting a commercial blast sand 20/40 gradation.

(5) The use of broadcast aggregate and/or broadcast sand is determined by the type of polymer system used and the overlay manufacturer/supplier.

740.3 CONSTRUCTION REQUIREMENTS

a. General. Portland cement concrete patches require a minimum cure period of 28 days before application of the polymer concrete overlay. At the preconstruction conference, discuss the patching material and the corresponding curing period. Submit changes, including a written statement from the polymer manufacturer/supplier recommending changes, to the Engineer for approval.

b. Equipment. Equipment is subject to approval of the Engineer and must comply with these requirements:

(1) Surface Preparation Equipment.

(a) Shot blasting equipment capable of removing all contaminants from the existing polymer overlay without damaging the overlay surface.

(b) Shot/Sand blast equipment capable of removing all contaminants from the repair patches, existing polymer overlay adjacent to bridge rails and barriers and areas not accessible with shot blast equipment.

(c) Empty shot blasters and dispose of waste material a minimum of 50 feet from the prepared bridge deck, on long structures empty shot blasters on the unprepared surface a minimum of 50 feet from prepared surface to prevent contamination of the deck by return of dust to the prepared surface.

(d) The Engineer must approve the use of scarifiers, scrablers, or milling machines.

(e) Wet sand blasting is prohibited.

(f) Do not use hydrodemolition to remove polymer concrete overlay or unsound portland cement concrete.

(g) Do not use jack hammers or chipping hammers heavier than the nominal 15-pound class for removal of the polymer overlay.

(2) Mechanical Application Equipment.

(a) Polymer mixing and distribution system capable of accurate and complete mixing of the polymer resin and hardening agent, metered verification of the mix ratio and uniform and accurate distribution of the polymer materials at the specified rate on 100% of the work area.

(b) A self-propelled aggregate spreader (if required) capable of uniform and accurate application of the dry aggregate over 100 % of the work area.

(c) An air compressor capable of producing a sufficient amount of oil free and moisture free compressed air to remove all dust and loose material.

(d) Adequate additional hand tools to facilitate the placement of the polymer concrete overlay in accordance with this specification and the manufacturer/supplier's recommendations.

(3) Hand Application Equipment.

(a) Calibrated containers for accurate measurement of the polymer components.

(b) Paddle type mixer or other mixing device capable of accurate and complete mixing of the polymer resin and hardening agent.

(c) Notched squeegees and brooms capable of spreading the polymer material in accordance with this specification and the manufacturer/supplier's recommendations.

(d) Aggregate spreader capable of uniform and accurate application of the dry aggregate.

(e) Adequate additional hand tools to facilitate the placement of the polymer concrete overlay in accordance with this specification and the manufacturer/supplier's recommendations.

c. Preparation For Polymer Concrete Overlay Repair.

(1) When specified, repair unsound bridge deck concrete according to **SECTION 731** and cure repairs prior to performing the polymer concrete overlay repair.

(2) Protect metal deck drains and areas of the curb or railing above the proposed surface from the shot blast.

(3) Close deck drains so the overlay materials will not pass through the drains.

(4) Remove asphalt material and unsound, damaged or delaminated polymer concrete overlay as shown in the Contract Documents and as designated by the Engineer.

(5) Saw cut existing polymer concrete overlay to a depth ¼ to ½ inch below the polymer concrete overlay and Portland cement concrete bridge deck interface. Dispose of removed material on sites approved by the Engineer.

(6) Removal area should extend a minimum of 6 inches beyond the edges of the unsound, damaged or delaminated polymer concrete overlay or 6 inches beyond patching of the concrete bridge deck.

(7) Shot blast/sand blast or bush hammer portland cement concrete patch surfaces to produce an acceptable surface for placement of the polymer concrete overlay patch. Produce a surface relief equal to the International Concrete Repair Institute (ICRI) Surface Preparation Level 6 to 7 or ASTM E 965 Pavement Macrotexture Depth of 0.04 to 0.08 inch.

(8) As the final preparation for the placement of the polymer concrete overlay patches, make a complete cleanup by shot blasting and/or other approved means, followed by an air blast with dry, oil free air or vacuum. Brooming is not acceptable. Remove all pavement marking, loose disintegrated concrete, dirt, paint, oil, asphalt, laitance carbonation, curing materials and other foreign material from portland cement concrete patches and the surface of the existing polymer bridge deck overlay.

(9) Place the polymer concrete materials within 24 hours of preparing the surface. Prepared surfaces exposed for more than 24 hours must be lightly sand blasted prior to application of the polymer concrete overlay material.

d. Placing Polymer Concrete Overlay Patches.

(1) Visible moisture on the prepared surface at the time of placing the polymer concrete overlay is unacceptable. Identify moisture in the surface by taping a plastic sheet to the deck for a minimum of 2 hours (ASTM D 4263).

(2) Place the polymer concrete patches in the same manner as the single-layer polymer concrete overlay, according to **subsection 740.3e**.

(3) When an overlay is specified, the polymer concrete overlay patches may be placed when the overlay is placed using polymer overlay material per manufacturer/supplier recommendations.

(4) Rain will not necessarily contaminate the surface. However, take care so no contamination occurs. Traffic adjacent to the prepared surface during a rain will contaminate the surface.

e. Placing the Single-Layer Polymer Concrete Overlay. Place the overlay according to the grades, thickness and cross-sections shown in the Contract Documents. Provide a technical representative of the polymer manufacturer/supplier on the job site during the placement of the overlay at no additional cost. The representative is to provide technical expertise to the Contractor and the Engineer regarding safe handling, placement and curing of the overlay.

(1) Lightly sandblast the existing polymer overlay to remove all contaminants. Do not over blast and damage polymer concrete patches or the existing overlay.

(2) As the final preparation for the placement of the polymer concrete overlay, make a complete cleanup by an air blast with dry, oil free air or vacuum. Brooming is not acceptable. Remove all loose disintegrated concrete, dirt, paint, oil, asphalt, laitance carbonation, curing materials from portland cement concrete patches and other foreign material from the surface of the existing polymer bridge deck overlay.

(3) Follow all manufacturer/supplier suggested safety precautions while mixing and handling polymer components.

(4) Some overlay systems require the placement of a polymer primer coat and/or a polymer seal top coat, with or without broadcast sand or aggregate. In the following requirements, the polymer primer coat and polymer seal top coat will be referenced with the understanding they are system specific. Apply primer, when needed, at the rate prescribed by the manufacturer/supplier. Place the prepared primer uniformly on the existing polymer concrete overlay with roller, brush, airless spray or mechanical application equipment.

(5) Place the polymer concrete overlay at the application rates shown in **TABLE 740-1**.

TABLE 740-1: POLYMER CONCRETE OVERLAY APPLICATION RATES	
Polymer Rate	**Aggregate Rate ***
Not Less Than 0.45 gal./sq yd	14.5 lbs./sq yd

*Apply enough aggregate to completely cover the polymer.

(6) For slurry polymer concrete, place the material with a minimum thickness of 0.25 inches.

(7) Use notched squeegees, gage rakes or mechanical application equipment to place the prepared polymer on the existing polymer overlay immediately and uniformly at the prescribed rate.

(8) If mechanical application equipment is used, take 2 ounce samples for each 100 gallons of resin placed to verify resin and hardener mix ratios and curing times. Place samples on the bridge rail or deck and note time to cure.

(9) The bridge deck and all prepared polymer and aggregate components must be at least 60°F at the time of application.

(10) Apply the dry broadcast aggregate if required to cover the prepared polymer uniformly and completely within 10 minutes of application.

(11) Recoat areas that do not receive enough aggregate before gelling of the polymer with additional polymer and aggregate.

(12) Locate any longitudinal joints along lane lines, or as approved by the Engineer. Keep the joints clear of wheel paths as much as practical.

(13) Produce and place the overlay within the specified limits in a continuous and uniform operation.

(14) Correct completed surface variations exceeding ⅛ inch in 10 feet unless directed otherwise by the Engineer.

(15) Tape all construction joints to provide a clean straight edge for adjacent polymer concrete placement. This includes joints between previously placed polymer concrete overlay materials and at centerline.

(16) Finish the exposed edges at the ends of the bridge and at expansion joints to minimize bridge deck roughness.

(17) Apply a bond breaker to all expansion joints.

(18) Vacuum or broom excess aggregate from the bridge deck after the polymer is sufficiently cured. If damage or tearing occurs, stop brooming or vacuuming and allow additional curing time. See **subsection 740.3g.** for polymer overlay material curing guidelines.

f. Face of Curbs, Barriers, and Corral Rail Posts. Use a paintbrush or roller to apply the polymer resin on the face of curbs, barriers, and corral rail posts.

- On bridges with a corral rail, apply the polymer resin to the front face and adjacent sides of all posts.
- On bridges with curbs apply the polymer resin to the top of the curb face.
- On bridges without curbs apply the polymer resin to the edge of the deck.
- On bridges with continuous concrete barrier rails, apply the polymer resin to the first break in the geometry of the barrier or a minimum of 6 inches, uniform. Protect areas above the break line (or minimum of 6 inches) from resin. Apply so the top threshold of the resin follows a uniform line along the rail.

This work is subsidiary to the bid item Single-Layer Polymer Concrete Overlay.

Apply primer (if required) and polymer to the curb or barrier as each of the overlay applications are performed.

g. Curing. Polymer concrete material curing guidelines.

(1) Epoxy. Follow **TABLE 740-2**.

TABLE 740-2: EPOXY OVERLAY CURE TIMES						
Average Temperature of Overlay Components, °F						
55-59	60-64	65-69	70-74	75-79	80-85	85+
Minimum Cure Time (hours)						
6.5	6.5	5	4	3	3	3

Cure the epoxy polymer concrete overlay for a minimum of 8 hours if the air temperature falls below 55°F during the curing period.

(2) Methyl Methacrylate. Follow **TABLE 740-3**.

TABLE 740-3:METHYL METHACRYLATE CURE TIMES						
Course	**Ambient Temperature °F**					
	30-40	40-50	50-60	60-70	70-80	80-90
Primer	30	25	22	20	15	10
Polymer Overlay	50	40	35	30	25	20
Sealer	35	30	25	22	20	15

Methyl Methacrylate cure times can be adjusted (longer or shorter) by changing the amount of hardener in the mix.

(3) Polyester. Proportion polyester such that the cure times are between 30 and 120 minutes. Accelerators and inhibitors may be required to achieve proper set times. Proportion all materials as recommended by the material manufacturer/supplier.

(4) Plan and perform the work in such a way as to provide for the minimum curing times specified.

h. Testing. Polymer Concrete Overlay Bond Evaluation for Portland cement concrete patches, polymer concrete patches and existing polymer concrete overlay surfaces as outlined in KT-70, Part V.

(1) Place a polymer concrete test patch of not less than 0.5 square yards per lane or planned completed day's work whichever is smaller. Submit a sequence plan to the Engineer. Test patches shall be full depth, placed by the normal construction sequence. Test patches should be representative of the work being performed.

(2) Perform a minimum of 4 pull-off tests on each patch as outlined in KT-70, Part V.

(3) Final acceptance will be based on the following results of the test outlined in KT-70, Part V:

- Type 1 – Failure in the concrete at a depth greater than or equal to ¼ inch over more than 50% of the test area for 3 out of 4 tests in the test patch.
- Type 2 – Failure in the concrete at a depth less than ¼ inch over more than 50% of the test area for 3 out of 4 tests in the test patch.
- Minimum Tensile Rupture Strength of 250 psi from an average of 3 out of 4 tests on a test patch regardless of depth of failure.

(4) If failure in the concrete is at a depth less than ¼ inch and the Minimum Tensile Rupture Strength is less than 250 psi, or the failure in the concrete is less than 50% of the test area, additional surface preparation is necessary.

(5) If failure is at the polymer to polymer bond and below 250 psi, more surface preparation of the existing polymer overlay or polymer concrete patches is necessary.

(6) If failure is in the new or existing polymer overlay (Type 4), remove the overlay and evaluate the material before proceeding with placement.

(7) A failure in the concrete below 250 psi and greater than ¼ inch deep indicates weak concrete, not poor overlay bond. No additional surface preparation is required.

(8) Do not perform tensile adhesion tests when ambient or deck temperatures are above 85°F.

i. Correction of Unbonded or Damaged Areas On New Work. Repair new overlay areas discovered to be unbounded by tapping or chaining and areas where the overlay was damaged by the Contractor's operation.

(1) Saw cut the unbonded or damaged areas to the top of the concrete bridge deck surface or the existing polymer concrete overlay surface, remove the unbounded or damaged overlay with small air tools (15-pound class maximum) or shot blasting.

(2) Shot blast the existing concrete bridge deck surface or existing polymer concrete overlay surface of the unbonded area to remove contaminants, and replace the overlay according to standard placement procedures at no additional compensation.

j. Weather Limitations.

(1) Epoxy. Do not place the polymer concrete overlay if the air temperature is expected to drop below 55°F within 8 hours of placement.

(2) Methyl Methacrylate. Do not place any component of the polymer concrete overlay if the air or substrate temperature is at or expected to drop below 40°F during installation without inclusion of cold temperature additive at the dosage specified by methacrylate manufacturer/supplier's mixing guide.

(3) Polyester. Do not place any component of the polymer concrete overlay if the air or substrate temperature is at or expected to drop below 40°F during installation.

(4) General. Do not place the polymer concrete overlay when the deck temperature will exceed 90°F.

Do not place the polymer concrete overlay if gel time is less than 10 minutes.

Polymer concrete overlay can be placed outside the specified temperature ranges with the approval of the Engineer and the material manufacturer/supplier. Discuss changes to temperature limitations at the preconstruction conference. Submit changes, including a written statement from the material manufacturer/supplier recommending the changes, to the Engineer for approval.

740.4 MEASUREMENT AND PAYMENT

The Engineer will measure polymer concrete overlay repair areas by the square yard prior to placing the patch material. The measured pay quantity will be those areas sounded by the Engineer and marked as unsound or delaminated polymer concrete overlay.

The Engineer will measure single-layer polymer concrete overlay by the square yard. The Engineer will measure the bridge roadway width and the bridge length from end of wearing surface to end of wearing surface.

Payment for "Polymer Concrete Overlay Repair" and "Single-Layer Polymer Concrete Overlay" at the contract unit price is full compensation for the specified work.

SECTION 741

CASED PILING

741.1 DESCRIPTION

Construct and install a casing to enclose and isolate piling within a retaining wall mass. Brace, dewater, backfill and place steel cap plate on casing.

BID ITEM	UNITS
Cased Pile	Linear Foot

741.2 MATERIALS

a. Casing. Provide a casing with a diameter 12 inches larger than the diameter of the pile, and of sufficient thickness to carry the working stresses and loads imposed on the casing during construction. At a minimum, use 14-gage corrugated metal pipe (CMP) for the permanent casing. When specified, provide a permanent casing that is less than or equal to 1 inch out-of-round. The deviation of a chord from end to end shall be a maximum of 2 inches.

The Engineer will accept the casing based on compliance with the specified requirements, and visual inspection of condition.

b. Aggregate. Provide meeting the following requirements:

Sieve Size	Percent Retained by Weight
3/8"	0 - 20%
No.8	40 - 80%
No.100	98 - 100%

Provide clean, naturally rounded (not crushed) aggregate. Provide aggregate free of deleterious substances such as shale, with a maximum limestone content of 10%. Obtain the Regional Geologist's approval of the aggregate, before installing it in the casing backfill system. Such approval could take up to 7 days.

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

c. Cap Plate. Provide structural steel cap plate conforming to ASTM–A36 materials and galvanized according to ASTM 123. Fabricate a round cap plate that is ¾-inch thick and 6 inches larger in diameter than the casing which it covers. The cap plate will fit the profile of the pile being used so that there is a maximum of a ½-inch gap between the cap plate and the pile. Cut out the shape of the pile into the cap plate, prior to galvanizing.

Submit shop drawings according to **SECTION 105**.

741.3 CONSTRUCTION REQUIREMENTS

- Prior to driving the pile, construct the cased pile by first pre-drilling a minimum of 5 feet into in-situ material at the location shown on the plans. Center the pre-drilled hole at the pile locations. Construct the pre-drilled hole 3 inches larger than the nominal diameter of the casing defined above. Locate and construct the casing according to the tolerances in **subsection 704.3c**.
- After driving the pile, install the casing over the pile and embed into the predrilled hole. Plumb and center the casing with the pile.
- Install the cap plate to rest on top of the casing and center on the pile and the casing.
- Brace the casing to prevent movement during backfilling and retaining wall construction.
- Backfill casing with the aggregate to within 15 feet of the top of the pile; the remainder will be left open.

741.4 MEASUREMENT AND PAYMENT

The Engineer will measure the cased pile by the linear foot.

Payment for "Cased Pile" at the contract unit price is full compensation for the specified work. Piling construction, measurement and payment will be handled under **SECTION 704**.

SECTION 742

HEAT STRAIGHTENING (IN-PLACE) OF DAMAGED STRUCTURAL STEEL

742.1 DESCRIPTION

Use heat straightening to repair damaged sections of the existing structural steel beams and girders shown in the Contract Documents, or designated by the Engineer.

BID ITEM	UNITS
Heat Straightening Repair	Linear Foot

742.2 MATERIALS

Provide materials that comply with the applicable requirements.

Organic Zinc Primer	**SECTION 1802**
Waterborne Acrylic Top Coat	**SECTION 1806**
Calcium Sulfonate Alkyd Paint System	**SECTION 1808**

742.3 CONSTRUCTION REQUIREMENTS

a. General. Heat Straightening is a repair procedure in which a limited amount of heat is applied in specific patterns to plastically deformed regions of damaged steel in repetitive cycles of heating and cooling to produce a gradual straightening of the member. A limited amount of force may be used to restrain the member from excessive out of plane movement during heating. Force is not the primary method of straightening.

Procedures using forces that result in stresses over the yield stress of the material at the applied temperature, such as Hot Mechanical Straightening and Hot Working, are prohibited.

The repair must be directly supervised by a person with successful experience in heat straightening repairs of comparable bridge structures. Provide the Engineer with written documentation of past experience before beginning the repair work.

b. Equipment. Use an oxygen-fuel combination for heating. For fuel, use propane, acetylene or a similar fuel. Apply heat using either single or multiple orifice tips only. The maximum tip size is limited to 1 inch.

Verify temperatures during heat straightening with temperature sensitive crayons, a pyrometer, or an infrared non-contact thermometer. Provide the heat indicating device, and make it available to the Engineer at all times.

Use either hydraulic or mechanical jacks, come-alongs or other force application devices.

c. Application of Heat. Apply heat to the member with vee (triangular shaped) heats or line heats to the flange and with vee, line or strip heats to the web. The base of individual vee heats shall not exceed 10 inches.

A series of heats applied consecutively to different elements of the member at the same cross section is referred to as a heating pattern. Select heating patterns and sequences to match the type of damage and cross section shape.

Do not heat the steel over 1100°F during heat straightening unless specified otherwise in the Contract Documents. Heat the steel in a single pass following the heating pattern and allow cooling to 250°F prior to reheating. Water-cooling is not permitted.

Shift vee heats along the zone of yielded material on successive heating patterns. Simultaneous vee heats are permitted provided that the clear spacing between vees is greater than the width of the plate element.

Heating patterns other than those suggested in the Contract Documents may be used if approved by the Engineer. If no suggested heating patterns are provided in the Contract Documents, submit proposed heating patterns to the Engineer for approval.

d. Application of Jacking Forces. Only use jacking forces to restrain the members or elements against undesired movement associated with expansion during the cycles of applying heats. Place jacks to resist forces during the heating process. As the straightening occurs during cooling, the forces should be relieved.

The maximum allowable jacking force for members may be calculated by a licensed Professional Engineer, in accordance with the methods outlined in US DOT report no. FHWA-IF-99-004, "Heat-Straightening Repairs of Damaged Steel Bridges", with calculations submitted for approval by the Bridge Office before work begins; or, the limit may be estimated in the field by limiting the jacking force to the force required to produce the following deflections on the unheated steel members.

For 36 ksi Steel:
$\delta_{max} = 1/y_{max} * (L/140)^2$

For 50 ksi Steel:
$\delta_{max} = 1/y_{max} * (L/120)^2$

where: δ = The maximum deflection (in inches) between supports for a jacking force producing a maximum bending stress equal to ½ of the yield stress. For lateral displacements this would be the lateral deflection.
y_{max} = The distance (in inches) from the centroid of the steel section to the extreme fiber about the axis of bending. For lateral displacement of an "I" shaped beam this would be ½ of the flange width.
L = The distance (in inches) between supports, for lateral displacements this is the distance between the cross frames/diaphragms in place during heat straightening.

Do not increase the jacking force during heating or until the steel is cool to the touch between heats.

Assume that the existing steel has a yield strength of 36,000 psi, unless specified otherwise in the Contract Documents.

No deflection is allowed for other bridge members being used as supports for the jacking device.

For repairs of local flange bending, the jacking force is limited to that which produces no deflection of the unheated flange.

e. Tolerances. Completed tolerances for straightness of the bottom flange are within ¼ inch of horizontal at the flange edge and ½ inch of horizontal sweep in 20 feet at the point of impact. The completed tolerances for the web are 1/100th of the web depth or ¼ inch, whichever is greater, out of vertical alignment; and no more than ¼ inch of localized deviation as measured with a straightedge vertically and horizontally against the web. Meet these tolerances before attaching any cross frames. Do not force the member into position and then attach the cross frame to hold the member in position.

f. Crack and Gouge Repair. Grind smooth all nicks, gouges and scrapes. Arrest all web cracks by drilling a 1 inch hole at each end of each crack. Locate the end of each crack by dye penetrant, magnetic particle or other approved non-destructive testing method.

g. Inspection. After straightening is complete inspect the flanges for crack by dye penetrant, magnetic particle or other approved non-destructive testing method. The Engineer will witness this testing. Remove minor (< ½ inch) cracks found by this inspection by grinding. Larger cracks found will be reviewed by the Engineer and repaired as directed by the Engineer. Any crack repair, unless shown in the Contract Documents, by methods other than grinding or drilling is considered Extra Work, **SECTION 104**.

h. Painting. Restore the paint on the damaged portions of the beams, girders, cross frames and diaphragms, including paint damaged by the repair process.

If the existing surface is a lead based paint system, clean the surfaces of loose material and oil, then coat the cleaned surfaces with a calcium sulfonate alkyd paint system according to the manufacturer's recommendations.

If the existing surface is not a lead based paint system, sandblast the surfaces clean, then coat the cleaned surfaces with an organic zinc primer and waterborne acrylic top coat according to "Repainting Existing Steel Bridges- Painting in Kind", **SECTION 702**.

As far as it is practicable, match the finish coat to the existing paint color. The Engineer is the final arbitrator of color match.

742.4 MEASUREMENT AND PAYMENT

The Engineer will measure the linear feet of primary member that requires heat straightening repair. Inspection, non-destructive testing, crack and gouge repair, secondary member heat straightening and painting are subsidiary.

Payment for "Heat Straightening Repair" at the contract unit price is full compensation for the specified work.

SECTION 743

ROLLED BEAM DETOUR BRIDGE

743.1 DESCRIPTION

Erect and Remove or Furnish the Rolled Beam Detour Bridge as shown in the Contract Documents.

BID ITEMS	UNITS
Erect and Remove Rolled Beam Detour Bridge	Lump Sum
Furnish Rolled Beam Detour Bridge	Lump Sum

743.2 MATERIALS

Use material complying with the details shown in the Contract Documents.

The Engineer will accept the material on the basis of compliance with dimensional requirements, condition, and visual inspection at the point of usage.

743.3 CONSTRUCTION REQUIREMENTS

Construct the rolled beam detour bridge as shown on the Contract Documents.

743.4 MEASUREMENT AND PAYMENT

The Engineer will measure the erect and remove rolled beam detour bridge and furnish rolled beam detour bridge by the Lump Sum.

Payment for "Erect and Remove Rolled Beam Detour Bridge" and "Furnish Rolled Beam Detour Bridge" at the contract unit price is full compensation for the specified work.

The Engineer will pay for Erect and Remove Rolled Beam Detour Bridge according to **TABLE 743-1**.

TABLE 743-1: PAYMENT FOR ERECT AND REMOVE ROLLED BEAM DETOUR BRIDGE

Pay % of Contract Unit Price	Milestone
75	Erection of the structure has been completed.
100	When the structure has been dismantled and all the parts to be returned have been properly inventoried and stockpiled at the storage site listed in the Contract Documents.

SECTION 744

STRUCTURAL STEEL FABRICATION - GENERAL

744.1 DESCRIPTION

Shop fabricate the structural steel according to the Contract Documents. This specification applies to all welded steel structures or items covered by American Welding Society (AWS) D1.1-2010, "Structural Welding Code – Steel", all welded aluminum alloy structures covered by the AWS D1.2-2014, "Structural Welding Code – Aluminum", and all stainless steel items covered by the AWS D1.6-2007, "Structural Welding Code – Stainless Steel". See **SECTION 705** for the fabrication of structural steel for bridges on highway and public roads carrying vehicular traffic and the field welding of structural steel to highway bridges.

744.2 MATERIALS

a. General. Provide materials that comply with the applicable requirements.

Castings	**DIVISION 1600**
Structural Steel	**DIVISION 1600**
Structural Steel Tubing	**DIVISION 1600**
Steel For Bridge Drain Systems	**DIVISION 1600**
Welded Stud Shear Connectors	**DIVISION 1600**
Steel Fasteners	**DIVISION 1600**
Steel Pipe	**DIVISION 1600**
Aluminum Alloys	**DIVISION 1600**

b. Preliminary Shop Requirements.

(1) Point of Fabrication. Within 10 business days after signing the contract, notify the appropriate KDOT office and the Bureau Chief of Construction and Materials in writing of the firm (name and location) that will fabricate the structure. Produce and fabricate all structural steel within the Continental United States (see **SECTION 106.1**).

(2) Shop Drawings. The Contractor or fabricator must submit shop drawings of structural steel, structural aluminum alloys, and castings according to **SECTION 105**. Do not perform any fabrication until the approved shop drawings are in the hands of the Inspector and fabricator, and the Engineer has authorized fabrication. Any purchase of materials before fabrication authorization is at the Contractor's risk.

Changes on approved shop drawings or contract plans are subject to the approval of the Engineer. Notify the Engineer with a record of such changes. Submit revised sheets of the same size as the shop drawings originally submitted.

Show approved welding procedure numbers in the tail of weld symbols on submitted shop drawings. Submit 2 copies of each procedure requiring approval to the Bureau of Construction and Materials. All weld procedures referenced in a set of shop drawings must be approved before the shop drawings can be approved.

Provide a diagram on the shop detail plans giving sufficient dimensions for accurate fabrication and inspection of the structure.

The Contractor is responsible for the correctness of the shop fit-up and field connections, even though the shop drawings have been approved by the Engineer. See **SECTION 105**.

(3) Notice of Beginning of Work. In order to provide inspection, notify the Engineer before beginning work in the shop. Give a minimum of 24 hours' notice before beginning work in shops in the State of Kansas, and give a minimum of 7 calendar days' notice before beginning work in shops in the contiguous United States.

(4) Material Acceptance. Submit to the Bureau Chief of Construction and Materials, 1 copy of each mill test report for each heat number to be used before the layout, and use such steel in the fabrication of the structure. If no shop inspection is provided by KDOT, submit mill test reports (Type A certifications) in accordance with **SECTION 2601**.

Submit a fabricator's guarantee indicating that the attached certified mill test reports pertain to all heat numbers used in the structure, and all material complies with the Contract Documents. Include the following in the guarantee:

- fabricator's name;
- KDOT project number;
- structure or station number;
- fabricator's purchase order number;
- list heat numbers;
- size and shape of pieces;
- number of pieces to be used for each size of each heat; and
- steel or aluminum alloy producer's name and the ASTM or AASHTO designation for the material that is required in the Contract Documents.

The guarantee must include the notarized signature of an official of the company who is authorized to legally bind the statement on the company's behalf.

All structural steel shall comply with the ASTM A 6 quality requirements until released for shipment.

Dependent on the material being used, repair welding shall comply with the requirements of AWS D1.1, "Structural Welding Code - Steel" or AWS D1.2, "Structural Welding Code – Aluminum", with the corresponding exceptions and additions noted later in this section, or AWS D1.6, "Structural Welding Code – Stainless Steel".

The term "mill" means any rolling mill or foundry where material for the work is manufactured. When any ASTM or AASHTO steel is specified in the Contract Documents, the mill must certify that the material complies with the specified chemical and physical requirements.

The fabricator must obtain written permission from KDOT to substitute a grade of steel or aluminum alloy that is not indicated in the Contract Documents for one that is shown in the Contract Documents.

(5) Facilities for Inspection and Testing. During all hours of operation allow the Engineer free access to all parts of the work and the shop where fabrication is performed.

Provide an enclosed office area for the exclusive use of the Engineer at the location of fabrication. The area must satisfy the requirements of a Field Office (Special) in **SECTION 803**, except as modified below:

- Minimum floor area = 120 square feet;
- Single workbench or table - 30 inch by 8 feet (minimum dimensions);
- Desk - 30 inch by 5 feet, with drawers;
- Swivel desk chair with arm rests;
- Waste paper basket; and
- Storage/Filing cabinet with lock and key

When directed by the Engineer, promptly repair or replace any damaged or non-functioning items. Provide parking near the office with direct accessibility to the office and shop.

(6) Test Specimens - Provide "all-weld-metal" tension specimens and specimens for other weld tests as directed by the Engineer. Preparation and possible shipment of specimens are subsidiary to the fabrication of the structure.

(6.1) – Steel Bar, Plate, Shapes. When directed by the Engineer, prepare 4 inch by 24 inch test specimens of the base metal. Orient the specimen so the direction of rolling is according to the latest edition of ASTM A 6.

(6.2) – Steel Tubes and Pipes, Aluminum Alloy Products – When directed by the Engineer, prepare base metal or product specimens of the dimensions specified by the Engineer.

c. Handling. Conduct the loading, transporting, unloading and storing of structural steel to keep the metal clean, above ground and free from injury. Use protective devices or softeners to safeguard plate edges.

Store structural steel, either plain or fabricated, above the ground on platforms, skids or other supports, and keep free from corrosion, dirt, grease and other foreign matter. Store girders and beams upright with sufficient support to prevent warping or change in design camber.

d. Shop Fabrication.

(1) Identification. All pieces of all grades of steel and aluminum alloy used in fabrication of main members must bear the heat number assigned by the rolling mill. Preserve the heat number until the Engineer advises the fabricator that the unit is acceptable for cleaning and painting. Identify the grade of steel as specified in ASTM A 6.

(2) Straightening Material. All mill material must be straight before being laid out for work. If straightening is required, do not injure the metal. Heat straightening must comply with AWS D1.1, "Structural

Welding Code - Steel" or AWS D1.2, “Structural Welding Code – Aluminum”, as applicable for the material being used. Submit the proposed heat straightening procedure to the Engineer for approval. Sharp kinks and bends are cause for rejection of the material. Steel mill material must not exceed dimensional tolerances outlined in the latest edition of ASTM A 6.

(3) Welding and Gas Cutting. Dependent on the material be used, perform welding and gas cutting of structural steel and aluminum alloy according to the requirements of the AWS D1.1, "Structural Welding Code - Steel" or AWS D1.2, “Structural Welding Code – Aluminum”, with the corresponding exceptions and additions noted later in this section, or AWS D1.6, “Structural Welding Code – Stainless Steel”.

(4) Finish. Neatly finish all work. Carefully and accurately shear and clip. Fabricate finished members true to line and detailed dimension, and free from twists, bends, open joints or other defects.

(5) Welded Stud Shear Connectors. Apply welded stud shear connectors to the designated structural steel members during shop fabrication.

If the circumstances warrant, and if the Engineer approves the Contractor’s procedures, welded stud shear connectors may be field applied. Approval is based on demonstrating to the Engineer’s satisfaction, that the Contractor can:

- remove any shop applied coating removed from the top flange without damaging the structural member;
- weld the stud shear connectors to the structural member; and
- blast clean and prime coat the top flange and stud shear connectors.

(6) Shop Assembly for Final Inspection. Unless otherwise provided both in writing and shown on the approved shop drawings, assemble, securely support, adjust and maintain to proper line, grade, camber and suitable clearances all members.

After the assembly is completely set up, the fabricator’s quality control personnel must check blocking, sweep and bearing-to-bearing measurements prior to any checking by the Engineer.

(7) Shop Painting. Prepare the structural steel surfaces and shop paint the prepared surfaces according to **SECTION 714**.

(8) Shop Bolted Connections. Perform all bolting according to **SECTION 712.**

(9) Overhead Sign Structures, Cantilever Sign Structures, Bridge Mounted Sign Attachments, High Mast Light Poles, Lighting and Traffic Signal Poles:

(9.1) except as noted in (9.2), nondestructively test 100% of all complete joint penetration (CJP) groove welds.

(9.1.1) use Radiography Testing (RT) or Ultrasonic Testing (UT) when the thickness of the thinnest connecting material is 1/4 inches or more.

(9.1.2) except as noted in (9.1.3), use Magnetic Particle Testing (MT) when the thickness of the thinnest connecting material is less than 1/4 inches.

(9.1.3) use RT for all CJP welds in High Mast Light Poles when the thickness of the thinnest connecting material is less than 1/4 inches.

(9.2) For mast arms having an OD of less than 6 inches (measured anywhere along it length), MT 100% of the mast arm to pole connection CJP welds on a random 1 out of 4 structures, or fraction thereof.

(9.3) Inspect partial penetration groove welds and fillet welds on a random 1 out of 4 structures, or fraction thereof. For each structure selected, inspect:

(9.3.1) a minimum of 4 inches out of every 48 inches of all partial penetration groove welds, including the 4 inches nearest a connection. Use MT.

(9.3.2) 100% of all tube-to-transverse plate (i.e. flanges, base plates, connection plate, etc.) welds. Use MT.

(9.3.3) 100% of the perimeter hand hole welds. Use MT.

(9.3.4) 100% of all welds connecting a device or accessory to the tube wall. Use MT.

(9.3.5) 100% of the mast arm-to-pole connection welds when the OD of the mast arm is less than 6 inches (measured anywhere along it length). Use Visible Liquid Penetrant Testing (PT).

(9.3.6) 100% of all tube-to-transverse plate welds of aluminum alloy structures or structural elements. Use PT while being witnessed by the Engineer.

(9.4) after galvanizing, UT only the tube-to-transverse plate CJP groove welds noted on the shop drawings as needing this additional inspection.

(10) Overhead Sign Structures. After heading the 7/8 inch diameter rivet used in the Truss to End Support Coupling, the minimum flange thickness can be no less than 3/8 inches, measured at any point along the head's circumference.

(11) Steel Bridge Bearings. At the option of the Engineer, steel bearing device inspection will require that either 1 device in 10, or fraction thereof, be tested 100%, or a10% of each device will be tested using PT or MT. When tested at the 1 in 10 rate, the Engineer will select which device to test. When tested at the 10% rate, the Engineer will select the weld locations to test, which can vary from device to device. The welding of dissimilar metals is not prequalified.

(12) Rejection. Repair or replace rejected items as directed by the Engineer.

(13) Release for Shipment. Do not release fabricated elements for shipment from the fabrication or paint shop without approval of the Engineer.

e. Supplemental Requirements to the Structural Welding Code - Steel. The section and paragraph references cited in the paragraphs below are to AWS D1.1-2010.

Add 2 new subsections as follows:

SUBSECTION 1.10 EQUIPMENT CHECK

Each DC generator shall have a service check by an NEWA member, a commercial electrical equipment company or by the fabricating plant's electrical maintenance engineer once each year. A service certificate shall be issued with each equipment check and shall be available for inspection by the Engineer.

SUBSECTION 1.11 TEMPORARY WELDING AND TACKING

The attachment of temporary fabrication, erection and construction items to main members by welding or tacking is prohibited except by written permission from the Bureau Chief of Construction and Materials. Permissible locations for such welds and tacks shall be only at locations shown on approved shop drawings or at locations designated in writing by the Engineer.

SUBSECTION 2.4.5 PLUG AND SLOT WELDS

Add the following paragraph 2.4.5.5:

Plug and slot welding is prohibited without the written approval of the Engineer. As a requirement for approval, all plug and slot welding shall be QC tested by nondestructive testing at no cost to the state. The type of testing shall be determined by the Engineer.

SECTION 3 PREQUALIFICATION OF WPSs

Add the following notes to Table 3.1:

- Only low hydrogen electrodes shall be used.

SUBSECTION 3.2 WELDING PROCESSES

Delete the first sentence of paragraph 3.2.2 and replace with the following:

ESW or EGW shall not be used. GTAW and GMAW-S welding may be used, provided the WPSs are qualified in conformance with the requirements of Clause 4.

SUBSECTION 4.2 GENERAL REQUIREMENTS - QUALIFICATION

Add the follow to paragraph 4.2.1.1:

All PQR tests must be witnessed by the Engineer, another state's representative approved by the Engineer, or an independent third party approved by the Engineer. If representatives from other states or third parties witnessed a test, provide records of the test signed by the witness. All mechanical and nondestructive tests performed by independent laboratories on qualification specimens will be at no charge to the State. Provide signed documentation of the independent lab's test results to the Engineer. When requested by the Engineer, allow KDOT access to the test samples and the independent lab's radiographs for inspection.

Add the following to paragraph 4.2.2.2:

All tests must be witnessed by the Engineer, another state's representative approved by the Engineer, or an independent third party approved by the Engineer. If representatives from other states or third parties witnessed a test, records of the test must be signed by the witness.

Add a new paragraph 4.2.4:

4.2.4 Additional Testing. The Engineer may order tests of welders, welding operators, tack welders, or WPSs whenever there is evidence that unacceptable welds are being or have been produced. This additional testing is at the fabricator's expense. The Engineer may disqualify personnel working for the fabricator who fail the additional testing, who commit serious violations of the specifications, or who repeatedly exhibit poor workmanship on KDOT projects.

Revise paragraph 4.3.3 as follows:

Replace "those authorized to examine them." with "the Engineer."

SUBSECTION 5.26 REPAIRS

Add the following to paragraph 5.26.2:

Do not use mechanical straightening methods without the approval of the Engineer, even when used in conjunction with the application of heat.

SUBSECTION 6.1 INSPECTION – GENERAL REQUIREMENTS

Add the following to paragraph 6.1.2.1:

This type of inspection shall not be performed by an inspector or their assistants who are, or were previously, engaged in the welding, the general assembly, or the application of coatings.

SUBSECTION 6.14 NONDESTRUCTIVE TESTING (NDT) PROCEDURES

Delete paragraphs 6.14.4 and replace with the following:

6.14.4 When magnetic particle testing (MT) is used, the procedure and techniques shall be in accordance with the dry powder magnetic particle examination of welds using the yoke method. The yoke method shall be performed according to ASTM E 709, and the standard of acceptance shall conform with Clause 6, Part C, of this code.

(1) The yoke method shall be performed using half-wave rectified direct current or alternating current.

(2) Electromagnetic yokes shall have lifting forces complying with **TABLE 744-1**.

TABLE 744-1: ELECTROMAGNETIC YOKE SPACING		
Current Type	**Yoke Pole Leg Spacing (YPS)**	
	2"≤YPS<4"	**4"≤YPS≤6"**
AC	10 lbs.	Not Applicable
DC	30 lbs.	50 lbs.

6.14.4.1 Prior to MT, the surface shall be examined, and any adjacent area within a minimum of 1 inch of the surface to be tested, shall be dry and free of contaminants such as oil, grease, loose rust, loose sand, loose scale, lint, paint, welding flux, and weld spatter.

Cleaning may be accomplished by detergents, organic solvents, descaling solutions, paint removers, vapor degreasing, sand or grit blasting, and ultrasonic cleaning methods.

6.14.4.2 The poles shall be oriented in two directions approximately 90 degrees apart at each inspection point, to detect both longitudinal and transverse discontinuities. The pole position shall overlap as testing progresses to insure 100 percent inspection of the areas to be tested. Discontinuities are best detected when their axis is normal to the magnetic lines of force. Therefore, the yoke technique is most sensitive to discontinuities whose major access is normal to a line drawn between the two poles.

6.14.4.3 A report of magnetic particle examination shall be prepared and provided to the owner.

(1) The report shall include the following minimum information:

(a) Part identification

(b) Examination procedure number (if applicable)

(c) Date of examination

(d) Technicians name, certification level, and signature

(e) Name and signature of contractors or owners, Inspectors, or both who witnessed the examination

(f) Examination results

(g) Equipment make and model

(h) Yoke spacing used

(i) Particle manufacturer's name and color

(2) One copy of the report shall be provided to the contractor for the owner.

Add the following to paragraph 6.14.5:

For detecting discontinuities in non-magnetic materials including stainless steel to stainless steel or stainless steel to carbon steel, visible liquid penetrate testing (PT) will be used in lieu of MT. The standard methods, set forth in ASTM E 165 shall be used for PT inspection, and the standards of acceptance shall conform to Clause 6, Part C, of this code.

SUBSECTION 6.17 RADIOGRAPHIC TESTING (RT) - PROCEDURE

Delete paragraph 6.17.9 and replace with the following:

6.17.9 FILM SIZE - When the joint thickness is less than 3 inches, radiographs shall be 4 1/2 inches x 17 inches in size. When the length of the joint is such that more than one radiograph is required, one of the films may be shortened to 4 1/2 inches x 10 at the contractor option. When joint thicknesses are 3 inches or greater, the minimum film size shall be 7 inches x 17 inches. Larger radiographs may be required in areas where there have been excessive repairs or where there are joints with unusual dimensions.

Delete paragraph 6.17.12 and replace with the following:

6.17.12 One radiograph identification number shall be painted on the steel no closer than 3/4 inch from the weld edge at each radiograph location. Corresponding lead numbers shall be superimposed on the painted numbers to produce an image on the radiograph. A combination of letters and numbers may also be used. Two location dots shall be painted on the steel at each radiograph location no closer than 3/8 inch from the weld edge. The dots shall be placed at a random distance from the steel plate edges which are perpendicular to the length of the weld. The dots shall be placed in different locations for each radiograph location. One lead arrow shall be placed so that its tip is superimposed on each of the two location dots. A location letter shall be painted immediately under each arrow and a lead letter shall be superimposed on each painted letter. When radiographs are viewed, only those films representing the same joint should have location arrows and location letters perfectly superimposed. Any additional information shall be produced on the radiograph no less the 3/4 inches from the edge of the weld either by pre-printing or by placing lead letters and numbers on the steel. See Figures 1 and 2. Information required to be shown on the radiograph shall include: the complete KDOT bridge number, initials of the radiographic inspection company, initials of the fabricator, the fabricator's shop order number, the radiographic identification number, the date, and the weld repair number if applicable.

Add a new paragraph 6.17.14:

6.17.14 Unless otherwise noted on the shop drawings all butt welds will be evaluated as tension welds.

f. Supplemental Requirements to the Structural Welding Code - Aluminum. The section and paragraph references cited in the paragraphs below are to AWS D1.2-2014.

Add 2 new subsections as follows:

SUBSECTION 1.9 EQUIPMENT CHECK

Each DC generator shall have a service check by an NEWA member, a commercial electrical equipment company or by the fabricating plant's electrical maintenance engineer once each year. A service certificate shall be issued with each equipment check and shall be available for inspection by the Engineer.

SUBSECTION 1.10 TEMPORARY WELDING AND TACKING

The attachment of temporary fabrication, erection and construction items to main members by welding or tacking is prohibited except by written permission from the Bureau Chief of Construction and Materials. Permissible locations for such welds and tacks shall be only at locations shown on approved shop drawings or at locations designated in writing by the Engineer.

SUBSECTION 2.6 PLUG AND SLOT WELDS

Add the following paragraph 2.6.9:

Plug and slot welding is prohibited without the written approval of the Engineer. As a requirement for approval, all plug and slot welding shall be QC tested by nondestructive testing at no cost to the state. The type of testing shall be determined by the Engineer.

SUBSECTION 3.1 GENERAL REQUIREMENTS – QUALIFICATION

Revise item (5) as follows:

Replace "those authorized to examine them." with "the Engineer."

Add 3 new paragraphs as follows:

3.1.1 All PQR tests must be witnessed by the Engineer, another state's representative approved by the Engineer, or an independent third party approved by the Engineer. If representatives from other states or third parties witnessed a test, provide records of the test signed by the witness. All mechanical and nondestructive tests performed by independent laboratories on qualification specimens will be at no charge to the State. Provide signed documentation of the independent lab's test results to the Engineer. When requested by the Engineer, allow KDOT access to the test samples and the independent lab's radiographs for inspection.

3.1.2 All welder, welding operator, and tack welder tests must be witnessed by the Engineer, another state's representative approved by the Engineer, or an independent third party approved by the Engineer. If representatives from other states or third parties witnessed a test, records of the test must be signed by the witness.

3.1.3 Additional Testing. The Engineer may order tests of welders, welding operators, tack welders, or WPSs whenever there is evidence that unacceptable welds are being or have been produced. This additional testing is at the fabricator's expense. The Engineer may disqualify personnel working for the fabricator who fail the additional testing, who commit serious violations of the specifications, or who repeatedly exhibit poor workmanship on KDOT projects.

SUBSECTION 4.22 CONTROL OF DISTORTION AND SHRINKAGE

Add the following to paragraph 4.22.4:

Do not use mechanical straightening methods without the approval of the Engineer, even when used in conjunction with the application of heat.

SUBSECTION 5.1 INSPECTION – GENERAL REQUIREMENTS

Add the following to the first section of paragraph 5.1.1:

Fabrication/erection inspection by the contractor shall not be performed by an inspector or their assistants who are, or were previously, engaged in the welding, the general assembly, or the application of coatings.

SUBSECTION 5.10 RADIOGRAPHIC TESTING (RT) - PROCEDURE

Delete paragraph 5.10.9 and replace with the following:

5.10.9 FILM SIZE - When the joint thickness is less than 3 inches, radiographs shall be 4 1/2 inches x 17 inches in size. When the length of the joint is such that more than one radiograph is required, one of the films may be shortened to 4 1/2 inches x 10 at the contractor option. When joint thicknesses are 3 inches or greater, the minimum film size shall be 7 inches x 17 inches. Larger radiographs may be required in areas where there have been excessive repairs or where there are joints with unusual dimensions.

Delete paragraph 5.10.12 and replace with the following:

5.10.12 One radiograph identification number shall be painted on the steel no closer than 3/4 inch from the weld edge at each radiograph location. Corresponding lead numbers shall be superimposed on the painted numbers to produce an image on the radiograph. A combination of letters and numbers may also be used. Two location dots shall be painted on the steel at each radiograph location no closer than 3/8 inch from the weld edge. The dots shall be placed at a random distance from the steel plate edges which are perpendicular to the length of the weld. The dots shall be placed in different locations for each radiograph location. One lead arrow shall be placed so that its tip is superimposed on each of the two location dots. A location letter shall be painted immediately under each arrow and a lead letter shall be superimposed on each painted letter. When radiographs are viewed, only those films representing the same joint should have location arrows and location letters perfectly superimposed. Any additional information shall be produced on the radiograph no less the 3/4 inches from the edge of the weld either by pre-printing or by placing lead letters and numbers on the steel. See Figures 1 and 2. Information required to be shown on the radiograph shall include: the complete KDOT bridge number, initials of the radiographic inspection company, initials of the fabricator, the fabricator's shop order number, the radiographic identification number, the date, and the weld repair number if applicable.

Add a new paragraph 5.10.14:

5.10.14 Unless otherwise noted on the shop drawings all butt welds will be evaluated as tension welds.

FIGURE 1

ITEMS TO BE PAINTED FOR RADIOGRAPHIC IDENTIFICATION

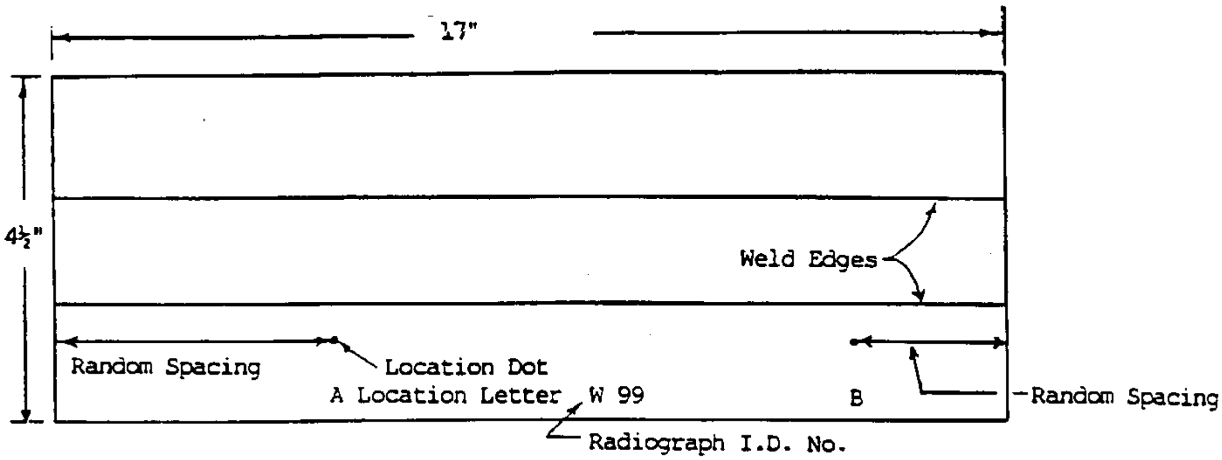
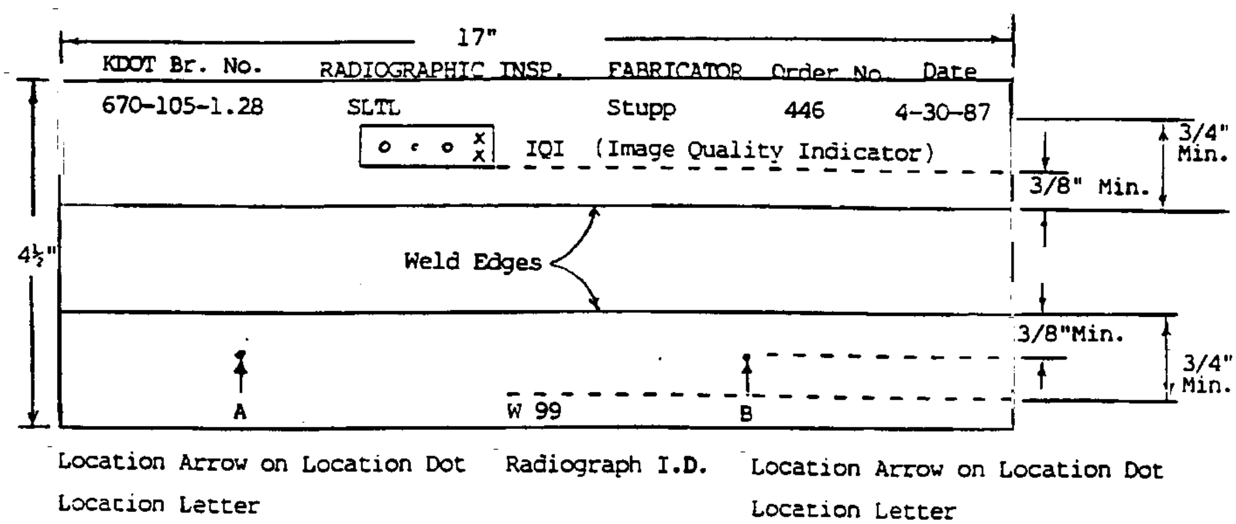


FIGURE 2

LEAD CHARACTER PLACEMENT FOR RADIOGRAPHIC IDENTIFICATION



744.3 MEASUREMENT AND PAYMENT

The Engineer will not measure fabrication of new structural steel or aluminum alloy for separate payment.

801 - MOBILIZATION

SECTION 801

MOBILIZATION

801.1 DESCRIPTION

Move required personnel, equipment, materials, supplies and incidentals to the project site prior to beginning work. Include other work and costs incurred before the project starts.

BID ITEMS	UNITS
Mobilization	Lump Sum
Mobilization (DBE)	Lump Sum

The bid item "Mobilization (DBE)" is only used on Federal Aid Projects having a DBE Goal set by KDOT. This bid item gives the Contractor the option to provide funds for mobilization to DBE subcontractors.

If the Contractor elects not to utilize the bid item "Mobilization (DBE)", a unit price of $0.00 is an acceptable bid for this item.

801.2 MATERIALS - None specified.

801.3 CONSTRUCTION REQUIREMENTS - None specified.

801.4 MEASUREMENT AND PAYMENT

a. Mobilization. The Engineer will make partial payments according to **TABLE 801-1**.

TABLE 801-1: MOBILIZATION PARTIAL PAYMENTS

Percent of Original Contract Amount Completed	Pay Lesser of the Two	
	% of Mobilization	% of Original Contract Amount
5	25	2.5
10	50	5
25	60	7.5
50	100	10
Accepted	100	NA

The Percent of Original Contract Amount Completed = the amount earned by the Contractor* divided by the total dollar value of the original contract (all bid items).

*Do not include monies earned for "Mobilization", "Traffic Control (Lump Sum)", "Contractor Construction Staking" and "Stored Materials".

b. Mobilization (DBE). On behalf of the DBE subcontractor(s), submit to the Engineer a written request for partial payment of this item. Requests may be made 30 days in advance of the DBE subcontractor beginning work or mobilizing. Limit the amount requested to the amount of mobilization necessary for the work that will begin within 45 days of the request. Make additional requests at appropriate times until 100% of this item is paid.

The lump sum amount bid for "Mobilization (DBE)" shall not exceed 10% of the total amount identified by the Contractor for each DBE. The total lump sum amount bid must equal the sum of the DBE mobilization amounts designated on 07-19-80, latest revision. Amounts recorded on 07-19-80, latest revision, must be actual amounts to be paid to the DBE's. Do not include any markups.

The Contractor is required to pay the DBE subcontractor the requested amount of partial payment for this item, no later than 5 days after the DBE begins mobilizing or work.

Payment for "Mobilization" and "Mobilization (DBE)" at the contract unit is full compensation for the specified work.

SECTION 802

CONTRACTOR CONSTRUCTION STAKING

802.1 DESCRIPTION

Provide land surveying and construction surveying services and set right-of-way survey monuments according to the Contract Documents, KDOT's Construction Manual-Part III and consistent with standard surveying practices.

BID ITEMS	UNITS
Contractor Construction Staking	Lump Sum
Right-of-Way Survey Monument	Each
Benchmark Monument (Concrete Cylinder)	Each
Monument Box	Each

802.2 MATERIALS

a. General. Provide the necessary materials to complete the specified surveying services. Provide materials and equipment that comply with the current requirements of the Kansas Statutes, Kansas State Board of Technical Profession's Regulations and the Contract Documents.

b. Benchmark Discs. Provide standard manufacture 2-inch diameter, domed, metal (either brass or bronze) survey monuments to be set in concrete.

Refer to **subsection 802.3.c.(5)** for individual stamping requirements.

c. Concrete. Use commercial grade concrete that complies with **SECTIONS 401** and **402**.

Volumetric proportioning and hand mixing of concrete is permitted for concrete footings where small quantities are required.

d. Miscellaneous Materials. Provide the following miscellaneous materials:

- Commercially available steel posts that comply with the physical requirements for steel delineator posts, **DIVISION 1600**;
- 3-inch x 8-inch x 16 gage metal sign blanks;
- Commercially available galvanized 2-inch x 5/16-inch bolts, with 2 flat washers, 1 lock washer and 1 nut per bolt;
- Commercially available ⅝-inch x 30-inch reinforcing steel bars (non-coated); and
- Other miscellaneous materials for R/W Survey Monuments detailed in the Contract Documents.

e. Monument Box. Provide a monument box of the brand and type shown in the Contract Documents.

f. Acceptance of Materials. The Engineer will accept materials for the specified surveying services, right-of-way survey monuments, miscellaneous materials and monument boxes based on compliance with dimensional and other specified requirements and visual inspection for condition.

802.3 CONSTRUCTION REQUIREMENTS

a. General.

(1) With the Engineer's approval, the Contractor's surveying operations may begin after the contract is signed, but prior to issuing the Notice to Proceed.

(2) Surveying Personnel. Before performing any surveying operations on the project, inform the Engineer of the Contractor's personnel responsible for land surveying, construction surveying and staking. Provide a Land Surveyor, trained and experienced in the construction staking and licensed by the Kansas State Board of Technical Professions according to Kansas Statutes to perform the required land surveys, the setting of all section corners, right-of-way survey monuments and reference point monuments set on the right-of way lines.

(3) Provide surveying equipment that complies with the following tolerances:

- Slope Staking: Horizontal and Vertical tolerance of ± 0.10 feet (per KDOT Construction Manual - Cross Sections 3.06.02). Use a GPS system, a Total Station, or a Level & Transit.
- Finish Staking: (grade hubs, blue tops, string lines, etc.) and Structures: Horizontal = ± 0.05 feet; Vertical = ± 0.01 feet (per KDOT Construction Manual, subsection 3.09 - Finishing Stakes, Part III). For Horizontal, use a GPS system or a Total Station. For Vertical, use a Level or Total Stations. Do not use GPS for Vertical.
- Critical Bridge Member Staking: Horizontal = ± 0.02 feet; Vertical = ± 0.01 feet (Vertical as per Construction Manual, subsection 3.09 - Finishing Stakes, Part III). For Horizontal, use a GPS system or a Total Station. For Vertical, use a Level. See **subsection 802.3c.(2)** for Critical Bridge Member Staking.
- Right of Way Survey Monuments: For relative precision of all R/W Survey Monuments, comply with the precision expressed in the Kansas Minimum Standards for Boundary Surveys from the project coordinate data. Use a GPS system or Total Station.
- Project Control Points: The relative precision of any project control point ± 0.05 feet from the project coordinate data. Use a GPS system or Total Station.
- Field Notes: For all land surveying and construction staking, record 2 measurements for verification in the field notes for all PLSS corners and all project control points.
- GPS equipment: Take 2 GPS measurements at a minimum interval of 2 hours with the base station at 1 or 2 project control points. Include in the field survey notebooks a copy of the site calibration. The site calibration includes an area extending a minimum of 200 feet beyond the beginning and ending of the project and the construction limits furthest offset to the left and right of the project centerline. Take a minimum of 4 calibration points or as directed by the Engineer. Use the sum of the maximum residual of the site calibration and the delta of the point being staked.
- Total Stations: To verify the tolerances, record total station measurements from 2 project control points (set-up or backsight) to the point being established. Use the average of the 2 resulting coordinate values for the point being staked for the specified tolerances.
- Levels: Record in the field notes a turn through each project benchmark as they are encountered during staking activities (per KDOT Construction Manual, subsection - 3.23.05 – Elevations, Part III).
- Control Stakes: Do not perform vertical control using GPS.

(4) Before proceeding with the field surveys, provide the Engineer with a written report of any errors or apparent discrepancies found in previous surveys or the Contract Documents. The Engineer will provide the corrections or necessary interpretations.

Correct any deficient engineering layout or construction work that is the result of inaccuracies in the Contractor's surveys or staking operations, or the failure to report inaccuracies found in the work previously done by KDOT, at no additional cost to KDOT.

(5) The Engineer will perform final checks, measurements and surveys involving the determination of any pay quantities. The Engineer may check the accuracy and control of the Contractor's construction staking at any time throughout the duration of the project.

b. Land Surveying.

(1) Before any construction activity starts in the immediate area of an endangered Public Land Survey System (PLSS) corner, recover all endangered section corners and accessories of the PLSS on the project. Endangered PLSS corners are those as defined by Kansas Statutes and/or shown in the Contract Documents as lying within the range from the project centerline to a distance 100 feet outside the construction limits, throughout the length of the project. Establish a minimum of 3 reference ties for each endangered PLSS corner. Each reference tie shall be a direct measurement to a precise (hard defined) point. Specify slope or horizontal measurement.

Complete a Land Survey Reference Report marked as a "Notice of Endangerment Activity" for each endangered PLSS corner. File the reports with the appropriate governmental custodian responsible for maintaining those records, as required by Kansas Statutes. Provide the Engineer with copies of the completed reports.

(2) Before any construction activity starts in the immediate area, clearly establish the right-of-way as shown in the Contract Documents. If the R/W Survey Monuments are set initially, determine each monument's position with the project coordinates, project stationing and offset. Provide the Engineer with a written report of each monument's position for each R/W Survey Monument set supplementary to those shown in the Contract

Documents including additional monuments, monuments requested by the Engineer and monuments offset near obstructions.

(3) Recover and verify, or reset all of the PLSS corners previously reported as endangered PLSS corners. Verify the top of all PLSS corners monuments are ¼ to ½ inch below the finish grade on concrete pavement and 4 to 6 inches below the finish grade on asphalt pavement. Establish a minimum of 3 reference ties for each of the PLSS corners. Each reference tie shall be a direct measurement to a precise (hard defined) point. Specify slope or horizontal measurement.

Complete a Land Survey Reference Report marked as a Notice of Completion of Endangerment Activity and Report of Restoration for each restored PLSS corner previously reported as endangered. File the reports with the appropriate governmental custodian responsible for maintaining those records, as required by Kansas Statutes. Provide the Engineer with copies of the completed reports.

(4) Before the completion of project construction, set all of the R/W Survey Monuments shown in the Contract Documents. If the R/W Survey Monuments were set initially, visually inspect each R/W Survey Monument to determine if it was either disturbed or destroyed. Reset all of the R/W Survey Monuments that are determined as disturbed or destroyed, at no cost to KDOT. Determine each reset monument's position with both the project coordinates and the project stationing and offset. Provide the Engineer with a written report of all right-of-way survey monuments set.

c. Construction Surveying and Staking.

(1) General.

- Check alignment and reference or re-reference all necessary control points.
- Establish or re-establish project centerline.
- Run a level circuit to check or re-establish plan benchmarks; set other benchmarks as needed.
- Take original cross-sections that are not incorporated in the plans.
- Stake or re-stake right-of-way where needed (to be done by a Licensed Professional Land Surveyor).
- Perform all construction layout and reference staking necessary for the proper control and satisfactory completion of all structures, grading, paving, drainage and all other appurtenances required for the completion of the work and acceptance of the project.
- Construction of ditches and other planned excavation and embankment designated in the Contract Documents may be performed by Global Positioning System (GPS) controlled grading equipment, according to the Contract Documents and this specification. GPS controlled grading equipment does not eliminate the need for finish staking or blue top staking. Once a week, provide the Engineer with documentation (on a preapproved form) verifying machine calibration to monitor, verify, adjust and compensate for the wearing surface of the cutting edge of the machine being utilized.

(a) GPS Equipment. Use GPS controlled grading equipment capable of meeting the end results specified in the Contract Documents. The Engineer may require verification of shot locations. This could be by witnessing the Contractor take shots with GPS Rover, etc.

Make available a GPS Rover (same brand and type being used on the project) to the Engineer for review of the work, as needed during normal working hours. This GPS Rover will be stored and maintained by the Contractor.

In addition, provide a minimum of 8 hours of formal training on the use of the Contractor's GPS systems to the Engineer, prior to beginning any GPS controlled machine grading. Conduct training to provide the Engineer with an understanding of the equipment, software and electronic data being used by the Contractor. For multi-year projects, the Engineer may require informal refresher-training on the use of the GPS Rover.

(b) Electronic Design Files/GPS Model. When available, KDOT will provide Electronic Design Files for the project. Convert the files provided by KDOT into the format required by the Contractor's system and equipment. Conform to the typical sections. Notify KDOT Design and the Field Office administering the contract, in writing, of any errors, omissions, ambiguities, or perceived inadequacies found in the Electronic Design Files provided by KDOT.

Make no claim on the contract under **SECTION 104**, for additional money, additional time or both because the KDOT produced plans differ from drawings generated from the Electronic Design Files, even if the Contractor did not manipulate the Electronic Design Files before generating the GPS Model. Accept sole responsibility for the adequacy and accuracy of all Contractor-generated, subcontractor-generated, or supplier-generated documents or GPS Models used on the project. Assume the risk of errors and omissions resulting from software conversions, Electronic Design File manipulation or other Electronic Design File creation used by the Contractor, subcontractors, suppliers or any combination thereof.

The GPS Model the Contractor generates from the Electronic Design Files may differ from the Contract Documents. The Contractor assumes the risk of such discrepancies.

KDOT printed plans controls over the related Electronic Design File(s) which controls over the Contractor's GPS Model.

(c) GPS 3D Model. Before beginning any GPS controlled machine grading, provide the KDOT Field Office and KDOT Design with an electronic copy of the GPS 3D Model created for that use. In addition to the GPS machine control, provide centerline stakes, slope stakes and grade stakes from the beginning thru the end of the project, at 500-foot intervals on straight runs, and at 250-foot intervals on curves, transitions, intersections, interchanges and break points. The Engineer may require closer staking intervals for other locations, such as transition areas. GPS controlled machine grading does not eliminate the need for finish staking or blue top staking.

The Engineer may review the Contractor's GPS machine control grading results, surveying calculations, records, field procedures and actual staking at any time. If the Engineer determines the work is not meeting the required horizontal and vertical tolerances, see Unacceptable Work, **SECTION 105**.

Contractor delays or errors due to operating the GPS machine control system will not result in any adjustment under **SECTION 104**, for additional money, additional time or both.

(2) Bridge. Prior to construction, set project control points and Critical Bridge Element control points for the horizontal and vertical location of the Critical Bridge Element features under the supervision of a Licensed Professional Land Surveyor. Critical Bridge Elements include, but are not limited to the features listed in **TABLE 802-1**.

Prior to construction, provide an independent survey performed under the supervision of a different Licensed Professional Land Surveyor to check the accuracy of the original survey of project control points and locations of the Critical Bridge Elements features.

Report any differences or discrepancies to the Project Engineer.

Resolve any differences or discrepancies, prior to construction of the Critical Bridge Elements.

After the Critical Bridge Elements have been constructed, provide a survey under the supervision of a Licensed Professional Land Surveyor to verify the locations and elevations of the Critical Bridge Elements.

All surveys shall be within the tolerances for that bridge element allowed in the Contract Documents. Report any discrepancies in excess of the tolerances to the Project Engineer.

TABLE 802-1: CRITICAL BRIDGE ELEMENTS

Critical Element	Critical Component(s)
Spread Footing	Location & Elevation of CL
Pile Cap Footing	Location & Elevation of CL
Drilled Shaft	Location & Elevation of Center
Drilled Shaft Cap	Location & Elevation of CL
Column	Location & Elevation of Center
Pile Bent with Web Wall	Location & Elevation of CL
Abutment Beam/Bearing Seat	Location & Elevation of CL
Pier Beam/Bearing Seat	Location & Elevation of CL
Bearing Devices	Location & Elevation of CL, Temp. Offset
Bearing Stiffener	Location & Elevation of CL, Temperature Offset
Girder/Beam	Location of CL
Anchor Bolts/Preformed Holes	Location of CL
Expansion Device	Gap (Corrected for Temp) and Alignment
Fillets (Tenth Points)	Elevation
Surface of Forms (Slab Bridge Tenth Points)	Elevation
Post-tensioning Duct	Location & Elevation
Bolted Field Splice	Elevation

(3) Documentation. Provide and maintain a current copy of all field survey notebooks at the project site at all times. Produce the original field survey notebooks for inspection upon request by the Engineer. Include a

detailed list of any abbreviations, codes, formatting or other nomenclature contained in the notebooks to facilitate clarity of the notes. Provide either one or a combination of both of the following types of notes, as directed by the Engineer:

- Provide standard, bound field notebooks where the handwritten field notes are indexed and kept in a clear, orderly and neat manner consistent with standard surveying practices and according to KDOT's procedures.
- Provide a legible ASCII file for electronic field notes where the "theoretical (calculated) point" can be checked against the "established point" set in the field. This method allows for a check of the inverse distance and direction for error tolerance. This procedure should be utilized for points with elevations. Before any construction staking begins, the procedures for all electronic field notes must be approved by the Engineer.

(4) Monuments. Upon completion of the surfacing, recover and verify or reset all of the field survey monuments (such as P.I.'s, P.O.T.'s, P.C.'s, P.T.'s, P.O.S.T.'s,) on the project centerlines or baselines, as shown in the Contract Documents. Verify that the top of the field survey monuments are set a maximum of ½ inch below the finish grade on concrete pavement, or a maximum of 6 inches below the finish grade on asphalt pavement. Verify the accuracy of the locations of all field survey monuments versus those of the project centerlines or baselines shown in the Contract Documents. Establish a minimum of 4 reference ties for each of the field survey monuments on the project centerlines or baselines.

(5) Reports. Provide a written report to the Engineer indicating the descriptions of all field survey monuments and their 4 reference ties, regardless if the information in the Contract Documents was revised or not. Include in the report "station calls" for each of the field survey monuments (such as P.I.'s, P.O.T.'s, P.C.'s, P.T.'s, P.O.S.T.'s) on the project centerlines or baselines shown in the Contract Documents.

Recover and verify all of the project benchmarks shown in the Contract Documents. Establish permanent replacement benchmarks for all project benchmarks that were destroyed during the construction using one of these methods:

- A benchmark disc "set in place" on new concrete structure.
- A benchmark disc "drilled and grouted" on existing concrete structure.
- A benchmark disc set in the top of a concrete footing (6-inch diameter x 4-foot depth into the ground, minimum) cast in place.
- As directed by the Engineer.

Stamp the benchmark caps with the "Project Number" and the permanent replacement benchmark number as a letter designation following the benchmark it is replacing (i.e.: destroyed BM #21 is replaced by BM #21A). Without exception verify that the maximum spacing between benchmarks is a maximum of 30 feet in vertical difference, 500 feet in horizontal distance in urban areas or 1500 feet in horizontal distance in rural areas.

Provide the Engineer with a written report of all post project benchmarks, listing the benchmark number, elevation, project stationing and offset, and a complete description of the monument type and its physical location. Include in the report, all of the remaining benchmarks shown in the Contract Documents, the permanent replacement benchmarks and the remaining additional "construction benchmarks" used for the staking of the project. Do not include in the report any "temporary benchmarks" used for the construction staking of the project that are classified as "temporary" or "degradable" in nature.

d. Right-of-Way Survey Monuments. Set all right-of-way survey monuments on and along the KDOT right-of-way lines at these locations:

- All P.I. locations along normal/tangent sections.
- All P.C. and P.T. locations along curved sections.
- At an offset where a physical obstruction impedes the exact location.

Set all Reference Point monuments on and along KDOT right-of-way at these locations:

- At points a maximum of 1320 feet apart where the right-of-way is straight, or on a continuous horizontal curve of constant radius.
- At the crest of a sharp hill or the shoulders of a large/rounded hill.
- At radial/perpendicular lines to all horizontal changes in the project centerline alignment (i.e., P.C. and P.T. offsets).
- As directed by the Engineer.

Set all right-of-way survey monuments according to the Contract Documents.

Fasten the R/W sign to the witness post in this sequence: bolt, flat washer, sign, post, flat washer, lock washer and nut.

When conditions warrant, the Engineer may adjust the specified depth. When it is impossible to set a right-of-way survey monument at the exact point because of an obstruction, set the right-of-way survey monument along the right-of-way line, or the extended right-of-way line, on both sides of the obstruction. Use 1-foot increments for the offset distance from the exact point to the set monument. Field stamp the aluminum cap “O/S” either below or to the right of the “R/W” stamping.

Provide the Engineer with a complete list of the locations of all right-of-way survey monuments set.

e. Concrete Footings. When required, construct footings of commercial grade concrete according to the Contract Documents.

Extend the top of the footing slightly above the ground line and steel trowel to a smooth finish with a slope to drain away from the post.

f. Monument Box. When required, install the monument box and survey marker by a Licensed Professional Land Surveyor as shown in the Contract Documents.

If the monument box is installed in concrete pavement, use the same mix as used in the pavement.

g. As-Built Construction Plans and Survey Notebooks. Upon completion of the project, provide the Engineer with a set of as-built construction plans with the following information:

- The monument descriptions and the 3 reference ties for all restored PLSS corners.
- The monument descriptions and the 4 reference ties for all field survey monuments on the project centerline or baseline.
- The project stationing and offset of the final position of every right-of-way survey monument and project alignment reference point that was set.
- The permanent replacement benchmarks and remaining construction benchmarks with benchmark number, project station and offset, elevation and description.

Deliver the original field survey notebooks to the Engineer upon completion of the project.

802.4 MEASUREMENT AND PAYMENT

The Engineer will measure each right-of-way survey monument, benchmark monument (concrete cylinder) and monument box as a unit. Contractor construction staking will be measured by the lump sum.

The Engineer will make partial payments according to **TABLE 802-2**. The Engineer may adjust the **TABLE 802-2**, based on Contractor’s progress and project complexity.

TABLE 802-2: CONSTRUCTION STAKING PAYMENT SCHEDULE*

Percent of Original Contract Amount Completed	Percent of Bid Item Paid
Work Started	25%
5%	40%
25%	60%
50%	80%
70%	95%
All field books, As-Built construction plans (**subsection 802.3g.**) and records have been submitted to the Engineer.	100%

*Until all appropriate information is received, and the bid item is 100% paid, the work is considered incomplete and subject to **SECTION 108**.

The Percent of Original Contract Amount Completed = the amount earned by the Contractor divided by the total dollar value of the original contract (all bid items).

Payment for "Contractor Construction Staking", "Right-of-Way Survey Monument", "Benchmark Monument (Concrete Cylinder)" and "Monument Box" at the contract unit prices is full compensation for the specified work.

SECTION 803

FIELD OFFICE AND LABORATORY

803.1 DESCRIPTION

Provide the designated types of field offices and laboratories shown in the Contract Documents.

BID ITEMS	**UNITS**
Field Office	Each
Field Office and Laboratory (*)	Each

*Type: A, B or C

803.2 MATERIALS

Provide a field office and laboratory that complies with **TABLE 803-1**.

TABLE 803-1: REQUIREMENTS FOR FIELD OFFICE AND LABORATORY

Requirements	Type A	Type B	Type C	Field Office
Minimum floor area (square feet).	230	160	120	160
Minimum inside width (feet).	9	7	7	7
Minimum ceiling height (feet).	7	7	7	7
Minimum number of windows with screens. Sliding or swinging windows (minimum area per window of 4 square feet) on a minimum of 2 sides of the building.	6	4	4	4
Minimum number of locking outside doors with screen doors.	2	1	1	1
Partitioned for a laboratory area and a drying room. 70 square feet minimum floor area for the drying room. Approximate length of workbench for the drying room of 7 feet. The drying room must have a minimum of 1 window and 1 outside door.	yes	no	no	no
Insulated and weather tight.	yes	yes	yes	yes
Electrical supply 110 volt AC. Install devices necessary to provide transient voltage surge suppression at the building main circuit breaker panel.	yes	yes	no	yes
Minimum number of electrical outlets. Space outlets uniformly throughout the building.	6	6	n/a	6
Minimum number of light fixtures. Uniformly space light fixtures to light the interior of the building.	3	2	n/a	2
Water supply. Provide a minimum pressure of 5 psi, or a minimum head of 12 feet, if a gravity tank is used.	yes	yes	yes**	no
Sink and faucet. Minimum sink dimensions: 30 inches long, 24 inches wide and 6 inches deep. The faucet must have a hose connection.	yes	yes	yes**	no
Minimum total length of workbench (feet). Minimum workbench dimensions: 30 inches wide and 36 to 42 inches high.	30	20	10	20
Number of chairs or stools for use at the workbenches.	2	2	2	2
Writing table or desk with chair. Approximate size of writing table or desk: 5 feet by 30 inches and 30 inches high.	yes	yes	yes	yes
Heating system capable of maintaining a minimum temperature of 70°F.	yes	yes	yes	yes

TABLE 803-1 (cont.)				
Requirements	**Type A**	**Type B**	**Type C**	**Field Office**
Air-conditioning system capable of maintaining a temperature below 85°F.	yes	no	no	yes
Provide a private telephone line service protected from surge voltages. Also, provide Broadband internet connection (for a minimum of 4 computers) to the Field Office and Laboratory (Type A) designated by the Engineer as the primary field office.	yes	no	no	yes
Exhaust fan.	yes*	yes*	no	no
Ovens for drying samples. Provide gas or electric as necessary for the ovens.	yes	no***	no***	no
Fire extinguisher	yes	yes	yes	yes

*Type A: Provide an exhaust fan in the drying room capable of changing the air in the room every minute.
Type B: the exhaust fan shall be capable of changing the air in the building every 3 minutes.
** Only when required for testing.
***Provide gas for drying samples, when required.

The Engineer will accept the field offices and laboratories based on compliance with the specified requirements and visual inspection for condition. The DME may accept a non-compliant field office and laboratory if it will meet the needs of the project.

803.3 CONSTRUCTION REQUIREMENTS

When ordered by the Engineer, provide the designated field offices and laboratories for the exclusive use of the Engineer. Set up the field offices and laboratories at the locations designated by the Engineer. Secure and support the field offices and laboratories to prevent vibrations. If the Engineer determines it is necessary to relocate the field offices and laboratories during the progress of the project, relocate the field offices and laboratories to the locations designated by the Engineer. Remove the field offices and laboratories when released by the Engineer.

If the Engineer determines that additional field offices and laboratories (of the types designated in the Contract Documents) are required, provide the types and number of field offices and laboratories requested.

On KDOT-tied projects, where the bid items for field offices and laboratories are shown only on one project, provide the field offices and laboratories for use on all of the related KDOT-tied projects.

On KDOT-tied projects, where the bid items for field offices and laboratories are shown on more than one project, the Engineer may determine separate labs are not needed for each project. If the same lab is used for all the projects, it will only be paid for on the project with the largest original contract dollar amount, and the bid item will be underrun from the other projects.

803.4 MEASUREMENT AND PAYMENT

If the Engineer informs the Contractor at the pre-construction conference that the field office or field office and laboratory are not required, the Engineer will underrun this item.

The Engineer will measure each field office and field office and laboratory.

The Engineer will measure each unit on each project only once, even if the unit is relocated. On KDOT-tied projects, the Engineer will measure each unit only once on one of the KDOT-tied projects, even when the unit is used on all related KDOT-tied projects. If the unit is shown on more than one project, it will only be measured and paid for on the project with the largest original contract dollar amount, and the bid item underrun from the other projects.

A Field Office and Laboratory (Type A) may be substituted for and measured for payment as a Field Office and Laboratory (Type B), a Field Office and Laboratory (Type C) or a Field Office. A Field Office and Laboratory (Type B) may be substituted for and measured for payment as a Field Office and Laboratory (Type C).

Payment for "Field Office and Laboratory" and "Field Office" at the contract unit prices is full compensation for the specified work. The contract unit prices for the various types of field offices and laboratories will govern, regardless of the number of units used on the project.

The Engineer will make partial payments according to **TABLE 803-2**.

TABLE 803-2: FIELD OFFICE AND LABORATORY PARTIAL PAYMENTS	
Condition	**Pay % of Contract Unit Price**
1st estimate after the unit is provided & accepted	40
3 months after accepted	70
When released by Engineer	100

If the Engineer determines that telephone service is unnecessary for "Field Office and Laboratory (Type A)" and "Field Office", the Engineer will reduce the contract unit price for these items by 10%.

If the Engineer determines that broadband internet service is not available for "Field Office and Laboratory (Type A)", provide a fax machine, at no additional cost.

If the Engineer determines that broadband internet service is unnecessary for "Field Office and Laboratory (Type A)", the Engineer will reduce the contract unit price for this item by 10%.

If the Engineer requests that the field office and laboratory be relocated, the Engineer will pay a relocation fee of $300 per relocation for "Field Office and Laboratory (Type A)" and "Field Office and Laboratory (Type B)" bid items, and $150 per relocation for "Field Office and Laboratory (Type C)" and "Field Office". The relocation fees will be paid for at the amounts shown, as Extra Work, **SECTION 104**.

SECTION 804

MAINTENANCE AND RESTORATION OF HAUL ROADS

804.1 DESCRIPTION

Maintain and restore public roads used as haul roads for construction materials.

For the purpose of this specification and when the bid item is included in the Contract Documents, a haul road is any public road in Kansas, excluding State highways over which material is hauled for the construction of the project. The most direct route to the nearest state highway that is used for hauling commercial material into or from a commercially established plant site is not designated as part of the haul road. Roads into and from quarries are not designated as part of the haul road.

When the bid item is not included in the Contract Documents, any haul road repair is subsidiary to the other items in the Contract Documents.

BID ITEM	**UNITS**
Maintenance and Restoration of Haul Roads (Set Price)	Lump Sum

804.2 MATERIALS

Provide the type of materials necessary to maintain and restore the haul road to its condition before the hauling begins. The Engineer will accept the materials used based on visual inspection at the point of usage.

804.3 CONSTRUCTION REQUIREMENTS

Provide the Engineer with a written description of the designated haul roads. The description shall include, materials being delivered, materials hauled to the project site and return routes from the project site. The Engineer will notify the owners of the roads (city and county) of the Contractor's designations.

Allow the Engineer sufficient time to inspect the designated haul roads before they are used. The Engineer, the Contractor and the owner of the roads (at their discretion) will jointly inspect the designated haul roads before they are used. The Engineer will document any deficiencies or special conditions regarding the existing roads and structures.

During the hauling operations, use only designated haul roads. Observe legal weight limits and speed limits.

Provide an adequate water supply and apply the water as needed to control dust. Control dust on active haul roads including return routes, in pits and staging areas, and on the project.

Perform preventative and repair maintenance as necessary to minimize the damage to the haul roads.

After the hauling operations are concluded, the Engineer, the Contractor and the owner of the roads (at their discretion) will jointly inspect the designated haul roads. The Engineer will review the results of the initial and final inspections, and will consider the impact of other parties that used the haul roads. Upon consideration of all these factors, the Engineer will determine the extent of restoration necessary to return the haul roads to their conditions at the time of the initial inspections.

Restore the haul roads as directed by the Engineer.

804.4 MEASUREMENT AND PAYMENT

When the Maintenance and Restoration of Haul Roads (Set Price) bid item is included in the Contract Documents, and the Contractor uses the designated haul roads, the Engineer will measure maintenance and restoration as a lump sum. This measurement for payment is made regardless of whether or not it is necessary for the Contractor to perform any maintenance or restoration. When the bid item is not included in the Contract Documents, any haul road repair is subsidiary to the other items in the Contract Documents.

If the bid item is in the contract and the Contractor does not designate any haul roads, no measurement for payment is made.

If the bid item is in the contract and the Contractor designates haul roads but does not use any, no measurement for payment is made.

804 - MAINTENANCE AND RESTORATION OF HAUL ROADS

If the Contractor uses haul roads (as defined in this specification) other than those designated, payment for "Maintenance and Restoration of Haul Roads (Set Price)" is forfeited. The Engineer will require that the Contractor restore the undesignated haul roads to their approximate condition before hauling to the project began. The Engineer will determine the extent of restoration necessary.

Payment for "Maintenance and Restoration of Haul Roads (Set Price)" at the contract unit price is full compensation for the specified work.

SECTION 805

WORK ZONE TRAFFIC CONTROL AND SAFETY

805.1 DESCRIPTION

Provide, erect, maintain and remove traffic control devices as shown in the Contract Documents.

BID ITEMS	UNITS
Work Zone Signs (0 to 9.25 Sq. Ft.)	Each Per Day
Work Zone Signs (9.26 to 16.25 Sq. Ft.)	Each Per Day
Work Zone Signs (16.26 Sq. Ft. and over)	Each Per Day
Work Zone Sign (Special) (**)	Each
Work Zone Barricades (Type 3 – 4 to 12 Lin. Ft.)	Each Per Day
Work Zone Barricades (Pedestrian)	Each per Day
Arrow Display	Each Per Day
Portable Changeable Message Sign	Each Per Day
Channelizer (Fixed)	Each Per Day
Channelizer (Portable)	Each Per Day
Channelizer (Pedestrian)	Each per Day
Work Zone Warning Light (Type "A" Low Intensity)	Each Per Day
Work Zone Warning Light (Red Type "B" High Intensity)	Each Per Day
Pavement Marking (Temporary)	
4" Solid (*)	Sta./Line
4" Broken (8 ft.) (*)	Sta./Line
4" Broken (3 ft.) (*)	Sta./Line
4" Dotted Extension (*)	Sta./Line
Broken (Line Masking Tape)	Sta./Line
Solid (Line Masking Tape)	Sta./Line
Symbol (*)	Each
Flexible Raised Pavement Marker (4" Broken (8 ft.))	Sta./Line
Flexible Raised Pavement Marker (4" Broken (3 ft.))	Sta./Line
Rigid Raised Pavement Marker (*)	Each
Flagger (Set Price)	Hour
Traffic Signal Installation (Temporary)	Lump Sum
Traffic Control	Lump Sum
Traffic Control (Initial Setup)	Lump Sum

*Type (Type I or II)
**Size

805.2 MATERIALS

Provide materials as shown in the Contract Documents that comply with the following requirements.

Retroreflective Sheeting ……………………………………………………….	**DIVISION 2200**
Portable Changeable Message Signs……………………………………………	**DIVISION 1700**
Work Zone Warning Lights……………………………………………………..	**DIVISION 1700**
Temporary Pavement Marking/Line Masking Tape……………………………	**DIVISION 2200**
Traffic Line Paint……………………………………………………………..	**DIVISION 2200**
Raised Pavement Markers……………………….…………………………..	**DIVISION 2200**

a. General. The size, shape, color, placement, installation, and maintenance of all traffic control devices and appurtenances shall comply with the details shown in the Contract Documents and the Manual on Uniform Traffic Control Devices (MUTCD).

Use crashworthy supports used for mounting signs or devices for temporary conditions that comply with AASHTO MASH. All traffic control devices shall be tested and found acceptable using test methods compliant with

MASH testing requirements. Devices that were accepted under the NCHRP 350 testing requirements prior to the adoption of MASH criteria may remain in place and continue to be used. Provide the following to the Engineer for a case by case approval of traffic control devices not addressed in the Contract Documents:

(1) A copy of the manufacturer's self certification stating that the Category 1 devices to be used on the project are crashworthy.

(2) A copy of the entire FHWA acceptance letter for the Category 2 devices to be used on the project.

(3) A copy of the entire FHWA acceptance letter for the Category 3 truck mounted attenuators (TMAs) to be used on the project and certification stating that the Category 3 items to be used on the project meet crashworthy specifications, as defined above.

b. Work Zone Signs. The size and layout of the sign message shall comply with the Contract Documents and the "Standard Highway Signs and Markings", latest edition. Use fluorescent orange Type IV or better sheeting for all work zone orange signs. Use standard colors in Type III sheeting or better for all other work zone signs. Opaque, fluorescent orange Type IV or better, roll up signs may be used in approved situations. Do not use mesh signs.

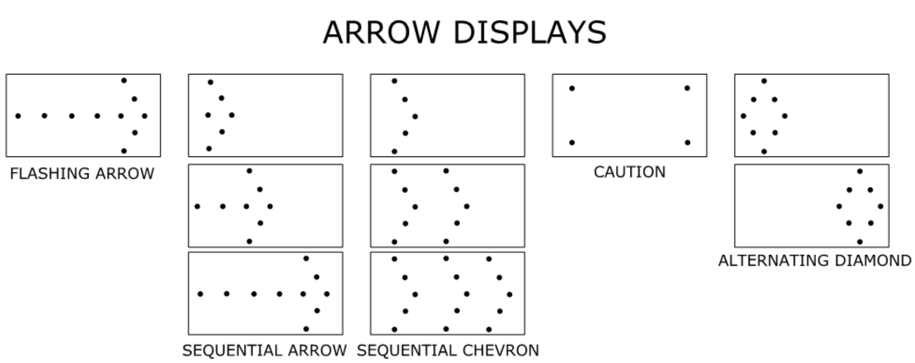
c. Work Zone Barricades. Size and design of all work zone barricades, including those used for pedestrian closures, shall comply with the Contract Documents. Provide Type 3 barricades with ASTM Type III orange and white retroreflective sheeting, as shown in the Contract Documents. Provide pedestrian barricades with orange and white high contrast sheeting as shown in the Contract Documents.

d. Flashing or Sequencing Arrow/Warning Display Signs. When specified, provide, install and maintain a flashing or sequencing arrow/warning display sign that complies with the Contract Documents and the MUTCD.

Provide a display that is capable of being legible for a minimum of ½ mile. Displays shall have an automatic control for lamp intensity, backed up by a manual switch and be capable of dimming 50% from the rated lamp voltage for nighttime operation. The display shall be capable of flashing lamps at a rate between 25 and 40 flashes per minute.

The minimum lamp "on time" shall be 50% for the flashing arrow and 25% for the sequential chevron. Display lamps or lenses shall be recessed or alternately equipped with a minimum 180° upper hood. The color of light emitted shall be yellow or orange.

The following are allowable displays:



e. Channelizers. Channelizers, fixed or portable or pedestrian, shall comply with the Contract Documents. Provide non-metallic drums, conical delineators, tubular markers, cones, Type 2 barricades, vertical panels and direction indicator barricades as shown in the Contract Documents.

Provide drums, tubular markers, cones, Type 2 barricades, and direction indicator barricades with Type III orange and white retroreflective sheeting, as shown in the Contract Documents. Provide Type IV fluorescent orange sheeting on conical delineators and on the directional indicator barricade arrow panel. The orange and white stripes on the direction indicator barricade and the white sheeting on the conical delineators will be Type III sheeting.

Provide drums and conical delineators that have at least 2 orange and 2 white Type III (or better) retroreflective sheeting stripes. Additional stripes may be non-retroreflective with a maximum width of 3 inches.

Provide tubular markers 28 - 42 inches tall that have at least 2 white Type III retroreflective sheeting stripes.

Provide pedestrian channelizers with Type III orange and white retroreflective sheeting on the side meant to face vehicular traffic. The side facing pedestrians must have high contrast orange and white sheeting that may be Type III retroreflective sheeting.

f. Automated Flagger Assistance Devices (AFADs). At Contractor's option, provide an AFAD that complies with the MUTCD.

805.3 CONSTRUCTION REQUIREMENTS

a. General. The safe and satisfactory movement of traffic through the project is a high priority and is the responsibility of the Contractor. Use reasonable and appropriate devices and methods to safeguard the persons and property of the traveling public on roads on which construction work is in progress. Failure of the Engineer to notify the Contractor to maintain such devices or use such methods does not relieve the Contractor of responsibility.

Traffic Control must be in place and in acceptable condition as shown in the Contract Documents for work to progress.

While working within the right-of-way limits on KDOT projects, all workers shall wear high visibility garments which comply with ANSI Class II during Daylight Hours and ANSI Class E retroreflectorized pants with an ANSI Class II vest during all other times.

Obtain the Engineer's approval before erecting, changing or removing traffic control devices, except if an emergency situation requires immediate action. Erect signs and traffic control devices as shown in the Contract Documents or Traffic Control Plan, unless directed otherwise by the Engineer. When directed by the Engineer, move any traffic control devices from one location to another and re-erect it. The Engineer may require additional traffic control devices or flaggers at any time, or at any place. When the Contract Documents provide that traffic be carried through construction, routing of traffic on a detour is prohibited without written approval from the Engineer.

At all times during the progress or temporary suspension of work, provide, erect, remove, relocate, clean, replace and maintain acceptable signs, barricades, channelizers or other necessary traffic control devices and pavement marking shown in the Contract Documents. With the Engineer, determine the frequency of inspections based on the needs of every project. Designate an employee who can be contacted 24 hours a day and can be on site within an agreed upon amount of time to repair, replace, remove, relocate, clean and maintain any traffic control device required as directed by the Engineer. Advise the Engineer of the name, address and telephone number of the person given this responsibility. Compliance with minimum inspections and providing a person to be contacted does not relieve the Contractor of the responsibility to inspect and maintain all required traffic control devices.

If traffic control issues come to the attention of the Engineer, the Engineer will notify the Contractor of any required repairs or replacements, which shall be addressed within the time specified in the notification. KDOT Rejected stickers may be used to identify unacceptable traffic control devices. When the Engineer determines an immediate repair or replacement is required, and the Contractor is unable to make the repair or replacement, the work may be performed by KDOT, and the associated cost deducted from the contract. This in no way relieves the Contractor of responsibility to inspect and maintain traffic control.

Immediately upon discovering or receiving notification of unacceptable traffic control devices, either repair or remove and replace the unacceptable traffic control devices. Record unacceptable traffic control devices and when the condition has been corrected.

Perform all work during Daylight Hours unless otherwise approved.

In order to minimize inconvenience for the traveling public and to increase the effectiveness of signs and traffic control devices, move the devices ahead as the work allows. When no work is in progress, remove from the road or completely cover all devices that are required only when work is actually being performed.

An alternate traffic control plan may be developed. Such plan requires approval from the District Office or the Bureau of Transportation Safety & Technology before installation. Such approval may take up to 10 business days.

Provide access (including the use of temporary surfacing, **SECTION 840**) for field accesses, driveways, business accesses, and side roads that tie into the work area on roads closed to through traffic. When 2-way access is required, provide sufficient width to maintain 2-way traffic as shown in the Contract Documents or as directed by the Engineer.

Park and store all vehicles, equipment, tools, debris and materials off the right-of-way or 30 feet from the edge of the travelled way, whichever is less. When this cannot be achieved, place appropriate signs, use positive protection or delineate with channelizers, as designated by the Engineer. Temporary traffic control devices required for this condition will be considered subsidiary to other bid items.

b. Work Zone Signs. Work Zone Signs (Special) are signs whose legends are specific to the project for which they are fabricated, and if used, will be designated in the Contract Documents. Do not place signs that restrict pedestrian and bicycle traffic on sidewalks or other areas designated for pedestrian or bicycle use. Signs that are anticipated to remain in place for 3 days or less are considered "portable". Mount portable signs on an approved support at least 12 inches above the edge of the traveled way. When directed by the Engineer, mount portable signs on an approved support at least 5 feet above the traveled way for increased visibility. Do not use the legend "Travel at Your Own Risk" on any sign.

When an existing Stop condition changes to a new location, or when a new Stop condition is created, attach 2 fluorescent-red flags and a Type "B" red high intensity warning light to the Stop sign posts. Leave flags and lights in place for at least 30 days after installation. Install or relocate the symbolic Stop Ahead sign (W3-1) an "A" distance in advance of the Stop sign if the Stop sign is not visible for a minimum "A" distance. See standard drawings to determine "A".

Remove, store and reset existing signs that interfere with the work, but are intended to remain in place after the project is complete. This work will be considered subsidiary to other bid items. Remove, turn away from all traffic or cover traffic signs or signals that conflict with or are not applicable to the traffic operations.

When existing signs need to be covered, use an opaque, breathable material. Do not use plastic bags, burlap or similar materials. Hanging or bolting rigid material to the sign is acceptable when approved by the Engineer and spacers are used to minimize contact between the rigid material and the sign face. Rigid components of the cover, such as a handle for lifting, shall not hang below the minimum sign height. Do not place tape directly to the face of any existing sign.

Install sign posts as shown in the Contract Documents. Mount signs that are anticipated to remain in place for more than 3 days on approved posts. Posts should extend to the top edge of the sign, but no more than 6 inches above the sign. In the case of hitting rock, or otherwise not being able to drive posts to comply with Contract Documents, shift sign location without violating minimum sign spacing or use a crashworthy sign stand, with the Engineer's approval.

The Engineer will establish all work zone speed limits, except for pilot car operations. Only use the Reduced Speed Ahead (W3-5) sign if the Engineer determines that a reduced speed is required on the project. Install Work Zone plaques (KM4-20) above all existing and temporary Speed Limit (R2-1) signs located between the Road Work Ahead (W20-1) and the End Road Work (KG20-2). Do not allow the plaque to overlap any portion of the Speed Limit sign.

Where two work zones are less than a mile apart in rural areas, or less than ¼ mile apart in urban areas, eliminate the End Road Work (KG20-2) for the first work zone and the Road Work Ahead (W20-1) for the second work zone.

c. Work Zone Barricades. To fully close a road, place Type 3 barricades end-to-end from pavement edge to pavement edge with striping sloped downward toward the center of the road. When Contractor access is required, stagger barricades longitudinally far enough apart that the intended vehicles can safely weave through while still maintaining the appearance of a full closure from the approach. Realign barricades end-to-end to fully close the road when construction activity has ceased for the day. When barricades are placed end-to-end or staggered, mount a Type "A" light to the top of the outside vertical post of each of the end barricades using crashworthy hardware.

Place winged Type 3 barricades in a level position off the pavement or on the shoulders when shown in the Contract Documents. Mount a Type "A" light to the top of each outside vertical post of each winged barricade using crashworthy hardware.

To fully close a sidewalk or other pedestrian pathway, place pedestrian barricades or pedestrian channelizers on the pathway from edge to edge.

d. Flashing or Sequencing Arrow/Warning Display Signs. Where specified, provide, install and maintain a lighted sign capable of displaying flashing or sequential arrows/warnings as shown in the Contract Documents. Mount on a portable chassis and operate continuously when required to divert or warn traffic. Adjust the lamp intensity for the display to prevent a blinding effect and to compensate for daytime and nighttime light conditions.

Use the arrow panel in Caution Mode or Alternating Diamonds Mode only for shoulder work, roadside work near the shoulder, blocking the shoulder or for temporary closure of 1-lane on a 2-lane 2-way roadway.

e. Portable Changeable Message Sign (PCMS). Where specified, provide, install and maintain a PCMS as shown in the Contract Documents. Mount on a portable chassis and operate continuously when required. Adjust the lamp intensity for the display to prevent a blinding effect and to compensate for daytime and nighttime light conditions. When feasible, place the PCMS behind guardrail or barrier, or delineate with channelizers. Messages must be approved by the Engineer prior to use.

f. Channelizers. Install the individual devices used for the channelization of traffic through the work area, as shown in the Contract Documents.

Channelizers (Fixed) are devices that are physically adhered to the road surface with an adhesive or mounting hardware, or are embedded into the ground.

Channelizer (Portable) devices are those that are self-standing and are held in place with deformable ballast material that is either integral with the device or is applied on or around the base of the device. When the Contract Documents specify Channelizer (Fixed), only fixed channelizers may be used. When the plans specify Channelizer (Portable), the Contractor has the option to use either fixed or portable devices, as approved by the Engineer.

Keep the devices clean and bright for maximum target value.

Traffic cones may be used as channelizing devices for daytime operations only.

Place channelizers according to the following:

(1) Tapers. Space devices in merging and shifting tapers so they do not exceed a distance in feet equal to ½ the posted speed limit (mph) prior to work starting.

(2) Advanced Warning Area and Activity Area. Space devices in the advanced warning area and the activity area so they do not exceed a distance in feet equal to 2 times the posted speed limit (mph) prior to work starting. Spacing should be reduced in some situations, such as to delineate access points or to maintain positive guidance when traffic regularly moves slowly in the work zone.

(3) Visibility. Place channelizing devices for optimum visibility, normally at right angles to the traffic flow.

(4) Diagonal Striping. Alternating diagonal orange and white striping must slope downward in the direction that traffic is expected to pass.

(5) Directional Barricades. Place direction indicator barricades in series to direct traffic onto the new path.

(6) Pedestrian Channelizers. Place pedestrian channelizers, as shown in the Contract Documents, along entire intended route, and end to end so that there are no gaps in the detectable edging or in the hand trailing surfaces.

g. Automated Flagger Assistance Devices (AFADs). The Contractor may choose to use a trained flagger operating an AFAD in lieu of a flagger at any time. Such use of AFADs will be subsidiary to other contract items.

h. Warning Lights. Use the required type warning lights as shown in the Contract Documents.

Provide, install, and maintain Type "A" warning lights which are lighted from sunset to sunrise. Use Type "A" warning lights on all post mounted action warning signs greater than 5 feet high. Do not use lights on portable signs.

Provide, install, and maintain red Type "B" (high intensity) lights lighted 24 hours per day. Use Type "B" lights on all changed and new Stop conditions.

Maintain lights so they are visible on a clear night from a distance of 3000 feet.

Mount warning lights on action warning signs, as shown in the Contract Documents, on the top of the sign post nearest to the traveled way such that moving flags will not interfere with the visibility of the warning light.

Mount the battery case, for warning lights whose batteries are located in a separate case, no higher than 1 foot above the ground and on the back side of the post holding the light.

Signs that require warning lights also require 2 flags. Flags are made of 18-inch square fluorescent red-orange cloth-like material. Do not use rigid material for the flags. Mount the flags as shown on the Contract Documents on flag staffs that are long enough to allow the flag to flutter without obscuring the warning light or sign.

i. Temporary Pavement Marking and Temporary Raised Pavement Markers (RPMs). When traffic is carried through construction, provide and maintain temporary pavement marking and temporary RPMs as shown in the Contract Documents. When work will occupy a location more than 3 days, remove or mask all conflicting pavement marking and any markings specified in the Contract Documents, according to **SECTION 808**, and mark all transition tapers, crossovers, relocated lane lines and relocated edge lines with temporary pavement marking. Use temporary pavement markings according to **TABLE 805-1**.

TABLE 805-1: TEMPORARY PAVEMENT MARKING ***	
Type	**Use**
Type I	Final surface (new pavement or any surface that will remain when the project is complete). When Type I is specified and in areas where permanent pavement marking will be placed in the same layout/location as the temporary markings, the Contractor has the option to use either Type I tape or paint. Do not use paint on final surfaces where the markings will not follow the same layout/location.
Type II	Any surface that is to be removed or covered by future construction. When Type II is specified, the Contractor has the option to use Type I tape, Type II tape, or paint.

***Do not use paint on Ultrathin Bonded Asphalt Surfaces to remain in place.

(1) Configuration. The following are general guidelines for temporary pavement marking and temporary RPM configurations. Use **TABLE 805-2** and **TABLE 805-3** to determine broken pavement marking dimensions.

- Solid and Broken (8 ft.) markings are intended for use on expressways, freeways, and for traffic configurations in place longer than 45 days, where the markings are different from the original or final pavement markings.
- Broken (3 ft.) markings are intended for use on intermediate lifts of asphalt surfacing projects where movement of traffic through the project is required, and on final surfaces that are opened to traffic prior to placing the permanent pavement markings.
- Flexible Raised Pavement Markers (Broken (8 ft.)), for use on expressways and freeways, and Flexible Raised Pavement Markers (Broken (3 ft.)) are for use in place of tape or paint for resurfacing projects where the permanent pavement marking is expected to be in place within 14 days.
- Dotted extension lines may be used to provide extra guidance through intersections or interchanges.
- Use the severe curve pattern on curves with less than a 1000-foot radius.
- Rigid Raised Pavement Markers (Type II) with Tubular Markers (Channelizer (Fixed)) in a repeating cycle according to the Contract Documents are used to separate opposing traffic in a normally divided roadway that is head to head during construction.

TABLE 805-2: BROKEN MARKING DIMENSIONS			
Type	**Approximate Length (ft.)**	**Gap (ft.)**	**Repeating Cycle (ft.)**
Broken (8 ft.)	8	24	32
Broken (3 ft.)	3	29	32
Dotted Extension	2	4	6
Severe Curve	2	14	16

TABLE 805-3: TEMPORARY RPM DIMENSIONS					
Condition	**Approximate Length (ft.)**	**Number of Devices**	**Approximate Device Spacing (ft.)**	**Gap (ft.)**	**Repeating Cycle (ft.)**
Broken (8 ft.)	8	6	1.5	24	32
Option	10	6	2	22	32
Broken (3 ft.)	3	3	1.5	29	32
Option	4	3	2	28	32
Severe Curve	2	3	1	14	16

(2) Placement. Place temporary pavement marking and temporary RPMs as close as practical to the intended alignment and parallel to the intended line. On HMA surfacing projects when traffic is being carried through the project, place temporary marking after each lift of HMA has been placed and before traffic is allowed on the new lift. Place temporary marking on intermediate HMA lifts within approximately 12 inches of the intended alignment. Place temporary markings on the final surface within approximately 6 inches of the intended alignment.

Place either temporary or permanent pavement markings or temporary RPMs the same day the existing markings are removed, and before opening to traffic, at the following locations: yellow skip line on undivided roads, white skip lines on multi-lane sections, white gore lines, white intersection dotted extension lines, and solid yellow ramp edge lines. Fixed tubular markers or conical delineators may be placed, and if used shall be maintained, in lieu of temporary gore lines with the Engineer's approval. If used, space the devices at 5-foot intervals on the gore edge line. They are subsidiary to other temporary pavement marking bid items.

(3) Maintenance. Maintain all temporary pavement markings and temporary RPMs for the duration of the project and for 14 days after the work is complete. Temporary pavement marking and temporary RPMs must be in an acceptable condition and location, as described in the Contract Documents.

When temporary pavement markings or temporary RPMs are deemed deficient by the Engineer (no longer retroreflective, damaged, displaced, etc.), the Engineer will notify the Contractor in writing of areas requiring replacement.

Replacement of temporary pavement marking or temporary RPMs could be required as soon as 24 hours from notification and will be noted in the notification. Failure to replace the temporary pavement marking or temporary RPMs within the allotted time could result in a deduct of $500 per day. Deduct assessments are cumulative until deficiencies are corrected, and could be assessed even if the project is in liquidated damages for failure to complete work within the specified time.

Conditions considered for deduct include, but are not limited to the following:

- Visibility less than 300 feet in daytime or nighttime conditions.
- Retroreflectivity less than what is specified for the specific type of pavement marking (**SECTIONS 806** and **807**) or temporary RPM (**DIVISION 2200**).
- Loss of material.

Temporary pavement marking or temporary RPMs exceeding the following loss thresholds are subject to the indicated daily deduct:

- Continuous markings cannot have deficiencies of more than 10% of the total feet of pavement marking. Also, no more than 50 consecutive feet can be deficient nor can any deficiency be within 10 feet of another deficiency.
- Intermittent markings, including but not limited to RPMs and broken markings, cannot have deficiencies of more than 10% of the total number of devices (or 10% of the broken markings required) and no more than 2 consecutive devices or markings can be deficient.
- No more than 10% of any temporary marking or temporary RPMs in a curve can be deficient.

(4) Temporary Pavement Marking Tape. Apply pavement marking tape according to the manufacturer's recommendations. If solid lane markings are required, cut through the entire width and thickness of the tape at approximately 100-foot intervals after it is applied to the pavement.

When shown in the Contract Documents, or with the Engineer's approval, apply line masking tape to the surface to temporarily cover the existing pavement markings in widths or sizes sufficient to extend approximately 1 inch beyond the edges of the existing pavement markings.

(5) Traffic Line Paint. When paint is approved, comply with **SECTION 807**.

(6) Flexible Raised Pavement Markers. With the Engineer's approval, the Contractor may place flexible RPMs in lieu of temporary skip lines and solid lines as shown in the Contract Documents. Adhere according to manufacturer's recommendations.

When used on asphalt seals, place the flexible RPMs on the roadway prior to the sealing operation and remove the cover protecting the retroreflective material after the sealing operation.

The adhesive used shall allow the markers to be removed without damage to the roadway surface. Acquire the Engineer's approval before using epoxy as an adhesive.

(7) Rigid Raised Pavement Markers (Type I or Type II). Install and maintain rigid RPMs at locations shown in the Contract Documents. Install and maintain according to the manufacturer's recommendations.

j. One Way Traffic. Provide 2-way traffic and avoid 1-way traffic, where reasonable. When 1-way traffic is required, do so according to the following:

(1) Flaggers. Provide courteous, competent flaggers, able to communicate with the traveling public, to direct traffic in a one-way traffic operation. Flaggers must be trained once every 3 years on the flagger procedures outlined in Part VI of the MUTCD and on the flagger procedures outlined in the KDOT Flagger Handbook, latest

version. Trained flaggers are expected to behave in accordance with the previously stated flagger procedures regardless of the source of the training. Once trained, flaggers shall carry certification cards showing the flagger's name and date of training. Copies of the KDOT Flagger Handbook are available on the KDOT website, from the Engineer or from the Bureau of Transportation Safety and Technology.

In addition to being trained in flagger procedures, flaggers shall have and use the following equipment:

- Stop/Slow Paddles: Equip flaggers with a minimum 18-inch wide Stop/Slow sign mounted on a rigid staff that is a minimum of 60 inches long from the end to the bottom of the sign.
- Flags: In emergency situations, equip flaggers with flags that are bright red, a minimum of 24 inches square, and attached to a minimum 36-inch long staff. Flags used at night shall be retroreflective.
- Apparel: Flaggers shall wear high visibility headgear and an ANSI Class II vest while on duty during daytime operations. When nighttime work is required, flaggers shall wear ANSI Class E retroreflectorized pants in addition to the high visibility headgear and ANSI Class II vest.
- Illumination: When nighttime work is required, illuminate flagger stations and equipment crossings with temporary lighting. Place all lighting so that it does not create a disabling glare for approaching road users, flaggers or workers. To determine if lighting is adequate and if disabling glare exists, drive toward the flagger station from all approaches at night.

(2) Law Enforcement. The Contractor may use uniformed enforcement officers as flaggers. When used as a flagger by the Contractor, law enforcement officers shall wear their official uniform with badge and meet the requirements for Flagger Apparel as shown in the Contract Documents.

(3) Traffic Signal Installation (Temporary). Install temporary traffic signals as shown in the Contract Documents. Place temporary signals on the shoulder when feasible, and in all cases, delineate with channelizers.

Temporary traffic signals may be used in lieu of flaggers and left unattended when each approach is visible to the other, and when approved by the Engineer. When each approach is not visible to the other, or if unattended signals are not approved by the Engineer, then the signal shall be manually operated, directly or by remote, by a Flagger trained in the operation of the signal. Temporary signals may be used at night. When signals are controlled by flaggers at night, comply with all nighttime flagger requirements. A single flagger may simultaneously operate multiple signals when:

- The flagger has an unobstructed view of the signals
- The flagger has an unobstructed view of approaching traffic in each direction; and
- The flagger is accurately able to read the signals' indicators.

(4) Automated Flagger Assistance Device (AFAD). AFADs may be used in the same manner as temporary traffic signals, except that they cannot be left unattended. Manually operate the AFAD directly or by remote, by a Flagger trained in the operation of the AFAD. AFADs may be used at night when the AFAD station is illuminated with temporary lighting and all other nighttime flagger requirements are met. A single flagger may simultaneously operate multiple AFADs when:

- The flagger has an unobstructed view of the AFADs;
- The flagger has an unobstructed view of approaching traffic in each direction; and
- The flagger is accurately able to read the AFADs' indicators.

(5) Pilot Cars. A pilot car may be used to assist and lead traffic between flaggers or flagger-manned AFADs. Maintain pilot car operations continuously, causing no delay to traffic for reasons such as refueling and breaks. The maximum time for a pilot car round trip is 15 minutes. Coordinate the work accordingly. Do not use the pilot car for other purposes.

Equip the pilot car with signs reading "Pilot Car Follow Me," complying with Contract Documents as they pertain to sign sheeting and lettering requirements. Mount signs a minimum of 1 foot above the top of the vehicle and clearly visible from the front and rear. Display the Contractor's company logo and contact information on pilot car vehicles.

Maintain one-way traffic and use the pilot car to restrict speeds to a maximum of 40 miles per hour in the work zone and restrict speeds in the vicinity of workers to 20 miles per hour until the last car in the pilot queue exits the vicinity of the workers.

k. Height Differential Treatment. On projects that carry traffic through construction, the following criteria shall be considered a minimum for treatment of height differentials adjacent to traffic lanes. A height differential is defined as the vertical distance between the top of the surface being constructed (or the riding surface) to the top of the adjacent pavement. Use **TABLE 805-4** to determine what treatment is required for the given situations.

When **TABLE 805-4** indicates the use of signs as part of the Traffic Control Plan, place the signs at the beginning of the condition and at each intersecting crossroad or approximately half mile intervals and remove or cover the signs when not applicable.

When the table indicates the use of a wedge, use hot mix asphalt or other material that will remain intact under anticipated traffic as approved by the Engineer.

TABLE 805-4: HEIGHT DIFFERENTIAL TREATMENT

Condition	Height Differential ("D")	Treatment
Nominal height differential between driving lanes open to traffic	1 inch $< D \leq 2$ inches	Use the Uneven Lanes signs (W8-11) as part of the Traffic Control Plan.
	2 inches $< D \leq 4$ inches	Use the Uneven Lanes signs (W8-11) as part of the Traffic Control Plan. Construct a 3:1 or flatter slope wedge against the pavement edge.
	$D > 4$ inches	This condition is not permitted unless otherwise indicated by the contract documents.
Nominal height differential between driving lane and shoulder or adjacent pavement that is closed to traffic	$D \leq 2$ inches	Use the Shoulder Drop-Off sign (W8-17 and W8-17P) as part of the Traffic Control Plan.
	2 inches $< D \leq 4$ inches	Use Shoulder Drop-Off signs (W8-17 and W8-17P) signs as part of the Traffic Control Plan. Construct a 1:1 or flatter slope wedge against the pavement edge. Channelizing devices may be used instead of a wedge if approved by the Engineer and when placed so the maximum device spacing, measured in feet, is equal to the posted speed limit prior to construction. height differential is expected to last longer than 2 weeks, the use of a 3:1 or flatter slope wedge against the pavement edge is required and the use of channelizing devices instead of a wedge is not permitted unless otherwise indicated in the Contract Documents.
	$D > 4$ inches	To the extent feasible, provide an obstruction free recovery area between the channelizing devices and height differential. Use Shoulder Drop-Off signs (W8-17 and W8-17P) as part of the Traffic Control Plan. **Construct a 3:1 or flatter slope wedge against the pavement edge.** Channelizing devices may be used instead of a wedge as approved by the Engineer when the channelizers are placed so the maximum device spacing, measured in feet, is equal to the posted speed limit prior to construction and no height differentials greater than 4 inches are left overnight without a wedge, unless otherwise indicated in the Contract Documents.

l. Weather and Increased Traffic Volume Conditions. During periods of inclement weather, or during periods of unusually heavy traffic, from any cause, the Engineer may require construction operations to cease in order to adequately handle traffic. The Engineer reserves the right to require the suspension or delay of certain operations, or the speeding up of specific operations, to obtain a sequence of operations that will aid the movement of traffic.

805.4 MEASUREMENT AND PAYMENT

a. General. No Adjustments in the contract unit price will be made regardless of the amount of underruns or overruns.

b. Traffic Control (Lump Sum). When traffic control is shown in the Contract Documents as a lump sum it will be measured as such. The Engineer will not measure Uneven Lane signs (W8-11), Shoulder Drop Off signs (W8-17 and W8-17P), or wedge material for separate payment.

TABLE 805-5: TRAFFIC CONTROL (LUMP SUM) PARTIAL PAYMENTS		
Percent of Original Contract Amount Completed*	**Pay Lesser of the Two**	
	% of Traffic Control	**% of Original Contract Amount**
10	50	5
80	100	10
100	100	NA

*The Percent of Original Contract Amount Completed = the amount earned by the Contractor** divided by the total dollar value of the original contract (all bid items).
**Do not include monies earned for "Mobilization", "Traffic Control (Lump Sum)", "Contractor Construction Staking" and "Stored Materials".

c. Individual Devices and Pavement Marking.

(1) General. When bid items are shown in the Contract Documents for individual traffic control devices, the Engineer will measure each item by the designated unit when the device is required and in acceptable condition and position. Once the Contractor has been notified, payment will not be made for any traffic control devices that remain in an unacceptable condition beyond the time specified in the notification.

Measurement for payment of traffic control devices will begin on the day they are installed for traffic control and direction. When traffic control devices are not needed, they shall be removed or covered and will not be measured. During non-working periods such as Sundays and holidays, the list of devices in satisfactory condition and location will be measured for payment on the day following, to determine the measurement for pay. During suspended periods, measurement of the devices used will be based on periodic checks conducted by the Engineer. These periodic checks do not relieve the Contractor of responsibility for traffic control. Units used for only a portion of a day will be paid for as one full day's use, regardless of the length of time they are used during the day and number of times the unit is moved and re-erected.

The following items are subsidiary to other items when specified by the Traffic Control Plan, shown in the Contract Documents, or used in an approved alternate Traffic Control Plan: barrier delineators, traffic cones, pilot cars, flaggers, temporary traffic signals used in addition to flaggers, AFADs, and wedges at the pavement edge, or channelizing devices used in lieu of wedges. Traffic cones and all traffic control devices used to delineate vehicles, equipment, tools, debris and materials stored within the right-of-way or 30 feet from the edge of the travelled way, whichever is less, are subsidiary to other items. The temporary removal, storage, and final placement of existing signs that conflict with construction work, but are intended to remain in place after the project is complete, is subsidiary to other items and signs damaged while in the Contractor's possession will be replaced at the Contractor's expense.

(2) Work Zone Signs (Size). The Engineer will measure each Work Zone Signs (Size) per each calendar day the device is required in acceptable condition and position.

(3) Work Zone Sign (Special)(Size). The Engineer will measure each Work Zone Signs (Special) when the sign is first installed and in place for traffic control and direction. No additional measurement will be made for relocating, repairing or maintaining the special signs. On the first estimate following the initial installation of a Work Zone Sign (Special), the price bid per sign will be paid for each sign installed.

(4) Barricades. The Engineer will measure each Work Zone Barricade per each calendar day the device is required in an acceptable condition and position. Quantities shown in the Contract Documents are for estimating purposes only. Quantities for barricades are estimated using 8-foot barricades.

(5) Arrow Displays and Portable Changeable Message Signs. The Engineer will measure each flashing warning or sequential arrow display and PCMS each calendar day the device is required and in an acceptable condition and position.

(6) Channelizer (Fixed, Portable, or Pedestrian). The Engineer will measure each channelizer, except traffic cones, per each calendar day the device is required in an acceptable condition and position.

(7) Work Zone Warning Lights (Type "A" or red Type "B"). The Engineer will measure each warning light per each calendar day the device is required in an acceptable condition and position.

(8) Temporary Pavement Marking and Temporary Raised Pavement Markers. The Engineer will measure temporary pavement marking and flexible RPMs used on HMA or other asphalt type surfaces per line of pavement marking per lift per station line. When double yellow centerline marking is required, the Engineer will measure both

lines for payment. The Engineer will measure temporary pavement marking and flexible RPMs used on other types of surfacing construction per station per line. If the Contractor elects to use Type I temporary pavement marking tape in place of Type II tape, the Type I marking will be measured and paid for as Type II temporary pavement marking. Required removal of all types of temporary pavement marking is subsidiary to other items in the contract.

When necessary, removal of existing permanent pavement markings will be measured and paid for according to **SECTION 808**. Required removal of all types of temporary pavement marking is subsidiary to other items in the contract.

The Engineer will measure each rigid RPM. No additional measurement will be made for cleaning or replacement of markers.

Contract Deduct assessments are cumulative until deficiencies are corrected.

(9) Flaggers (Set Price). When flaggers are specified in the Contract Documents or approved Traffic Control Plan, they will not be paid for separately, but will be considered as subsidiary to other bid items. If the Contractor is allowed to use temporary traffic signals in lieu of flaggers, temporary signals will not be paid for separately, but will be considered subsidiary to other items of the contract. If the Contractor elects to use AFADs in addition to flaggers, AFADs will not be paid for separately, but will be considered subsidiary to other items of the contract. If the Engineer determines that additional flaggers are required, each additional flagger will be measured for each hour they are required.

(10) Traffic Signal Installation (Temporary). The Engineer will measure temporary traffic signals by the Lump Sum, when shown in the Contract Documents as part of the Traffic Control Plan. The Engineer will make payments as follows:

Pay 75% of the contract unit price after the traffic signals are initially installed and operational.

Pay 100% after the traffic signals are no longer needed for the movement of traffic and have been removed or stockpiled, as specified.

(11) Traffic Control (Initial Set Up). If the amount bid for this item is less than 25% of the sum of amounts bid for all traffic control items, 100% of the amount bid for this item will be paid on the first estimate following the beginning of any traffic control set up done on the project. If the bid amount for this item is 25%, or greater, than the sum of the amounts bid for all traffic control items, the amount equal to 25% of the sum of the amounts bid for all traffic control items will be paid on the first estimate following any traffic control set up done on the project. Upon completion of all work on the project, 100% of the amount bid for this item will be paid.

(12) Uneven Lane and Shoulder Drop Off Signs. When individual traffic control bid items are shown in the Contract Documents, the Engineer will measure the Uneven Lane signs (W8-11) and the Shoulder Drop Off signs (W8-17 and W8-17P) each per day. See **subsection 805.4b.** when traffic control is bid lump sum.

(13) Liquidated Damages. Once the Contractor is being assessed liquidated damages according to **SECTION 108**, no traffic control devices will be measured for payment. This does not relieve the Contractor from the responsibility for providing and maintaining all necessary traffic control on the project until it has been completed and accepted. Such traffic control will be at the Contractor's expense.

On calendar completion date projects with interim completion dates, no traffic control devices will be measured other than those required between the interim completion date and the next beginning work period. This does not relieve the Contractor from the responsibility for maintaining all necessary traffic control on the project until it has been completed and accepted.

Contract Deducts may be assessed while the contract is in liquidated damages.

d. Payment. Payment for all individual traffic control devices, "Pavement Marking (Temporary)", "Flexible Raised Pavement Markers", "Rigid Raised Pavement Markers", "Traffic Signal Installation (Temporary)", "Traffic Control" and "Traffic Control (Initial Set Up)" at the contract unit prices is full compensation for the specified work. Payment for "Flaggers (Set Price)" at the contract set price is full compensation for the specified work.

If any deductions are assessed due to the Contractor's failure to complete required corrective actions, the Engineer will deduct any such assessment from the date the assessment is first made until corrective action is performed using the bid item Contract Deduct.

No payment will be made while Contractor is assessed liquidated damages for failure to comply with winter shutdown period or project completion date in other Project Special Provisions included in the Contract Documents.

SECTION 806

DURABLE PAVEMENT MARKING

806.1 DESCRIPTION

Prepare the pavement and apply the pavement markings as shown in the Contract Documents.

When rumble strips are to be constructed on the project, construct the centerline rumble strips before installing centerline pavement marking.

BID ITEMS	UNITS
Pavement Marking (*) (**) (***) (*****)	Linear Foot
Pavement Marking Symbol (*) (White) (****) (*****)	Each

*Type of Pavement Marking: Cold Plastic, Patterned Cold Plastic, Epoxy, Thermoplastic, Preformed Thermoplastic, Thermoplastic-Spray, Intersection Grade, High Durability or Multi-Component
** Color
*** Width
**** Type of Symbol
***** Contrast

806.2 MATERIALS

Provide durable pavement marking materials that comply with **DIVISION 2200**.

806.3 CONSTRUCTION REQUIREMENTS

a. General.

(1) Equipment. Use equipment designed for the preparation and application of the appropriate type of pavement marking material.

(2) Contractor's Personnel. Provide a minimum of 1 employee on the project holding an American Traffic Safety Services Association (ATSSA) pavement marking certification and experienced in the application of the appropriate type of pavement marking material.

(3) Pavement Marking Contractors. Provide a letter of certification from the pavement marking manufacturer indicating the Contractor's qualifications to install their product.

(4) Test Strip. Before beginning pavement marking operations, at a location approved by the Engineer complete a 300-foot test section for epoxy, thermoplastic, sprayed thermoplastic and multi-component pavement markings that meet the requirements of this specification. The Engineer will inspect the test strip 24 hours after it has been placed. Do not begin pavement marking operations, until the Engineer approves the test strip.

(5) Surface Preparation. On existing pavements, remove the existing permanent, pavement markings (removed and paid for under **SECTION 808**) and according to the recommendations of the manufacturer of the new pavement markings.

Remove temporary pavement markings, if any, the same day the durable pavement markings are applied. Removal of temporary pavement marking is subsidiary to temporary pavement marking bid items.

Remove loose particles, dirt, tar, grease, residue of prior pavement markings and other deleterious material from the pavement surfaces.

(6) Alignment. Lay out the pavement marking as detailed in the Contract Documents. If the Contract Documents do not provide details, submit to the Engineer for approval, a layout plan for the pavement markings that complies to the MUTCD. Locate longitudinal pavement marking stripes a minimum of 2 inches and a maximum of 8 inches from longitudinal joints. Provide adequate guide marks (approximately 2 inches by 12 inches at approximately 30 to 50-foot intervals) for the application of the pavement markings.

When applying pavement markings at locations with newly constructed rumble strips, use the same guide marks that were used for milling the rumble strips, or when approved by the Engineer, establish a new guide mark, if the guide mark used with the rumble strips is not visible enough to follow.

(7) Pavement Marking Width. Apply the pavement markings at the specified plan width or a maximum of ¼ inch above the specified plan width. See **TABLE 806-3** for minimum pavement marking widths.

(8) Pavement Marking Application. Provide the Engineer with a copy of the manufacturer's application instructions. Apply the pavement markings according to the manufacturer's recommendations.

Follow the manufacturer's recommendations regarding pavement and ambient temperature at the time of application. The Engineer will verify the pavement and ambient temperatures before beginning work and when deemed necessary.

Apply pavement markings straight and close to the intended alignment without abrupt changes that result in an unacceptable appearance.

Meet the minimum retroreflectivity requirements in **TABLE 806-1**.

(9) Unsatisfactory Pavement Marking. Remove and replace unsatisfactory pavement marking according to the Contract Documents.

(a) General. Remove and replace pavement markings that:

- have drag marks, gashes, gouges, foreign covering, discolored areas or areas that have failed to solidify.
- have improper adhesion, length or thickness.
- have areas that present a ragged appearance, areas that do not present sharply defined edges, or areas with abrupt unintended changes in alignment.

(b) Alignment. Lines that deviate laterally from the intended alignment more than 2 inches in 200 feet may be rejected.

(c) Width. The Engineer will take a minimum of 10 width measurements per color line randomly spaced every 1 mile. Remove and replace the deficient widths of pavement markings so the total length of deficiency in any 1 mile section is less than 300 feet.

(d) Retroreflectivity. See **TABLE 806-1** for minimum retroreflectivity requirements for pavement marking.

TABLE 806-1: MINIMUM RETROREFLECTIVITY REQUIREMENTS

Type of Material	Color	millicandelas/sq m/lux* (minimum) (Initial)
Cold Plastic	White	250
	Yellow	175
Patterned Cold Plastic	White	500
	Yellow	300
Epoxy or Multi-Component	White	325
	Yellow	250
High Durability Tape	White	225
	Yellow	175
Thermoplastic, Preformed Thermoplastic or Spray Thermoplastic	White	300
	Yellow	225

NOTE: Provide an acceptable 100-foot retroreflectometer to use on the project which will remain the property of the Contractor. In the presence of the Engineer, measure the retroreflectivity between 12 hours and 14 days after the application of all pavement markings. Take a minimum of 5 randomly spaced readings per color line every 1 mile. The Engineer will average all of the readings for each color line within the 1 mile section to determine the retroreflectivity.

If the pavement markings have a retroreflectivity reading as measured for **TABLE 806-1** (in any 1 mile section) less than that shown in **TABLE 806-2**, remove and replace the entire 1 mile section.

TABLE 806-2: RETROREFLECTIVITY READINGS REQUIRING REMOVAL OF PAVEMENT MARKING

Type of Material	Color	Retroreflectivity reading (R) in a 1 mile section (millicandelas)
Cold Plastic	White	200
	Yellow	125
Patterned Cold Plastic	White	450
	Yellow	250
Epoxy or Multi-Component	White	275
	Yellow	200
High Durability Tape	White	175
	Yellow	125
Thermoplastic, Preformed Thermoplastic or Spray Thermoplastic	White	250
	Yellow	175

(10) Acceptance of Pavement Marking. The Engineer will not examine pavement marking for final acceptance until the pavement markings complete a 180 calendar day observation period. The Contractor is responsible for the pavement marking during this period. The 180 calendar day observation period begins the day following the completion of the pavement marking. Providing all other work on the contract is complete, the Engineer will not assess working day charges during the 180 calendar day observation period.

Immediately following the 180 day observation period, arrange with the Engineer to have a joint meeting to examine the pavement marking. The Engineer will provide written results of the final examination to the Contractor within 5 business days of the joint meeting.

Before the project is accepted, replace all failed pavement markings, at own expense. The pavement marking is failed, when more than 10% of the substrate is exposed in a 2,000-foot section of longitudinal pavement marking line. The transverse lines and symbols will be evaluated separately for the exposure of 10% substrate. Abrasion of pavement marking at private entrances or intersections may be excluded from examination.

If the Contractor fails to complete the required replacement of pavement markings within 10 business days of the date of the notice of the unacceptable pavement markings, during which the application of pavement markings is not precluded by adverse weather or road surface conditions, the Engineer, after giving the Contractor written notice, will reinstate the assessment of working day charges or Liquidated Damages. Working day charges or Liquidated Damages will continue until the work is accepted.

If more than 30% of pavement marking is required to be replaced, the replacement pavement markings will not be accepted until the completion of an additional 180 calendar day observation period.

The Engineer will, upon satisfactory inspection of the pavement marking, accept the work and terminate the Contractor's responsibilities.

b. Cold Plastic/Patterned Cold Plastic Pavement Marking. Grind an inset for the pavement marking into the surface of the pavement. Grind the inset 0.08 inches (+ 0.01 inch tolerance) deep, with the width and length of the inset a maximum of 2 inches greater than the dimensions of the pavement marking.

On new or existing PCCP, cut the marking tape at any joint in the pavement that is crossed by the tape.

Apply adhesive-sealer primer of a type recommended by the manufacturer. Primer is required on all tape applications regardless of temperature, date or season.

c. Epoxy Liquid Pavement Marking. When pavement markings are applied to PCCP (including concrete bridge decks) less than 1 year old, remove all curing compounds and laitance by shot, sand or waterblasting.

Use a slower curing epoxy material (40 minutes) for pavement markings applied to PCCP. For other surfaces, fast setting (10 minutes) epoxy material may be used with approval of the Engineer.

Apply the epoxy liquid material closely behind the surface cleaning procedures.

Before mixing the components of the pavement marking material, heat the individual components to the temperature ranges recommended by the manufacturer of the material. Do not exceed the maximum recommended temperature at any time.

Apply the epoxy liquid pavement marking material at a thickness of 20-25 mils on all pavement. Immediately apply all glass beads (double drop system or blended bead) to the epoxy liquid pavement marking at the glass bead gradation and bead drop rate recommended by the manufacturer to obtain the required level of retroreflectivity.

d. Multi-Component Liquid Pavement Marking. When pavement markings are applied to PCCP (including concrete bridge decks) less than 1 year old, remove all curing compounds and laitance by shot, sand or waterblasting. For intersection grade multi-component, grind the inset 15 mil (+10 mil tolerance) deep, with the width and length of the inset a maximum of 2 inches greater than the dimensions of the pavement marking on concrete surfaces.

Multi-component liquid pavement marking will only be allowed for use on concrete pavement on a pre-qualified basis.

Apply the multi-component liquid material closely behind the surface cleaning procedures.

Before mixing the components of the pavement marking material, heat the individual components to the temperature ranges recommended by the manufacturer of the material. Do not exceed the maximum recommended temperature at any time.

Apply the multi-component liquid pavement marking material at the thickness of 20-25 mils on all pavement. Immediately apply the glass beads (double drop system or blended drop) to the multi-component liquid pavement marking at the glass bead gradation and bead drop rate recommended by the manufacturer to obtain the required level of retroreflectivity.

e. Intersection Grade Pavement Marking.

(1) Multi-Component. Follow **subsection 806.3d**.

(2) High Durability Tape. Grind an inset for the pavement marking into the surface of the pavement. Grind the inset 80 mil (+10 mil tolerance) deep with the width and length of the inset a maximum of 2 inches greater than the dimensions of the pavement marking. Apply adhesive-sealer primer of a type recommended by the manufacturer. Primer is required on all tape applications regardless of temperature, date or season.

On new or existing PCCP, cut the marking tape on either side of any joint in the pavement that is crossed by the tape.

(3) Preformed Thermoplastic. Grind the inset 40 mil (+ 20 mil tolerance) deep with the width and length of the inset a maximum of 2 inches greater than the dimensions of the pavement marking on concrete surfaces.

Use a heating device recommended by the material manufacturer to fuse the preformed thermoplastic to the pavement. Apply adhesive-sealer primer of a type recommended by the manufacturer. Primer is required on all preformed applications on concrete regardless of temperature, date or season.

Apply the pavement markings as recommended by the manufacturer.

f. All Thermoplastic Pavement Marking. The Engineer will verify the thickness of the thermoplastic pavement marking. Thickness will be checked by placing metal plates or other suitable material of known thickness in a 3-foot section along the path of application at 2 to 3 locations. After the application of the thermoplastic material, the samples will be cut free. The material thickness will be measured using either a micrometer or vernier calipers (with proper correction for the metal plate). The thickness recorded for the locations within the 3-foot section will be averaged. Initially, thickness determinations will be made every ⅓ mile for each color and each stripe width. Once a pattern of compliance is established, the Engineer may reduce the frequency of thickness verification to once each 1 mile section. Failure of a section will require testing to return to the initial frequency until compliance may be re-established. The location of the 3-foot sample segment within the sample section will be selected at random.

The Contractor may provide other devices for gauging thickness to the Engineer for approval.

Apply thermoplastic pavement markings between April 15 and October 15. If the manufacturer's recommendations allow, the Engineer may waive the date restrictions. The Engineer will notify the Contractor in writing of any allowed variance.

(1) Thermoplastic Pavement Marking. The required thickness for longitudinal markings is a minimum of 90 mil at the edges, and a maximum of 125 mil at the center of the stripe. The required thickness for transverse markings and symbols is a minimum of 90 mil at the edges, and a maximum of 140 mil at the center.

For transverse markings on concrete, grind the inset 40 mil (+20 mil tolerance) deep, with the width and length of the inset a maximum of 2 inches greater than the dimensions of the pavement marking on concrete surfaces.

Apply the binder-sealer according to the manufacturer's recommendations. Primer is required on all transverse applications on concrete regardless of temperature, date or season. The Engineer will not approve the application of the thermoplastic material until the binder-sealer applied to the pavement is devoid of all solvent or water.

Apply prepared thermoplastic material in a molten state within a temperature range of 400 to 440ºF. The Engineer will not approve the use of scorched material or prepared material that has been maintained at 440ºF for a period exceeding 4 hours.

Apply glass beads (double drop system or blended bead) to the thermoplastic pavement marking at the glass bead gradation and bead drop rate recommended by the manufacturer to obtain the required level of retroreflectivity.

g. Leading/Trailing Configuration. Installation of leading/trailing pavement markings may be used for intermittent markings on concrete or asphalt surfaces. The trailing (black) pavement marking shall be placed concurrently to the white pavement marking line when applied to the roadway.

Apply black, opaque coal slag (20-40 mixture) to the trailing pavement marking line at a rate of 8-10 pounds per gallon of liquid pavement marking to achieve a skid resistance value of 50 BPN.

Apply leading/trailing pavement markings that follow the same space configuration as broken lines, dotted extension and lane drop markings in the Contract Documents.

806.4 MEASUREMENT AND PAYMENT

The Engineer will measure the various widths and colors or pavement markings by the linear foot. When the Contract Documents specify that the contrast pavement markings are installed in a leading/trailing configuration, the Engineer will measure the black pavement marking and white pavement marking separately by the linear foot.

The Engineer will measure each symbol.

The Engineer will pay for 90% of the completed quantity for each of the various widths and colors of pavement marking and symbols. Upon acceptance of the pavement markings following the 180 day observation period, the Engineer will pay for the remaining 10% of the completed quantity for each of the various widths and colors of pavement marking and symbols.

When necessary, removal of permanent pavement markings will be measured and paid for under **SECTION 808**. Removal of temporary pavement markings is subsidiary to the temporary pavement marking item.

Payment for "Pavement Marking" and "Pavement Marking Symbol" at the contract unit prices is full compensation for the specified work.

Pay adjustments for width and retroreflectivity deficiencies (see **TABLES 806-3** and **4**) will be entered on the Contractor's Payment Vouchers (intermediate and final) under the bid item Contract Deduct.

TABLE 806-3: DURABLE PAVEMENT MARKING WIDTH DEFICIENCY DEDUCTION (Epoxy, Thermoplastic, Spray Thermoplastic and Multi-Component)

Specified Width (inches)	Actual Width (inches)	Distance (D) the width is deficient in any 1 mile section	Deduction
4	3 ¾ to 4	$D \leq 50$	No deduction.
4	3 ¾ to 4	$50 < D < 300$	20% deduction of the contract line item for the entire 1 mile section.
6	5 ¾ to 6	$D \leq 50$	No deduction.
6	5 ¾ to 6	$50 < D < 300$	20% deduction of the contract line item for the entire 1 mile section.

TABLE 806-4: DURABLE PAVEMENT MARKING RETROREFLECTIVITY DEDUCTION*			
Type of Material	**Color**	**Retroreflectivity reading (R) in a 1 mile section (millicandelas)**	**Deduction of the contract line item for the entire 1 mile section**
Cold Plastic	White	225 ≤ R < 250	15%
		200 ≤ R < 225	25%
	Yellow	150 ≤ R < 175	15%
		125 ≤ R < 150	25%
Patterned Cold Plastic	White	475 ≤ R < 500	15%
		450 ≤ R < 475	25%
	Yellow	275 ≤ R < 300	15%
		250 ≤ R < 275	25%
Epoxy or Multi-Component	White	300 ≤ R < 325	15%
		275 ≤ R < 300	25%
	Yellow	225 ≤ R < 250	15%
		200 ≤ R < 225	25%
High Durability Tape	White	200 ≤ R < 225	15%
		175 ≤ R < 200	25%
	Yellow	150 ≤ R < 175	15%
		125 ≤ R < 150	25%
Thermoplastic, Preformed Thermoplastic or Spray Thermoplastic	White	275 ≤ R < 300	15%
		250 ≤ R < 275	25%
	Yellow	200 ≤ R < 225	15%
		175 ≤ R < 200	25%

*Retroreflectivity readings used for calculating the deduction will be taken from reading required in **TABLE 806-1**.

SECTION 807

PAINTED PAVEMENT MARKING

807.1 DESCRIPTION

Apply pavement markings as shown in the Contract Documents.

BID ITEMS	UNITS
Pavement Marking (Paint) (*) (**)	Linear Foot
Pavement Marking Symbol (Paint) (White) (***)	Each

* Color
** Width
*** Type of Symbol

807.2 MATERIALS

Provide paint that complies with **SECTION 2200**.

807.3 CONSTRUCTION REQUIREMENTS

a. Equipment. Use self-propelled or truck-mounted equipment designed for the purpose of applying painted pavement markings of the type, width and thickness required. Hand application or towing of the equipment will be allowed for smaller areas as approved by the Engineer. Equip the machine with an adjustable guide-on to obtain proper placement of the line.

b. Contractor's Personnel. Provide a minimum of 1 employee on the project holding an American Traffic Safety Services Association (ATSSA) pavement marking certification and experienced in the application of the appropriate type of pavement marking material.

c. Surface Preparation. On existing pavements, remove the existing pavement markings according to **DIVISION 808** and the recommendations of the manufacturer of the new painted pavement markings.

Remove temporary pavement markings, if any, the same day the painted pavement markings are applied.

Remove loose particles, dirt, tar, grease, residue of prior pavement markings and other deleterious material from the pavement surfaces as a result of surface preparation.

d. Alignment. Lay out the pavement marking as detailed in the Contract Documents. If the Contract Documents do not provide details, submit a layout plan for the pavement markings to the Engineer for approval. Locate longitudinal pavement marking stripes a minimum of 2 inches and a maximum of 8 inches from longitudinal joints. Provide adequate guide marks (approximately 2 inches by 1 foot at approximately 50-foot intervals) for the application of the pavement markings.

e. Pavement Marking Application. Provide the Engineer with a copy of the manufacturer's application instructions. Apply paint according to the manufacturer's recommendations.

Apply paint at a wet film thickness of 18 mils at an approximate rate of 3.8 gallons per 1,000-foot for 4-inch solid line, and 0.95 gallons per 1,000-foot for 4-inch broken line. For other widths of marking, increase the amount of paint proportionally.

Apply glass beads to the painted line at a rate of 12 pounds of glass beads for each gallon of paint. Use an automatic bead dispenser attached to the striping machine in such a manner that the beads are dispensed almost instantaneously upon the line as it is being installed. Equip the glass bead dispenser with an automatic cut-off control synchronized with the cut-off of the paint.

Keep traffic from crossing the newly applied lines by coning off the lines until the lines are dry to no-pick-up. The Contractor may reduce or eliminate the need for this by using fast dry paints and approved traffic control.

Do not apply the paint when the air temperature is below 40ºF, upon damp or frosted surfaces, or when, in the opinion of the Engineer, conditions are not satisfactory for the work.

f. Replacement of Unsatisfactory Pavement Marking. Apply pavement markings straight and close to the intended alignment without abrupt changes that result in an unacceptable appearance. Lines that deviate laterally from the intended alignment more than 2 inches in 200 feet may be rejected.

Remove and replace pavement markings that have:

- drag marks,
- gashes,
- gouges,
- foreign covering,
- discolored areas,
- areas that have failed to solidify,
- improper adhesion,
- improper width, length or thickness,
- areas that present a ragged appearance,
- areas that do not present sharply defined edges,
- areas with abrupt unintended changes in alignment.
- Do not meet **TABLE 807-1**.

TABLE 807-1: PAINTED PAVEMENT MARKING MINIMUM RETROREFLECTIVITY REQUIREMENTS

TYPE OF MATERIAL	COLOR	millicandelas/sq m/lux* (minimum) (Initial)
Waterborne Traffic Paint	White	250
	Yellow	175

NOTE: Provide an acceptable 100-foot retroreflectometer to use on the project which will remain the property of the Contractor. In the presence of the Engineer, measure the retroreflectivity between 12 hours and 7 days after the application of all pavement markings. Take a minimum of 5 randomly spaced readings per color line every 1 mile. The Engineer will average all of the readings for each color line within the 1 mile section to determine the retroreflectivity.

Removal and replacement of unsatisfactory pavement marking will be at the Contractor's expense.

807.4 MEASUREMENT AND PAYMENT

The Engineer will measure the painted pavement marking by the linear foot for the various widths and classes.

The Engineer will measure each symbol.

Payment for "Pavement Marking (Paint)" and "Pavement Marking Symbol (Paint) (White)" at the contract unit prices will be full compensation for the specified work.

SECTION 808

REMOVAL OF EXISTING PAVEMENT MARKINGS

808.1 DESCRIPTION
Remove the existing pavement markings and symbols as shown in the Contract Documents.

BID ITEMS	UNITS
Pavement Marking Removal	Linear Foot
Pavement Marking Removal (Plowable Raised Marker)	Each

808.2 MATERIALS - None specified.

808.3 CONSTRUCTION REQUIREMENTS
a. Removal of Existing Stripes and Symbols. Completely remove the existing pavement markings and symbols without damaging the asphalt or concrete pavement surface or longitudinal and transverse joints. Waterblasting will only be allowed for removal of markings on concrete surfaces. As the work progresses, remove all material deposited on the pavement as a result of the removal operations. When blast cleaning within 10 feet of the traveling public, continuously remove all residue and dust.

When replacement of the removed existing markings is a part of the Contract Documents, follow the manufacturer's requirements for the new pavement markings as to the method of removal of the existing markings, or surface preparation requirements.

b. Removal of Plowable Raised Markers. If the plowable raised markers are to be reinstalled, remove them without damaging. All damaged plowable raised markers will be replaced at the Contractor's expense.

c. Repair. Use methods approved by the Engineer to repair all pavement damaged during the pavement marking removal operations.

808.4 MEASUREMENT AND PAYMENT
The Engineer will measure the removal of each skip and solid line of existing pavement marking by the linear foot. NOTE: Removal of temporary pavement marking is subsidiary to the temporary pavement marking bid item.

The Engineer will measure each plowable raised marker removed.

The Engineer will not measure removal of existing pavement marking symbols for payment.

Payment for "Pavement Marking Removal" and "Pavement Marking Removal (Plowable Raised Marker)" at the contract unit prices is full compensation for the specified work.

SECTION 809

CONCRETE SAFETY BARRIER

809.1 DESCRIPTION

Construct permanent cast-in-place concrete safety barrier according to the Contract Documents. Place and remove temporary precast concrete safety barrier according to Contract Documents.

BID ITEMS	UNITS
Concrete Safety Barrier (*)	Linear Foot
Concrete Safety Barrier (*) (Temporary)	Linear Foot
Concrete Safety Barrier (*) (Temporary - Installation Only)	Linear Foot
Concrete Safety Barrier (*) (Temporary - Relocate)	Linear Foot
*Type	

809.2 MATERIALS

a. Permanent Cast-in-Place Concrete Safety Barrier. Provide materials that comply with the Contract Documents and **DIVISIONS 1000 - 2500**. The Engineer will visually inspect the completed installation before making final acceptance.

b. Temporary Precast Concrete Safety Barrier. Provide certification (prepared by the manufacturer or Contractor) that the temporary precast concrete safety barrier complies with the requirements on the Contract Documents. Provide either new or used, temporary precast concrete safety barrier. The Engineer will accept, either new or used, temporary precast concrete safety barrier upon acceptance of the provided certification, and visual inspection of the delivered and installed temporary precast concrete safety barrier on the project.

c. Median Filler Material. Provide SB-3 for median filler material that complies with **DIVISION 1100**.

809.3 CONSTRUCTION REQUIREMENTS

a. Permanent Cast-in-Place Concrete Safety Barrier. Construct the cast-in-place concrete safety barrier as shown in the Contract Documents and according to **DIVISION 700**.

Place median filler material as indicated in the Contract Documents.

b. Temporary Precast Concrete Safety Barrier. Install and remove the precast concrete safety barrier as required. Do not use temporary precast concrete safety barrier that is damaged or deteriorated. Erect the temporary precast concrete safety barrier as shown in the Contract Documents. The temporary precast concrete safety barrier will remain the property of the Contractor, unless shown otherwise in the Contract Documents.

If the Contract Documents require installation only, transport from the designated stockpile, install and return the temporary precast concrete safety barrier to the designated location.

Relocate the temporary precast concrete safety barrier as shown in the Contract Documents, or as directed by the Engineer.

Remove and replace all sections of temporary precast concrete safety barrier damaged during or after placement. Remove, clean or replace temporary precast concrete safety barrier (including barrier delineators) that has deteriorated to the point of being non-effective.

809.4 MEASUREMENT AND PAYMENT

a. Permanent Cast-in-Place Concrete Safety Barrier. The Engineer will measure cast-in-place concrete safety barrier by the linear foot along the centerline of the barrier.

Payment for "Concrete Safety Barrier (*)" at the contract unit prices is full compensation for the specified work. Median filler material is subsidiary to other items in the contract.

b. Temporary Precast Concrete Safety Barrier. The Engineer will measure the precast concrete safety barrier by the linear foot (number of sections times the nominal section length). A precast concrete safety barrier transition section (regardless of actual length) will be measured as a nominal section length of temporary precast concrete safety barrier.

The quantity of precast concrete safety barrier measured for payment is the maximum quantity required on the project at any one time, plus any replacement sections measured for payment, and is paid for as Concrete Safety Barrier (*) (Temporary). Each section of temporary precast concrete safety barrier will be measured for payment when put in use on the project.

Sections of temporary precast concrete safety barrier used to replace sections damaged by traffic while in use will be measured for payment and paid as Concrete Safety Barrier (*) (Temporary-Installation Only) when put in use on the project. When provided by the Contractor, sections of temporary precast concrete safety barrier used to replace deteriorated sections or sections damaged through negligence of the Contractor are not measured for payment.

When stage construction requires that the precast concrete safety barrier be moved from its initial position to an alternate position, the Engineer will measure the relocated barrier by the linear foot (number of sections times the nominal section length). The barrier will be measured for payment in each relocated position the barrier is placed and is paid as Concrete Safety Barrier (*) (Temporary-Relocate). If the stage construction requires that the barrier be removed from the project to a storage location, and returned to the project during a subsequent construction stage, each movement of the barrier will be considered a relocation.

Removal of the precast concrete safety barrier, when no longer required on the project, is not measured for separate payment.

Payment for "Concrete Safety Barrier (*) (Temporary)", "Concrete Safety Barrier (*) (Temporary-Installation Only)", and "Concrete Safety Barrier (*) (Temporary-Relocate)" at the contract unit prices is full compensation for the specified work.

The quantities shown in the Contract Documents for the various items of temporary precast concrete safety barrier are estimated. The contract unit prices will not be adjusted, regardless of overruns or underruns.

SECTION 810

INERTIAL BARRIER SYSTEM

810.1 DESCRIPTION

Install and relocate inertial barrier systems as shown in the Contract Documents. Stockpile the replacement modules at the project site.

BID ITEMS	UNITS
Inertial Barrier System	Each
Replacement Modules (*)	Each
*Series	

810.2 MATERIALS

Provide aggregate for underdrains, UD-1 or fine aggregate for concrete, or FA-A that complies with **DIVISION 1100**.

Provide inertial barrier systems and replacement modules that comply with **DIVISION 1700**.

Provide commercially available rock salt. The Engineer will accept the rock salt based on visual inspection at the point of usage.

Impact attenuators prequalified under **DIVISION 1700** may be substituted for inertial barrier systems with approval of the Engineer.

810.3 CONSTRUCTION REQUIREMENTS

Provide the Engineer with the manufacturer's product data sheets for the inertial barrier system. Install the inertial barrier system according to the manufacturer's recommendations.

At the beginning of each project and in the presence of the Engineer, fill the inertial barrier system modules with a mixture of 95% aggregate and 5% rock salt by weight. Use aggregate with a moisture content of 3% or less by weight, determined according to **DIVISION 2500**. Fill each of the modules with any of the specified mixture of aggregates and rock salt. Do not mix the types of aggregates within a module.

When shown in the Contract Documents relocate the inertial barrier system.

Install replacement modules of the inertial barrier system when damaged by traffic.

Unless otherwise noted in the Contract Documents, the inertial barrier system and replacement modules are the property of the Contractor upon completion of the project.

810.4 MEASUREMENT AND PAYMENT

The Engineer will measure each inertial barrier system. Each unit will be measured only once, even if the unit is relocated on the project.

The Engineer will measure each replacement module used on the project. The quantity of replacement modules stockpiled on the project site, but not used on the project, will not be measured for payment.

Payment for each for "Inertial Barrier System" and "Replacement Modules" at the contract unit prices is full compensation for the specified work.

SECTION 811

IMPACT ATTENUATOR

811.1 DESCRIPTION

a. Permanent Impact Attenuator. Install the impact attenuation devices at the locations designated in the Contract Documents.

b. Impact Attenuator (Temporary). When specified as part of project traffic control, install and relocate the temporary impact attenuation devices at the locations designated in the Contract Documents.

Stockpile the required replacement modules for each type of temporary system used on the project at the project site. Install replacement modules when damaged.

BID ITEMS	**UNITS**
Impact Attenuator (*) *Type (TL-2, TL-3 or Severe Duty)	Each
Impact Attenuator (Temporary)	Each
Replacement Modules	Each

811.2 MATERIALS

a. Permanent Impact Attenuator. Provide the type and model of impact attenuator designated in the Contract Documents or an approved equivalent. The Bureau of Construction and Materials will maintain a list of approved impact attenuators.

The Engineer will accept the impact attenuators based on the brand name and model, and visual inspection for condition at the point of usage.

b. Impact Attenuator (Temporary). Provide the type and model of impact attenuator designated in the Contract Documents or an approved equivalent. An inertial barrier system is not an approved equivalent. The Bureau of Construction and Materials will maintain a list of approved impact attenuators.

The Engineer will accept the impact attenuators based on the brand name and model, and visual inspection for condition at the point of usage.

c. Materials for Base. Provide concrete and reinforcing steel that comply with **SECTIONS 401, 402, 1102** and **DIVISON 1600**.

811.3 CONSTRUCTION REQUIREMENTS

a. Permanent Impact Attenuator. Construct the reinforced concrete base according to the applicable portions of **DIVISION 700** and as shown in the Contract Documents.

Provide the Engineer with a printed copy of the manufacturer's recommendations for installation of the impact attenuator. Install the impact attenuation device according to the manufacturer's recommendations.

b. Impact Attenuator (Temporary). Construct the reinforced concrete base according to the applicable portions of **DIVISION 700** and as shown in the Contract Documents.

Provide the Engineer with a printed copy of the manufacturer's recommendations for installation of the impact attenuator. Install the impact attenuation device according to the manufacturer's recommendations.

When shown in the Contract Documents, relocate the temporary impact attenuator.

Install replacement modules of the temporary impact attenuator when damaged.

Unless otherwise noted in the Contract Documents, the temporary impact attenuator and replacement modules are the property of the Contractor upon completion of the project.

811.4 MEASUREMENT AND PAYMENT

a. Permanent Impact Attenuator. The Engineer will measure each impact attenuator.

Payment for the "Impact Attenuator (*) at the contract unit price is full compensation for the specified work.

b. Impact Attenuator (Temporary). When installed as part of project traffic control, the Engineer will measure each temporary impact attenuator. Each unit will be measured only once, even if the unit is relocated on the project.

The Engineer will measure each replacement module used on the project. The quantity of replacement modules stockpiled on the project site, but not used on the project, will not be measured for payment.

Payment for the "Impact Attenuator (Temporary)" and "Replacement Modules" at the contract unit price is full compensation for the specified work.

SECTION 812

PERMANENT SIGNING

812.1 DESCRIPTION

Install highway signs, delineators and object markers as shown in the Contract Documents.

BID ITEMS	UNITS
Barricade (Type 3) (Fixed)	Each
Sign (*1) (High Performance)	Square Foot
Sign Post (4" x 6" Wood) (*2)	Linear Foot
Sign Post (*3 Steel Beam)	Linear Foot
Sign Post (*4 U Steel)	Linear Foot
Sign Post (*5 Perforated Square Steel Tube)	Linear Foot
Sign Post (4" x 6" Structural Steel)	Linear Foot
Sign Post (3 I 2.25 Aluminum)	Linear Foot
Sign Post Stub and Breakaway Base Plate (*3)	Each
Sign Post Breakaway Base Plate (*3)	Each
Sign Post Footing (*6 Concrete)	Linear Foot
Sign Post Footing (Sign Post Square Coupler) (*11)	Each
Sign Post Footing (*5 Perforated Square Steel Tube)	Each
Signing Object Marker (*7)	Each
Signing Delineator (*8) (*9 Rigid, "U" Post)	Each
Signing Delineator (*8) (*9 Flexible) (*10 Anchor)	Each
Signing Delineator (*8) (*9 Bracket)	Each
Sign (Remove and Reset)	Lump Sum

*1 Type of substrate: Flat Sheet, Reinforced Panel or Overlay
*2 Type of sign: Flat Sheet Sign or Reinforced Panel Sign
*3 Size and weight of post: W 6 x 9, W 10 x 12 or W 10 x 22
*4 Weight per foot: 2 lbs./ft. or 3 lbs./ft.
*5 Size of post: 1¾ inch, 2 inch, 2¼ inch or 2½ inch
*6 Diameter: 18- inch wood post, 24- inch steel beam post or 30- inch steel beam post
*7 Type: Type 2 or Type 3
*8 Type: Type A or Type B
*9 Color: Yellow or White
*10 Type: Type 1 or Type 3
*11 Size: 2 ¼ inches

812.2 MATERIALS

a. Materials for Permanent Signs.

(1) Provide Grade 3.0 concrete for sign post footings that complies with **SECTIONS 401, 402** and **1102**. If allowed, provide expanded foam foundations according to **DIVISION 1700**.

(2) Provide asphalt material for sealing gaps between the wood posts and the concrete footings approved by the Engineer.

(3) Provide steel reinforcement bars, structural steel tubes, anchor bolts, steel fasteners, steel sign posts, steel delineator posts, aluminum sign blanks, aluminum sign overlay panels, aluminum I-beams, aluminum Z-bars and aluminum post clips that comply with **DIVISION 1600**.

(4) Provide organic zinc-rich paint for repairing damaged spelter coatings that complies with **DIVISION 1800**.

(5) Provide retroreflective sheeting, process inks and flexible delineator posts and anchoring devices that comply with **DIVISION 2200**.

(6) Provide wood posts and preservative treatment of and drilled holes that comply with **DIVISION 2300**.

b. Shop Fabrication of Signing Items.

(1) Flat Sheet Signs. Provide flat sheet sign blanks that comply with the Contract Documents. Remove warps, burrs and other defects.

(2) Reinforced Panels. Provide reinforced panels of either extrusheet or extruded fabrication that comply with the Contract Documents and these requirements:

- Cut the ends of all panels at 90º angles to within ⅛ inch of the length shown in the Contract Documents.
- If the panel is extrusheet fabrication, do not exceed a $^{1}/_{32}$ inch mismatch between the edge of the sheet and the extrusion it is fastened to.
- Remove warps, burrs and other defects.

(3) Flat Sheet Sign Blank and Reinforced Panel Preparations. After fabrication, prepare the metal for sheeting application using a Class 2 conversion coating according to ASTM B 921, "Standard Specification for Non-hexavalent Chromium Conversion Coatings on Aluminum and Aluminum Alloys".

Handle the metal with a mechanical device or clean canvas gloves, between the etching operation and application of retroreflective sheeting. Prevent the metal from coming in contact with greases, oils or other contaminants before the application of sheeting, films or inks.

(4) Application of Retroreflective Sheeting. Use either heat activated or pressure sensitive retroreflective sheeting of the color shown in the Contract Documents.

Apply the sheeting to the treated blanks and panels according to the manufacturer's recommendation, or by a method that will produce an equivalent result.

During fabrication of sign faces comprised of 2 or more pieces of retroreflective sheeting on reinforced panels, carefully match adjacent pieces of sheeting for color to provide uniform appearance and brilliance under both day and night illumination. Any apparent contrast between adjacent pieces of applied sheeting or panels is cause for rejection of the sign.

Overlap pressure sensitive sheeting a minimum of $^{3}/_{16}$ inch at splices. If heat activated sheeting is spliced, the minimum overlap is $^{3}/_{16}$ inch. If adjacent sheets of heat activated sheeting are butted together, the gap between adjacent sheets may not exceed $^{1}/_{32}$ inch.

On reinforced panel signs, vertical splices a minimum of 4 feet apart are permitted.

On flat sheet signs, 1 vertical or horizontal splice is permitted. Make horizontal lap splices with the uppermost piece overlapping the lower piece. Splicing is prohibited if the sign face is made using the reverse screen process.

(5) Sign Legend and Border Details. Provide sign legend and border that complies with the requirements specified in the Contract Documents.

Use capital letters and numbers that comply with the standard rounded capital letter alphabets in the latest edition of Standard Alphabets for Highway Signs. Use lower case letters that comply with the latest edition of Standard Lower Case Alphabet for Highway Signs. Use initial capital letters that are 1⅓ times the loop height of the lower case letters, from a modified series "E" alphabet in which the stroke width is increased to approximately $^{1}/_{5}$ of the height of the letter or number.

Make the sign face for flat sheet signs using one of these processes:

- Direct Screen: the legend and border color is applied to the face of the sign by the silkscreen process.
- Reverse Screen: a transparent color is applied to the face of the sign by the silkscreen process to form the legend and border.
- Direct Applied: the legend and border is retroreflective sheeting applied to the face of the sign by the appropriate methods.
- Digital Printing.

Use the Direct Applied process to make the sign face for reinforced panel signs.

(6) Application of Process Inks and Lettering Films. Use the color of film or ink to obtain the sign face, legend and border as shown in the Contract Documents.

Apply process inks to the sign faces according to the retroreflective sheeting manufacturer's recommendation, or by a method that will produce an equivalent result. Apply lettering films to the sign faces according to the lettering film manufacturer's recommendation, or by a method that will produce an equivalent result.

(7) Sign Identification. Install a clear or light colored, pressure sensitive decal with a printed (not handwritten) black legend on the back of each sign, including the following information:

Sign Number (by sign fabricator)
Erection Date (by sign installer) (month-day-year)*
*A punch-out-the-date option may be used.

Locate the legend horizontally, vertically or diagonally along the bottom or right edge of the sign in a position that is not covered up when the sign is installed.

On a sign with an area of less than 16 square feet, the legend shall be a minimum of ½ inch in height. On a sign with an area of 16 square feet or more, the legend shall be a minimum of 1 inch in height.

(8) Sign Overlays. Provide sign overlays that comply with the Contract Documents. Fabricate the sign overlays from flat sheet blanks covered with retroreflective sheeting. Prepare the flat sheet blanks and apply the retroreflective sheeting as specified for flat sheet signs. Apply the legend and border to the retroreflective sheeting as specified for the flat sheet sign.

(9) Delineators. Provide the types of delineators specified in the Contract Documents.

Fabricate delineators for steel post mount or bracket mount from flat sheet blanks covered with retroreflective sheeting. Prepare the flat sheet blanks and apply the retroreflective sheeting as specified for flat sheet signs.

(10) Object Markers. Provide the type of object markers specified in the Contract Documents.

Fabricate Type 1 object markers from 18-inch by 18-inch flat sheet blanks covered with yellow high performance retroreflective sheeting.

Fabricate Type 2 object markers from 6-inch by 12-inch flat sheet sign blanks covered with yellow high performance retroreflective sheeting.

Fabricate Type 3 object markers from 12-inch by 36-inch flat sheet blanks covered with yellow high performance retroreflective sheeting with black non-reflective hash marks as shown in the Contract Documents.

Prepare the flat sheet blanks and apply the retroreflective sheeting as specified for flat sheet signs.

(11) Fabrication of Sign Posts. The total length of posts shown in the Contract Documents is estimated. The number, type and size of posts shown in the Contract Documents are determined from theoretical sections. Do not order sign posts until the Engineer provides the length of each post for the sign or the sign assembly based on actual field measurements (**see subsection 812.3c.**).

Wood posts, steel "U" posts and perforated square steel tube posts may be ordered in stock lengths and cut to the required length in the field. Do not torch-cut steel posts. Drill breakaway holes in the wood posts at the project site. Treat all field cuts and drilled holes in wood posts with preservative material. Paint all cut ends of steel posts with zinc-rich paint.

Fabricate steel beam posts, base plates and fuse plates to the specified dimensions. Drill the specified holes in the posts and plates. The preferred method of cutting plates is sawcuts; however, flame-cutting is permitted. Grind all edges smooth and remove all burrs projecting beyond the planes of the plate faces, cuts or drilled holes.

After the base plates are galvanized, remove all runs or beads in the areas where washers are placed.

812.3 CONSTRUCTION REQUIREMENTS

a. General. Erect the permanent signing as necessary to expedite the completion of the project and the opening of the highway. The Engineer may require that the Contractor mobilize permanent signing operations whenever it is feasible to complete a portion of the project. The Contractor may have to mobilize and, upon completion of all currently feasible work, suspend the permanent signing operations more than once before the project is completed.

It is the Contractor's responsible to verify the utility locations.

If a temporary sign interferes with the installation of a permanent sign, remove and reset the temporary sign to a location designated by the Engineer.

b. Sign Location and Orientation. Locate and stake each sign installation according to the Contract Documents. Orient the signs in relation to the highway alignment as shown in the Contract Documents.

If the Contract does not include the item of Contractor Construction Staking, the Engineer will stake the location of each sign.

c. Sign Post Lengths. The Engineer will provide the Contractor with the length of each sign post.

If the contract includes Contractor Construction Staking, provide the Engineer with the information necessary to determine the length of each sign post. Provide the Engineer with the vertical and horizontal measurements from the top of the pavement edge to:

- the ground line (for posts with no footings)
- the top of the footing (for posts with footings)
- the top of the stub post base plate (for steel beam breakaway posts)

If the Contract does not include the item of Contractor Construction Staking, the Engineer will obtain the measurements necessary to determine the length of each sign post.

d. Sign Post Installation.

(1) Footings.

(a) Post Holes for Wood Posts. Excavate the post holes to the shape and dimensions shown in the Contact Documents. Prevent water from entering the excavated holes.

(b) Concrete Footings for Wood Posts and Steel Beam Stub Posts. Excavate the footings to the shape and dimensions shown in the Contract Documents. Remove all non-compacted material from the excavation. Form the top 12 inches of the footings. Place the reinforcing steel and post sleeves or stub posts in the footings as shown in the Contract Documents. Vibrate the concrete placed in the footings and finish the footings as detailed in the Contract Documents. Backfill the footings as detailed in the Contract Documents, placing the backfill soil in uniform layers (maximum layer of 8 inches, loose measurement), and compact each layer until no further consolidation is observed.

(c) Perforated Square Steel Tube Post Footings. Install the perforated square steel tube post footings plumb as shown in the Contract Documents. Do not damage the galvanized coating during installation or alter the cross-sectional dimensions of the perforated square steel tubes. Remove and replace any footing damaged during the perforated square steel tube installation.

(d) Expanded Foam Foundations. When a concrete footing is not specified, expanded foam foundations may be used on Sign Post (4" x 6"), Sign Post (4" x 6" Wood) (*****[2]), and Sign Post (*****[5] Perforated Square Steel Tube). The post hole must be dry or damp with no standing water. Install the foam foundation and post according to the manufacturer’s instructions.

Do not substitute a concrete footing with expanded foam.

(2) Post Installation. Install the posts as shown in the Contract Documents. Plumb the sign posts as they are installed. The maximum allowable tolerance from vertical is 1 inch (from the top of the post to the ground line).

(a) Wood Posts in Soil. Place the posts in the post holes, plumb the posts and backfill with the soil from the post hole excavation in uniform layers (maximum layer of 8 inches, loose measurement) around the posts, and compact each layer to the original ground line until no further consolidation is observed. After backfilling, drill breakaway holes in the posts as shown in the Contract Documents. Treat the breakaway holes with preservative materials.

(b) Wood Posts in Concrete Footings. After curing, place the posts into the post sleeves, plumb the posts, secure the posts with wedges and seal the gaps between the posts and the post sleeves with asphalt material. Drill breakaway holes in the posts as shown in the Contract Documents after the posts are secured. Treat all field cuts and drilled holes in wood posts with materials for preservative treatment.

(c) Steel Beam Breakaway Posts. After curing, place the steel beam post with base plate onto the stub post base plate, plumb the post and tighten the base plate bolt assemblies as detailed in the Contract Documents. Attach the structural tubing to the steel posts.

(d) Perforated Square Steel Tube Posts. Install and attach the perforated square steel posts in the footings as detailed in the Contract Documents.

(e) Steel "U" Posts. Install the posts by driving. Do not alter the cross-sectional dimensions of the posts or damage the coating during installation. Remove and replace damaged posts.

(f) Assemble the sign post square couplers according to the manufacturer’s instructions.

e. Sign Installation. Mount the signs as shown in the Contract Documents. Position the signs so the sign face is vertical. If required for installation, drill the holes in the fabricated signs from the sign face sheeting side.

After the sign is installed, the post shall be plumb and secure in the ground.

Repair damaged retroreflective sheeting on the sign faces. Use pressure sensitive retroreflective sheeting to patch the damaged areas, overlapping the damages area a minimum of ¼ inch. Match the retroreflective sheeting patch to the adjacent pieces of sheeting for color and uniform appearance and brilliance under both day and night illumination. Repair damaged galvanized areas on posts and structural members by cleaning and painting with zinc-rich paint.

f. Delineators and Object Markers. Install delineators and object markers as shown in the Contract Documents.

g. Remove and Reset Existing Signs. Remove, transport, store and reset existing signs according to the details in the Contract Documents. Provide new bolts, nuts, washers, post clips and other attachments as necessary to reset the existing signs. When directed by the Engineer, repair or replace all existing signs damaged during the removal and resetting operations at own expense.

812.4 MEASUREMENT AND PAYMENT

The Engineer will measure the finished face of flat sheet signs, reinforced panel signs and sign overlays by the square foot.

The Engineer will measure wood posts, steel beam posts, "U" steel posts, perforated square steel tube posts, structural steel posts, aluminum posts and concrete footings by the linear foot. If the alternate grade of steel beam posts is provided, the measurement is based on the primary grade steel size and weight posts.

The Engineer will measure various sizes and types of each sign stub post with breakaway base plate, sign post breakaway base plate, perforated square steel tube sign post footing, object marker and delineator.

The Engineer will measure removal and resetting of existing sign by the lump sum.

The Engineer will measure each barricade, sign post square coupler and sign post coupler footing.

Payment for the various permanent signing bid items at the contract unit prices is full compensation for the specified work.

SECTION 813

RUMBLE STRIPS (MILLED)

813.1 DESCRIPTION

Construct milled rumble strips in the existing surface by milling concave depressions into the surfaces as shown in the Contract Documents.

BID ITEMS	UNITS
Rumble Strips (Milled) (*)	Station
Rumble Strips (Milled) (*) (Centerline)	Station
Rumble Strips (Milled) (*) (Edgeline)	Station
*Asphalt or Concrete	

813.2 MATERIALS - None specified.

813.3 CONSTRUCTION REQUIREMENTS

a. General. Use equipment capable of milling the concave depressions with a smooth cut to the dimensions shown in the Contract Documents. Use equipment with the milling head suspended independently from the machine, and that will self-align (parallel to the shoulder surface) with the surface of the paved shoulder regardless of the shoulder slope. Mill the concave depression to obtain a relatively smooth surface, with a maximum tolerance of ⅛ inch between peaks and valleys.

Before beginning work on the project, demonstrate to the Engineer, the ability to achieve the specified rumble strip depressions with regard to dimensions, alignment, smoothness and consistency. Construct a test strip approximately 75 feet longitudinally, at a site mutually agreed upon between the Engineer and Contractor, to demonstrate compliance with the requirements.

Provide adequate guide marks (approximately 2 inches by 12 inches at approximately 30 to 50-foot intervals) for milling the rumble strips.

b. Rumble Strips (Milled). Clean the shoulders before constructing the rumble strips. Mill the concave depression to the dimension shown in the Contract Documents. Align the concave depressions as shown in the Contract Documents.

c. Rumble Strips (Milled) (Centerline). Clean the centerlines before constructing the rumble strips. Mill the concave depression to the dimension shown in the Contract Documents. Align the concave depressions as shown in the Contract Documents.

d. Rumble Strips (Milled) (Edgeline). Clean the edgelines before constructing the rumble strips. Mill the concave depression to the dimension shown in the Contract Documents. Align the concave depressions as shown in the Contract Documents.

e. Clean Up. After the concave depressions are milled into the surface, use a power broom or sweeper/vacuum to collect the waste material resulting from the milling operations. Unless specified otherwise in the Contract Documents, uniformly spread the waste material just off the edge of the paved surface.

813.4 MEASUREMENT AND PAYMENT

The Engineer will measure rumble strips by the station for each shoulder longitudinally along the edge of the pavement.

The Engineer will measure centerline rumble strips by the station longitudinally along the centerline of the pavement.

The Engineer will measure rumble strips by the station for each edgeline longitudinally along the edge of the pavement.

The Engineer will not measure bridge decks, acceleration/deceleration lanes and other sections where rumble strips are not constructed.

Payment for "Rumble Strips (Milled)", "Rumble Strips (Milled) (Centerline)" and "Rumble Strips (Milled) (Edgeline)" at the contract unit price is full compensation for the specified work.

SECTION 814

ELECTRIC LIGHTING SYSTEMS AND TRAFFIC SIGNALS

814.1 DESCRIPTION

Install electric lighting systems and traffic signal items as shown in the Contract Documents.

BID ITEMS	UNITS
Electric Lighting System	Lump Sum
Electric Conduit (*) (**)	Linear Foot
Electric Service Box	Each
Traffic Signal	Lump Sum
Traffic Signal Interconnect	Lump Sum
Emergency Vehicle System	Lump Sum
Loop Detector Replacement	Linear Foot
Loop Detector Replacement (Set Price)	Linear Foot

*Size

**Type: Metallic or Non-metallic, no entry denotes either is allowed.

814.2 MATERIALS

a. General. Provide equipment and materials for electric lighting system and traffic signal items that comply with **DIVISION 1700**. Provide all parts necessary to complete the electric lighting system or traffic signal or modify existing systems. Before starting any construction activities, submit for the Engineer's approval, a schedule of all equipment and materials for the highway lighting system or traffic signal. Submit 7 copies of catalog cuts, diagrams and drawings to the Bureau of Transportation Safety and Technology. The Engineer will accept or reject the equipment or materials within 2 weeks.

For concrete foundations, use Grade 3.0 concrete that complies with **SECTIONS 401, 402** and **1102**, and steel reinforcement that complies with **DIVISION 1600**, unless shown otherwise in the Contract Documents.

b. Standard Fabrication. Fabricate the standards as shown in the Contract Documents.

Provide straight standards with a maximum variation of 1 inch at the mid-point of 30 to 45-foot standards and ¾ inch at the mid-point of 20 to 30-foot standards. A maximum static deflection (without wind load) of 4 inches is permitted for poles less than 30 feet in height and 4 ½ inches for poles 30 feet or greater in height. Measure static deflections with mast arms and luminaries in place.

The design of the standard, the mast arm and method of attaching the mast arm to the standard must be approved by the Engineer.

c. Loop Detector Replacement. Provide materials that comply with the specifications of the loop detector owner. The information necessary to contact the owner is shown in the Contract Documents.

The Engineer will accept the materials based on catalog cuts and visual inspection.

d. Loop Detector Replacement (Set Price). If the Contract Documents do not designate loop detector replacement, the Engineer may approve the addition of loop detector replacements at the set price. The Contract Documents may designate loop detector replacements at the set price.

Provide materials that comply with the specifications of the loop detector owner. The information necessary to contact the owner is shown in the Contract Documents.

The Engineer will accept the materials based on catalog cuts and visual inspection.

814.3 CONSTRUCTION REQUIREMENTS

a. Codes and Regulations. Perform all electrical work according to:

- National Electric Code.
- National Electric Safety Code.
- Regulations of the National Board of Fire Underwriters.

- Rural Utility Service (RUS)
- Illumination Engineers Society (IES)
- Standards of the American Society for Testing and Materials (ASTM)
- American Accommodation Policy
- Local ordinances.
- Details in the Contract Documents.

Before starting any work on existing street lighting and circuits, obtain daily safety circuit clearance from the serving company. Before beginning work, pull cut-out plugs and warning signs posted at cut-out boxes.

b. General.

(1) Provide and install all incidental parts not shown in the Contract Documents which are necessary to complete the electrical system or traffic signal or modify existing systems as shown in the Contract Documents. All utility hookups are subsidiary, unless shown otherwise in the Contract Documents.

(2) Provide continuous welds that develop the full strength of the member.

(3) Perform welds by the submerged arc process.

(4) Grind exposed welds flush with the base material.

(5) Smoothly finish all exposed edges of plates which make up the base assembly. Round all exposed corners of such plates to ⅛ inch radius.

c. Removals and Excavations. Perform removals of existing structures and excavations to minimize damage to existing structures and right-of-way.

Remove the existing concrete foundations (including anchor bolts) to the elevation shown in the Contract Documents.

Limit the excavation for the conduits, foundations and other appliances to that necessary for the installation of the equipment and materials. Do not excavate until immediately before installing the equipment and materials.

Place plastic warning tape (12 inches below the surface) directly over conduit.

Place excavated material where no damage and obstruction to vehicles and pedestrian traffic will occur. Do not impede surface drainage.

At the end of each day's work and at all times when construction operations are suspended, remove all equipment and other obstructions from the portion of the roadway open for use by public traffic.

d. Backfill. Place the backfill material in uniform layers (maximum 6 inches compacted) evenly on all sides of the structure. Compact the backfill using pneumatic tampers, vibratory compactors or other equipment approved by the Engineer. Compact the backfill to comply with the Contract Documents. If backfill requirements are not specified, compact each layer until no further consolidation is observed.

Remove surplus excavated material from the project and dispose on sites approved by the Engineer. Reseed the areas disturbed by the excavations. Hand seeding methods may be used.

e. Replacing Damaged Improvements. Replace all sidewalks, curbs, gutters, pavements and other improvements removed or damaged during installations of the lighting systems or traffic signals. Replace or reconstruct the removed or damaged improvements with the same type and quality of materials originally used. If part of an existing slab of concrete pavement or square of sidewalk is removed or damaged, replace the entire slab or square.

f. Foundations.

(1) Concrete Foundations. Form the foundations and place the concrete according to **DIVISION 700**. Hold conduit ends and anchor bolts securely in the proper position when the concrete is placed.

Cure the concrete foundations with wet burlap or polyethylene for a period of 72 hours. Prevent concrete temperatures from falling below 32ºF.

Do not attach poles until the concrete has cured for 14 days.

If a foundation can not be constructed as shown in the Contract Documents because of an obstruction, the Engineer will determine how to construct the foundation.

(2) Screw-In Foundation Anchors. Pre-drilling holes for screw-in foundation anchors is prohibited. As the foundation anchors are screwed into the ground, make sure they are plumb. The pole base of the screw-in foundation anchor shall be level when the installation is complete.

Use the connectors to make minor leveling adjustments on poles with breakaway connectors. Use galvanized or cadmium plated shims or washers (maximum thickness ¼ inch) to make minor leveling adjustments on other types of poles. Only 1 shim or washer is allowed on any 1 anchor bolt, with a maximum of 2 shims or washers on any pole.

(3) Removal of Existing Foundations. Remove the designated existing foundations to the depth shown in the Contract Documents. Backfill the resulting holes according to **DIVISION 200**. Dispose of the removed foundations and anchor bolts.

g. Conduit.

(1) Run all conductors between standard locations, either in duct or conduit. Use conduit of the size and type shown in the Contract Documents. If desired, use larger size conduit at no additional cost to KDOT. Use the large size conduit for the entire length of the run from outlet to outlet. Do not use reducing couplings.

When PVC or HDPE is specified, install according to the manufacturer's instructions.

When steel conduit is used, ream the ends of all conduits to remove burrs and rough edges. Make field cuts square and true so the ends will match for the full diameter. Do not use slip joints or running threads for coupling conduit. Use an approved threaded union conduit, if a standard coupling can not be used. Before couplings are made up, paint threads on all conduits with a rust preventative paint. Fit and tighten all couplings until the end of the conduits are brought together. Paint any damaged coating on conduit with rust preventative paint.

Thread and cap all steel conduit ends with standard pipe caps, until wiring is started. When caps are removed, provide threaded ends with approved conduit bushings.

Except factory bends, use conduit bends with a radius of greater than or equal to 6 times the inside diameter of the conduit. Where factory bends are not used, make conduit bends without crimping or flattening, using the longest radius practicable.

Mark the location ends of all conduit for future electrical circuits in structures with a "Y" a minimum of 3 inches high cut in the face of curb, gutter or wall directly above the conduit.

(2) Conduit Entrenched. On electric lighting projects where possible, and on surfacing projects as shown in Contract Documents, install the electrical conduit on straight lines and cover with compacted earth.

Place conduit as shown in the Contract Documents.

(3) Conduit Jacked. Use **TABLE 814-1** to determine the conduit depth. Place conduit under existing pavement by approved jacking or drilling methods. Do not disturb pavement without written permission of the Engineer. Keep jacking or drilling pits 2 feet clear of the edge of any type of pavement.

TABLE 814-1: JACKED CONDUIT DEPTH

Location Condition	Minimum Depth
Pavement	36 inches below top of pavement.
Trenches on shoulder and in park areas	36 inches below natural ground level.
Finished surface in street areas	36 inches below the street surface.*
Railroad tracks	42 inches below top of tie.

*Conduit may be laid on top of and secured to the existing pavement in curbed dividing strips.

(4) Vertically extend conduit set in standard bases approximately 3 inches above the foundation, or slope towards the base opening where transformer bases are used. Locate conduit entering through the bottom of a pull box near the ends to leave the major portion of the box clear. Terminate conduit entering concrete pull boxes 2 inches inside the box wall and 2 inches or greater above the bottom and slope to facilitate pulling of cable. At all outlets, enter the conduit from the direction of the run.

For conduit carried through existing culverts or bridge structures, pick up the trenched cable for 3 feet in the ground and run up the face of the culvert headwall to the nearest upper corner or top, through the culvert, down the opposite headwall and into the ground for 3 feet. Fasten conduit to concrete surfaces by means of approved clamps and fasteners.

Clean existing underground conduit to be incorporated into a new system with a mandrel, and blow out with compressed air.

Conduit runs shown in the Contract Documents may be changed with approval of the Engineer to avoid underground obstructions.

h. Electric Service Boxes. Install electric service boxes as shown in the Contract Documents.

i. Pull Boxes. Install pull boxes as shown in the Contract Documents. To facilitate work, additional pull boxes may be used at the Contractor's expense.

j. Expansion Fittings. Install expansion fittings as shown in the Contract Documents, where conduit crosses an expansion joint in the structure. Provide each expansion fitting with a bonding jumper of No. 6 A.W.G. copper wire or equal.

k. Wiring. Neatly arrange and lace up wiring within junction boxes, transformer bases and on standards, etc.

Do not splice cable in conduit or outside of pull boxes, splice boxes or standards, unless shown in the Contract Documents. When not fastened to existing structure or carried through conduit, lay conductor cable to the depth shown in the Contract Documents.

Use powdered soapstone, talc or other approved lubricant when inserting conductors in conduit.

Pencil, trim to conical shape and roughen conductor insulation before applying splice insulation.

When conductors and cables are pulled into the conduit, tape all ends to exclude moisture until the splices are made or terminal appliances are attached.

l. Bonding and Grounding. When a closed system enclosed in conduit is used, bond metallic cable sheaths, conduit and metal standards to form a continuous system, and effectively ground. When an open system such as an overhead wiring or direct burial underground is used, effectively ground only standards and service points, except where conduit runs used under pavement cross a water system.

Install ground electrodes as shown in the Contract Documents.

m. Traffic Signal Interconnect. Install traffic signal interconnects as shown in the Contract Documents.

n. Emergency Vehicle System. Install emergency vehicle systems as shown in the Contract Documents.

o. Operating Instructions. Provide all operating instructions to the Engineer.

p. Loop Detector Replacement. Install loop detectors as shown in the Contract Documents and as specified by the owner.

814.4 MEASUREMENT AND PAYMENT

If shown as a bid item in the contract, the Engineer will measure electrical conduit by the linear foot from the outside edge to outside edge of service boxes, junction boxes or traffic light footings.

Excavation, removal, backfilling and Grade 3.0 concrete are subsidiary.

The Engineer will measure electric lighting systems, traffic signal installations, emergency vehicle systems and traffic signal interconnects by the lump sum.

The Engineer will measure each electric service box.

The Engineer will measure the loop detector replacements by the linear foot of saw cut required for the installation.

Payment for "Electric Lighting System", "Electric Conduit", "Electric Service Box", "Traffic Signal", "Traffic Signal Interconnect", "Emergency Vehicle System" and "Loop Detector Replacement" at the contract unit prices and "Loop Detector Replacement (Set Price)" at the set price is full compensation for specified work.

SECTION 815

CATCH BASINS, INLETS, OUTLETS, MANHOLES, JUNCTION BOXES AND OTHER EXISTING STRUCTURES

815.1 DESCRIPTION

Install catch basins, inlet, outlets, manholes and junction boxes as shown in the Contract Documents.

BID ITEMS	UNITS
Catch Basin*	Each
Inlet*	Each
Outlet*	Each
Manhole*	Each
Junction Box	Each
*Type	

815.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete and Mortar	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTION 1102**
Reinforcing Steel	**DIVISION 1600**
Gray Iron Castings	**DIVISION 1600**
Steel Castings	**DIVISION 1600**
Structural Steel	**DIVISION 1600**
Brick	**DIVISION 1300**
Manhole Steps	**DIVISION 1700**

815.3 CONSTRUCTION REQUIREMENTS

a. Excavation. Comply with **SECTION 204**.

b. Concrete. Comply with **DIVISION 700** for concrete form work, placing, curing and protection. Use Grade 3.0 concrete, unless shown otherwise in the Contract Documents.

c. Masonry. If shown in the Contract Documents, brick masonry or concrete masonry units may be used in place of concrete for the walls of catch basins, manholes or curb inlets. Masonry manholes may be constructed circular with an inside diameter equal to the greater of the inside dimensions indicated in the Contract Documents for the concrete manhole.

When masonry is used in place of concrete for square or rectangular structures, use the inside dimensions of the structure shown in the Contract Documents.

Use mortar for masonry as specified in **DIVISION 400**. Lay the brick or concrete masonry units with full mortared joints and with sufficient header courses to tie the masonry together properly.

d. Reinforcement. Comply with **DIVISION 700**.

e. Placing Castings. Set castings in full mortar beds or as shown in the Contract Documents. Mix mortar for setting castings as specified in **DIVISION 400**. Set castings to correct elevation so no adjustment is required.

f. Backfilling. Comply with **SECTION 204**.

g. Cleaning. Clean all catch basins, manholes, inlets, outlets, etc. from any accumulation of silt and debris.

h. Painting. Paint structural steel cover plates with 1 shop coat of an approved primer, 1 field coat of aluminum paint (tinted) and 1 field coat of aluminum paint. Perform painting as specified in **SECTION 714**. Painting of castings is not required unless shown in the Contract Documents.

i. Pre-Cast Units. Use pre-cast units when shown in the Contract Documents. If the Contract Documents do not contain fabrication details for the pre-cast unit, submit 6 copies of shop drawings (**SECTION 105**) to the Engineer for approval.

815.4 MEASUREMENT AND PAYMENT

The Engineer will measure each catch basin, inlet, outlet manhole and junction box.

Masonry and pre-cast units will not be measured or paid for as a separate item but will be paid for as the completed unit as provided above.

Payment for "Catch Basins", "Inlets", "Outlets", "Manholes" and "Junction Boxes" at the contract unit prices is full compensation for the specified work; however the unit bid price will be adjusted according **TABLE 815-1** for increases and decreases in the height indicated in the Contract Documents.

TABLE 815-1: CHANGE IN HEIGHT PAYMENT ADJUSTMENTS

Change in Height (feet)	Increment of Increases or Decreases in Unit Bid Price	Total Increase or Decrease
0 to 0.49	None	None
0.50 to 1.00	7.5%	7.5%
1.01 to 2.00	10.0%	17.5%
2.01 to 3.00	12.5%	30.0%

For change in height of more than 3.00 feet, the increment of increase or decrease is 15% for each foot or fraction over 3.00 feet.

OSHA requires different construction procedures and safety requirements when excavated depths reach 5.0 feet or greater. In consideration of this, if a plan height of less than 5.0 feet is adjusted to a height of 5.0 feet or greater, or a plan height of 5.0 feet or greater is adjusted to a height of less than 5.0 feet, an additional 25% of the unit price will be added or deducted from the bid price. This is in addition to normal correction applied from the **TABLE 815-1**.

SECTION 816

ADJUSTMENT OF INLETS, MANHOLES AND OTHER EXISTING STRUCTURES

816.1 DESCRIPTION

Adjust inlets, manholes and other existing structures as shown in the Contract Documents.

BID ITEMS	UNITS
Adjustment of Catch Basins	Each
Adjustment of Curb Inlets	Each
Adjustment of Manholes	Each
Adjustment of Manholes (Set Price)	Each
Structural Steel	Pound
Cast Steel	Pound
Cast Iron	Pound
Adjustment of Meter Box (*)	Each
Adjustment of Valve Box (*)	Each
Adjustment of Existing Structures	Lump Sum

* Type

816.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete and Mortar	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTION 1102**
Reinforcing Steel	**DIVISION 1600**
Gray Iron Castings	**DIVISION 1600**
Steel Castings	**DIVISION 1600**
Structural Steel	**DIVISION 1600**
Brick	**DIVISION 1300**
Existing Structures	**DIVISIONS 1000-2500**

816.3 CONSTRUCTION REQUIREMENTS

Carefully remove and reinstall or store structural steel or cast fixtures for future use by the owners as shown in the Contract Documents. If the height of brick walls is increased, the addition may be of brick, masonry units or Grade 3.0 concrete, unless shown otherwise in the Contract Documents. Masonry brick salvaged from the project and in good condition may be used to increase the height of the walls. If no bricks are salvaged, provide new brick or concrete blocks. Place masonry, concrete and castings according to **DIVISION 800**.

Adjust existing manholes by raising the frame to the desired grade using adjustable metal extension rings. Use adjusting rings of an approved type and rigidly secure to the existing frame by approved methods. Make the adjustment at any one location by using a maximum of 2 adjustment rings.

Salvage existing manhole covers and reuse in the adjustment.

Use methods for the adjustment of meter or valve boxes according to the requirements of the utility company involved.

Adjust existing structures as shown in the Contract Documents. If the existing structure is damaged during the adjustment operations, replace any damaged materials with new materials matching the originals.

816.4 MEASUREMENT AND PAYMENT

The Engineer will measure each adjustment of catch basin, inlet, manhole, meter box and valve box.

The Engineer will measure structural steel, cast steel and cast iron by the pound as provided in **DIVISION 700**.

The Engineer will measure the adjustment of existing structures by the lump sum.

Payment for "Adjustment of Catch Basins", "Adjustment of Curb Inlets", "Adjustment of Manholes", "Structural Steel", "Cast Steel", "Cast Iron" "Adjustment of Meter Box (*)", "Adjustment of Valve Box (*)" and "Adjustment of Existing Structures" at the contract unit prices and "Adjustment of Manholes" at the contract set price is full compensation for the specified work.

817 - PIPE CULVERTS, EROSION PIPE, STORM SEWERS, SANITARY SEWERS & END SECTIONS

SECTION 817

PIPE CULVERTS, EROSION PIPE, STORM SEWERS, SANITARY SEWERS AND END SECTIONS

817.1 DESCRIPTION

Install the size and type of pipe culvert, erosion pipe, storm sewer, sanitary sewer, end section and concrete headwall specified in the Contract Documents.

Provide materials for, and construct the sanitary sewer system as shown in the Contract Documents.

BID ITEMS	UNITS
Entrance Pipe (*) (**) (+) (++) (^) (^^)	Linear Foot
Cross Road Pipe (*) (**) (+) (++) (^) (^^)	Linear Foot
Erosion Pipe (*) (**) (+) (++) (^) (^^)	Linear Foot
Storm Sewer (*) (**) (^) (^^)	Linear Foot
Sanitary Sewer (*) (**)	Linear Foot
End Section (*) (**) (+) (++)	Each
Concrete Headwall	Each
Fly Ash Slurry Grout (xx)	Cubic Yard
Sanitary Sewer System	Lump Sum

*Size
**Type
+Provide Only
++Install Only
xx High Strength or Low Strength
^BC-Bituminous Coated
^^FP-Fully Paved

TYPES OF PIPES

RCP - Round Reinforced Concrete Pipe
RCPA - Reinforced Concrete Pipe-Arch
RCPHE - Reinforced Concrete Pipe Horizontal Elliptical
CSP - Galvanized Round Corrugated Steel Pipe
CSMAC - Galvanized Corrugated Steel - Metal Arch Culvert
ACSP - Aluminized (Type 2) Round Corrugated Steel Pipe
ACSMAC - Aluminized (Type 2) Corrugated Steel - Metal Arch Culvert
CAP - Round Corrugated Aluminum Pipe
CAMAC - Corrugated Aluminum - Metal Arch Culvert
PEP - Polyethylene Pipe
CIP - Cast Iron Pipe
CIPP - Cast Iron Pressure Pipe
CISP - Cast Iron Soil Pipe
PVCP - Polyvinyl Chloride Pipe

TYPES OF END SECTIONS

RC - Round Reinforced Concrete
RCA - Reinforced Concrete Arch
RCHE - Reinforced Concrete Horizontal Elliptical
CS - Galvanized Round Corrugated Steel
CSMA - Galvanized Corrugated Steel - Metal Arch
ACS - Aluminized Corrugated Steel
CA - Round Corrugated Aluminum
ACSMA - Aluminized (Type 2) Corrugated Steel - Metal Arch
CAMA - Corrugated Aluminum - Metal Arch

SIZE DESIGNATIONS FOR ARCH CULVERTS AND HORIZONTAL ELLIPTICAL CULVERTS

Bid item size designations for arch culverts and horizontal elliptical culverts are based on minimum waterway requirements, **TABLE 817-1**. Unless shown otherwise in the Contract Documents, provide CSMAC, ACSMAC, CAMAC, RCPA or RCPHE.

TABLE 817-1: MINIMUM WATERWAY REQUIREMENTS FOR ARCH CULVERTS AND HORIZONTAL ELLIPTICAL CULVERTS

Bid Item Size Designation (minimum Sq. Ft. area of waterway)	CSMAC/ACSMAC/ CAMAC (Sq. Ft. area of waterway)	RCPHE (Sq. Ft. area of waterway)	RCPA (Sq. Ft. area of waterway)
1.0	1.1	1.8	1.7
1.5	1.6	1.8	1.7
2.0	2.2	3.3	2.2
2.5	2.9	3.3	2.8
3.0	4.5	3.3	4.4
4.0	4.5	4.1	4.4
5.0	6.5	5.1	6.4
6.0	6.5	6.3	6.4
7.0	8.9	7.4	8.8
8.5	8.9	8.8	8.8
10.0	11.6/11.7	10.2	11.4
11.0	11.6/11.7	12.9	11.4
12.5	14.7/15.6	12.9	14.3
14.0	14.7/15.6	16.6	14.3
16.5	18.1/19.3	16.6	17.7

a. Pipe Culverts, Erosion Pipe, Storm Sewer and End Sections. Provide the type of pipe specified in the Contract Documents. If the type of pipe and end section is not specified in the proposal or the plans, provide any of the types permitted in **TABLE 1901-1: USES OF PIPES**. Use the same type of pipe base metal (steel) throughout any individual run, installation of pipe or for pipe extensions. Provide end sections of the same type as the pipe, except as follows:

- Provide CS, ACS, CA or RC with PEP or PVCP.

b. Sanitary Sewer. Use cast iron pipe of the bell and spigot type.

c. Reinforced Concrete Box Storm Sewer. Construct reinforced concrete box storm sewer in place as shown in the Contract Documents according to **DIVISION 700**.

817.2 MATERIALS

Provide materials that comply with the applicable requirements.

Pipes, Fittings and End Sections .... **DIVISION 1900**
Steel Encasement Pipe .... **DIVISION 1600**
Concrete and Fly Ash Slurry Grout .... **SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade .... **SECTION 1102**
Portland Cement .... **DIVISION 2000**
Water .... **DIVISION 2400**
Coarse, Fine and Mixed Aggregates .... **DIVISION 1100**
Reinforcing Steel .... **DIVISION 1600**
Plastic Joint Compound .... **DIVISION 1500**
Material for Sealing Joints in Pipes .... **DIVISION 1500**
Factory Molded Joints .... **DIVISION 1500**
Flowable Fill .... **SECTION 843**

Provide materials for the sanitary sewer system as shown in the Contract Documents.

The Engineer will accept the materials for the sanitary sewer system based on catalog cuts, product data (including general bulletins), materials of construction, manufacturer's certifications or affidavits of compliance with specified standards, and visual inspection for compliance with dimensional and other requirements detailed in the Contract Documents.

817.3 CONSTRUCTION REQUIREMENTS

a. General. If PEP or PVCP pipe is used, prior to the pre-construction conference, submit for evaluation by the Engineer, a résumé of experience installing PEP or PVCP. A representative of the manufacturer of PEP or PVCP must attend the pre-construction conference for all projects where the Contractor has minimal or no experience with PEP or PVCP installation, or if no résumé is submitted.

If "Provide Only" is specified, provide and deliver the pipe, coupling bands and end sections to the storage location shown in the Contract Documents.

If "Install Only" is specified, KDOT will provide the pipe, coupling bands and end sections. The location of the materials is shown in the Contract Documents.

If neither "Provide Only" or "Install Only" is designated, provide and install the pipe, coupling band and end sections as shown in the Contract Documents.

Use Grade 3.0 concrete to construct headwalls for erosion pipe. Perform formwork, placing, curing and protection of concrete according to **DIVISION 700**.

If aluminum pipe or aluminized corrugated steel pipe is to come in contact with fresh portland cement concrete or grout, completely cover the contact area of the pipe with an asphaltic paint (approved by the Field Engineer) to prevent corrosion.

b. Excavation.

(1) General. Beginning at the outlet end and proceeding toward the upper end, excavate the bottom of the channel to the line, grade and elevation shown in the Contract Documents. Construct the width of the trench sufficient to lay and backfill the pipe with a minimum width equal to the diameter of the pipe plus 6 inches on each side.

Follow OSHA safety regulations for sloping the sides of excavations. Use shoring and bracing as required.

Do not disturb any railroad, existing street or highway, when tunneling underneath is required (See **SECTION 819** for tunneling, jacking or boring requirements). Methods of tunneling are subject to Engineer approval.

When it is required to remove an existing street or highway surface in constructing the pipe or sewer, replace the surface with an equivalent material at Contractor's expense, unless otherwise shown in the Contract Documents.

Firm the foundation in the trench to prevent subsequent settlement. Remove soft, unstable materials and replace with suitable materials. If the foundation is on firm earth, pare or mold the earth to give full support to each pipe for a depth a minimum of ¼ the external diameter of the pipe. When bell and spigot pipe is used, cut notches to receive the bell.

The Contractor may undercut the trench and backfill with sand or other suitable material to obtain proper, uniform bearing of the pipe at no additional cost to KDOT.

If rock is encountered, remove the rock to an elevation 12 inches below the elevation shown in the Contract Documents for the bottom of the channel. If blasting is used to remove rock, take the precautions to protect the previously placed portions of the structure. Backfill and compact the bottom 12 inches of the excavation with soil from the roadway excavation. If the foundation is in rock, place an equalizing bed a minimum of 6 inches thick of well-compacted sand or similar material upon the rock.

When shown in the Contract Documents, or ordered in writing by the Engineer, place a concrete cradle or encasement under or around the pipe to provide a suitable foundation for the pipe. Use the dimensions and grade of concrete as shown in the Contract Documents, or as directed by the Engineer.

(2) Pipes and Culverts 3 feet or less in diameter. While excavating, use a template to shape the bottom of the channel so that at least 10% of the overall height of the pipe or culvert is in contact with the bottom of the channel. Excavate recesses into the channel to accept all protrusions from the perimeter of the pipe or culvert.

Alternate methods of bedding the pipe or culvert:

- Place a bed of granular material (4 inch minimum thickness) on the bottom of the channel, and then use a template to shape the granular material to accept the culvert.
- Place the pipe or culvert on the bottom of the channel, then place and tamp granular material (4 inch minimum thickness) under the haunch area of the pipe or culvert.

(3) Pipes and Culverts greater than 3 feet in diameter. Excavate recesses into the channel to accept all protrusions from the perimeter of the pipe or culvert. After the pipe or culvert is placed on the bottom of the channel, place and tamp granular material under the haunch area of the pipe or culvert so that 20% of the overall height of the pipe or culvert is bedded in the granular material.

An alternate method of bedding the pipe or culvert is to place and compact a bed of granular material (approximately half the total quantity needed) on the bottom of the channel, then use a template to shape the granular material to accept the pipe or culvert. Place and tamp the remainder of the granular material after the pipe or culvert is placed so that 20% of the overall height of the pipe or culvert is bedded in the granular material.

(4) Polyethylene (PEP) and Polyvinyl Chloride (PVCP) Pipe. Excavate and form a bed for PEP and PVCP according to **subsections 817.3b.(1)** thru **(3)** and the following additions and exceptions:

- The minimum trench width = (1 ½ x pipe diameter) + 12 inches.
- The space between the pipe and the trench wall shall be wider than the compaction equipment used in the pipe zone.
- The trench width in unsupported, unstable soils will depend on the size of the pipe, the stiffness of the backfill and insitu soil, and the depth of cover.
- Place a 6 inch (minimum) equalizing bed of pipe backfill (PB) upon the foundation as specified in **SECTION 1107**.

c. Laying. Do not lay pipe until the Engineer approves the foundation bed.

(1) General. When placing 2 or more pipe culverts adjacent to each other, separate the pipe culverts by a distance equal to a minimum of ½ the diameter of the pipe. The minimum distance for pipe culverts is 18 inches, and the minimum distance for metal arch culverts is 24 inches.

Before installing corrugated steel pipe, repair any damage to the metallic coating on the pipe. Clean the damaged area to bright metal by blast cleaning, power disk sanding or wire brushing. Apply zinc-rich paint over the cleaned area. Use zinc-rich paint to repair both aluminized and galvanized coatings.

Before installing asphalt coated pipe, repair any damage to the asphalt coating on the pipe. Use material that is compatible with the original asphalt coating. The repaired area shall have the same thickness as the original asphalt coating. For erosion pipe, weld any bends or angles prior to applying the asphalt coating.

In finished trenches, start laying pipe at the outlet end so the spigot ends (when bell and spigot pipe is used) point to the direction of flow. Install all pipes true to line and grade, with ends abutting. When using multiple sections of pipe in an individual run, place the longest section at the upstream end, the next longest section at the outlet end, and shorter sections in the middle of the run. When installing spiral, corrugated pipe, rotate the sections during installation so that the corrugations on the end of one section match those on the end of the adjoining section. Lay pipe in the bed so the lower portion of each pipe is supported for its entire length to a depth a minimum of ¼ the external diameter of the pipe. When laid in the trench, fit and match pipes to form a smooth, uniform invert. Carefully clean bell ends before pipes are lowered into the trenches. Avoid unnecessary handling in the trench when lowering.

Place sections of corrugated metal pipe with the ends abutting and join with the manufacturer's coupling bands. Install and tighten the coupling bands according to the manufacturer's recommendations.

Cement joints of pipe over 24 inches in diameter with a cement mortar or plastic joint compound. Use cement mortar composed of 1 part portland cement and 3 parts fine aggregate mixed with sufficient water to form a plastic mortar. As each section of pipe is laid, clean the bell or hub of the preceding pipe and fill the bottom portion with mortar. After the pipe is placed, fill the remaining portion of the joint. Smooth finish and wipe clean the inside of the joint. After the initial set, protect the mortar on the outside from the sun using soil or other approved covering. Prepare and apply plastic joint compound according to the manufacturer's recommendations.

On 24 inch or smaller RCP's, use plastic joint compound to join the sections.

(2) Polyethylene (PEP) and Polyvinyl Chloride (PVCP) Pipe. Install PE and PVC pipes according to **subsection 817.3c.** and the following additions and exceptions:

- Assemble PEP and PVCP according to the manufacturer's instructions, starting at the downstream end.
- Properly assemble the gasketed bell and spigot joints to prevent the infiltration of soil fines.

- The maximum allowable opening is 1 inch.
- If the opening is greater than ⅛-inch, the bell channel length shall be 4 times the size of the opening.

d. Concrete Headwalls. Construct headwalls for erosion pipe with Grade 3.0 concrete. Formwork, placing, curing and protection of the concrete shall comply with **DIVISION 700**. Place reinforcing steel as shown in the Contract Documents.

e. Backfilling.

(1) General. Do not begin backfilling the pipe until the Engineer approves the pipe installation. Backfill all trenches and excavated areas with suitable material without disturbing or damaging the pipe. Dispose of excess material and leave the area in a neat presentable condition.

Backfill trenches within the embankment or beneath entrances, side roads, sidewalks, other intersecting traveled ways, or those designated in the Contract Documents to the required grade in layers 6 inches (maximum, compacted thickness). Compact to Type A compaction according to **SECTION 205**.

If the top of a pipe or culvert extends above the original ground line, continue the compacted backfill to the top of the pipe culvert. Place the backfill 1½ times the external diameter of the pipe on each side of the culvert for the full width of the roadway embankment. Take the necessary precautions to prevent distortion of the pipe or culvert while backfilling.

When approved by the Engineer, granular material (of sufficient moisture content and that may be adequately rolled or tamped in place) may be used for backfill material. Place granular material in uniform layers a maximum of 12 inches thick. When deemed necessary by the Engineer, terminate the granular backfill material a minimum of 8 inches below the subgrade or ground level, and use suitable soil to backfill the remaining portion.

If it is necessary for construction equipment to travel over CAP, CSP, PE or PVC before the backfill is completed above the top of the culvert, place additional backfill over the top of the pipe. Use **TABLE 204-1** as a guide.

TABLE 204-1: APPROXIMATE MINIMUM COVER OVER THE TOP OF THE PIPE				
Size (inches)	**Approx. Min. Cover Required for Axle Load of 18 to 50 Kip (feet)**	**Approx. Min. Cover Required for Axle Load of 50 to 75 Kip (feet)**	**Approx. Min. Cover Required for Axle Load of 75 to 110 Kip (feet)**	**Approx. Min. Cover Required for Axle Load of 110 to 150 Kip (feet)**
CAP and CSP				
12 to 42	2.0	2.5	3.0	3.0
48 to 72	3.0	3.0	3.5	4.0
78 to 120	3.0	3.5	4.0	4.0
PE and PVC				
12 to 36	2.0	2.5	3.0	3.0
42 to 48	3.0	3.0	3.5	4.0
54 to 60	3.0	3.0	3.5	4.0

(2) Sewers. On all sewers which do not meet the requirements of **subsection 817.3e.(1), second paragraph**, carefully deposit and satisfactorily tamp the material in uniform layers a maximum of 6 inches thick until the backfill reaches the top of pipe. Backfill and tamp the remainder of the trench either in uniform layers a maximum of 12 inches thick, or completely fill the trench and settle by satisfactory methods of jetting or flushing. Continue operations until the backfill is slightly above ground level.

(3) Erosion Pipe. Install cover over the erosion pipe according to the Contract Documents. Place the cover in lifts l8 inches (maximum, loose measurement), and compact each lift to Type A compaction, **SECTION 205**. On projects where Type B compaction is required on the adjacent roadway, compact the cover according to Type B compaction, **SECTION 205**. Use hand or mechanical tampers or rollers to achieve compaction.

(4) Structural Plate Structures and Metal Pipes Greater than 60 inches. Backfill structural plate structures and metal pipes greater than 60 inches in diameter with granular backfill. Use deflection control measures, including hand tamping, to maintain the original shape of the structure.

(5) Reinforced Concrete Pipe. If the height of fill over the top of a reinforced concrete pipe is greater than 27.5 feet, place the backfill using the imperfect trench method in this manner:

- Place the reinforced concrete pipe in the excavation, as specified.

- Place and compact the earthen backfill to a height above the top of the pipe equal to the external width of the pipe.
- After the backfill is placed and compacted as specified, excavate the compacted earth from the prism directly over the pipe.
- Backfill the resulting trench with earth placed in the loosest possible condition.
- After the trench is filled with loose earth, construct the remainder of the embankment as specified in the Contract Documents.

(6) Polyethylene (PEP) and Polyvinyl Chloride (PVCP) Pipe. Backfill PEP and PVCP with either granular backfill or flowable fill, according to **subsection 817.3e.**, with these additions and exceptions:

- If the fill from the top of pipe to the top of the subgrade is 3 feet or less, backfill with granular material to the top of the subgrade.
- If the fill from the top of pipe to the top of the subgrade is greater than 3 feet, backfill with granular material to a point 1 foot above the top of the pipe.
- Prevent damaging or floating the pipe during the backfilling operations. Do not deform or damage the pipe while compacting the granular backfill. Hand tamping may be necessary adjacent to the pipe to prevent distortion.
- The maximum barrel deflection of the pipe (reduction of the barrel nominal base inside diameter) shall not exceed 5%. Use a mandrel to measure the barrel deflection of the pipe. Take the measurement at least 30 days after the installation and backfilling. If oversized diameter pipes are installed, actual inside pipe diameters may need to be considered. Remove, reinstall or replace any pipes deformed more than 5%.

A minimum of 30 days following the installation and backfilling, measure the barrel deflection of each pipe run.

Measure the deflection using a mandrel or any other device (approved by the Engineer) that can physically verify the dimensions of the pipe and is not limited by poor lighting, water-flow, pipe length or other limiting conditions of the installed environment. Measure the deflection in the presence of the Engineer.

Pipes larger than 24 inches may be entered and deflection levels measured directly. Take a measurement once every 10 feet for the length of the pipe.

If a mandrel is used for the deflection test, use a 9 (or greater odd number) arm mandrel, sized to the actual inside diameter of the pipe installed, and inspected by the Engineer prior to testing. Use a properly sized proving ring to check or test the mandrel for accuracy. Pull the mandrel through the pipe by hand with a rope or cable. When applicable, incorporate pulleys into the system to change the direction of pull so that inspection personnel need not physically enter the pipe or manhole.

If any pipes deform between 5% and 7.5%, conduct an evaluation (by a licensed Professional Engineer) and submit to the Engineer for review and approval. In the evaluation consider the severity of the deflection, structural integrity, environmental conditions and the design service life of the pipe. The Engineer may require removal, reinstallation or replacement of the pipe where the evaluation indicates that the deflection could be problematic.

The maximum barrel deflection of the pipe (reduction of the barrel based on the actual inside diameter) is 7.5%. Remove and reinstall or replace, as directed by the Engineer, any pipes deformed more than 7.5%.

c. Cast Iron Pressure Pipes for Sanitary Sewers. Handle according to this specification with the following additions and exceptions.

(1) Handling. Do not injure the pipe or pipe coating. Do not place any pipe or material inside of a pipe or fitting after the coating is applied.

(2) Cutting. Cut the pipe without damaging.

(3) Placing and Laying. While suspended in the sling and before lowering into the trench, the Engineer will inspect the pipe for defects by tapping lightly with a hammer. Damaged pipe will be rejected. Carefully embed the pipe with bell holes excavated so each pipe will rest firmly upon its bed for the full length. After placing a length of pipe in the trench, hold the packing material for the joint around the bottom of the spigot so the packing enters the bell as the pipe is pushed into position. Center the spigot in the bell and push the pipe into position in the required alignment. Lay pipe with the bells facing the direction of laying, except where necessary in making connections with other lines. Position a minimum of 2 lengths of pipe ahead of each joint, with packing installed and earth fill tamped alongside the pipe before the joint is poured, except at closures.

(4) Joints. Before jointing bell and spigot pipe, remove all lumps, blisters, excess coating materials, oil and grease from the bell and spigot ends of the pipe. Rub with a wire brush, wipe clean and dry the outside spigot and inside of the bell. Carefully place the packing, and tightly caulk to a uniform thickness. No loose or frayed ends of fiber may protrude into the space to be filled with joint filler. Carefully inspect each joint and check for proper depth before the joint runner is attached. The depth of load in lead filled joints shall be a minimum of 2 ¼ inches back of the face of the bell. In a melting pot near the joint to be poured, heat lead to the proper temperature so that when stirred the surface will show a rapid change in color. Before pouring lead, remove all scum. On the outside of the pipe, dam the pouring gate with clay to fill the joint even with the top of the bell. Make each joint with 1 pour completely filling the joint space. Caulk toward the joint gate to secure tight joints without overstraining the bells. If the packing has been insufficiently caulked, permitting the lead to be driven to a depth more than ¼ inch from the face of the bell at any point during caulking, remove the lead and remake the joint.

d. Sanitary Sewer System. Install the sanitary sewer system as shown in the Contract Documents. Make all service connections unless specified otherwise in the Contract Documents.

Use Grade 3.5 concrete that complies with **SECTION 401** unless specified otherwise in the Contract Documents.

817.4 MEASUREMENT AND PAYMENT

The Engineer will measure all types of pipe by the linear foot, along the centerline of the pipe. Gain in pipe length due to the fit of the pipe sections at the coupling bands or joints is not measured for payment.

The Engineer will measure each end section, concrete headwall and sanitary sewer system.

The Engineer will measure fly ash slurry grout by the cubic yard.

The Engineer will not measure excavation for separate payment.

Payment for "Entrance Pipe", "Cross Road Pipe", "Erosion Pipe", "Storm Sewer", "Sanitary Sewer", "End Section", "Concrete Headwall", "Fly Ash Slurry Grout" and "Sanitary Sewer System" at the contract unit prices is full compensation for the specified work.

SECTION 818

ENCASEMENT PIPE

818.1 DESCRIPTION

Install the size and type of encasement pipe specified in the Contract Documents.

BID ITEM	UNITS
Encasement Pipe (*) (**) (***)	Linear Foot
*Size	
**Type	
***Method	

818.2 MATERIALS

Provide the size and type of encasement pipe specified in the Contract Documents.

818.3 CONSTRUCTION REQUIREMENTS

Install the encasement pipe as detailed in the Contract Documents. The Engineer must approve the methods used to install the encasement pipe.

Connect the encasement pipe as recommended by the manufacturer.

If the Contract Documents specify compaction, backfill and compact the excavation according to **DIVISION 200**.

818.4 MEASUREMENT AND PAYMENT

The Engineer will measure encasement pipe by the linear foot, along the centerline of the pipe.

Payment for the "Encasement Pipe" at the contract unit price is full compensation for the specified work.

SECTION 819

BORED, JACKED OR TUNNELED PIPE

819.1 DESCRIPTION

Install the designated pipe by boring, jacking or tunneling as shown in the Contract Documents. If the method of installation is not specified in the Contract Documents, the Contractor has the option to use any of the 3 methods.

BID ITEMS	UNITS
* Pipe (Bored, Jacked or Tunneled)	Linear Foot
*Type and Size of Pipe	

819.2 MATERIALS

Provide materials that comply with the applicable requirements.

Pipe .... **DIVISIONS 1600/1900**
Grout .... **SECTION 401**

819.3 CONSTRUCTION REQUIREMENTS

a. General. If the pipe is bored, jacked or tunneled under a highway, railroad, street or other structure, the installation of the pipe shall not interfere with the operation of the highway, railroad, street or other structure. Do not weaken or damage existing roadbeds or structures.

If the grade of the pipe (at the point of boring, jacking or tunneling) is below ground, construct the pits or trenches necessary to install the pipe complying with OSHA requirements. Backfill such pits and trenches upon completion of the pipe installation. Compact the backfill to Type A, MR-5-5, **SECTION 205**.

Submit to the Engineer for approval a detailed plan for the proposed method of installing the pipe.

Install the pipe beginning at the lower elevation (downstream) and progressing to the higher elevation (upstream). Do not vary the final position of the pipe from the specified line or grade more than 1 inch in 10 feet. Variations, if any, shall be regular and in one direction. The flowline shall be in the specified direction.

Repair or replace, as determined by the Engineer, all pipes damaged or misaligned during the boring, jacking or tunneling operations.

b. Boring. Use either a pilot hole or the auger method.

(1) Pilot Hole Method. Bore a pilot hole (approximately 2 inches) the length of the crossing. Before boring the larger hole, check the pilot hole for line and grade at the opposite end of the bore from the work pit. The pilot hole serves as the centerline of the larger hole bored later.

(2) Auger Method. Use a steel encasement pipe (of the approximate diameter of the pipe to be installed) equipped with a cutter head to perform the excavation. Use augers of sufficient size to convey the excavated material to the work pit.

In unconsolidated soil formations, the Engineer will permit the use of a gel-forming colloidal drilling fluid (with a minimum of 10% high grade, bentonite) to consolidate the cuttings, seal the walls of the hole, lubricate the removal of the cuttings and lubricate the immediate installation of the pipe.

c. Jacking. Use heavy duty jacks suitable for the intended purpose. Use a jacking head and bracing between the jacks and the jacking head, to apply uniform pressure around the ring of pipe. The Engineer will allow the use of joint cushioning material. Use a jacking frame or backstop. Use guides that support and direct the pipe in the proper line and grade.

As the pipe is jacked, excavate the material just ahead of the pipe (a maximum of 2 feet in advance). Remove the excavated material through the pipe. Excavation for the underside of the pipe, for a minimum of ⅓ of the circumference of the pipe, shall follow the contour and grade of the pipe. Over-excavation (maximum of 2 inches) for the upper half of the pipe is allowed. The over-excavation shall taper to nothing at the point the excavation conforms to the contour of the pipe. Fill over-excavation in excess of 1 inch with a slurry grout the length of the installation after the pipe is installed.

The Engineer may allow the use of a cutting head of steel plate around the head end of the pipe. The cutting edge may extend a short distance beyond the end of the pipe. Construct (with inside angles or lugs) the cutting edge to prevent it from slipping back into the pipe.

When the pipe jacking operations begin, to the extent possible, continue the operations without interruptions to prevent the pipe from becoming firmly set in the excavation.

d. Tunneling. Use a tunnel lining of sufficient strength to support the overburden. Fill the space between the tunnel lining and the limits of the excavation with slurry grout. Provide access holes in the tunnel lining (maximum spacing of 10 feet) for the grouting operations.

819.4 MEASUREMENT AND PAYMENT

The Engineer will measure pipe by the foot along the centerline of the pipe. Gain in pipe length due to the fit of the pipe sections at the coupling bands or joints is not measured for payment.

Payment for the specified "Pipe (Bored, Jacked or Tunneled)" at the contract unit price is full compensation for the specified work.

SECTION 820

FLUME INLETS AND SLOPE DRAINS

820.1 DESCRIPTION

Construct the designated type of flume inlets and slope drains as shown in the Contract Documents.

BID ITEMS	UNITS
Flume Inlet (*)	Each
Slope Drain (*)	Linear Foot
Slope Drain (Special)	Linear Foot

*Type: concrete, grouted stone or stone

820.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete and Grout	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTION 1102**
Stone for Flume Inlets and Slope Drains	**DIVISION 1100**
Type 2 Liquid Membrane-Forming Compound	**DIVISION 1400**
Reinforcing Steel	**DIVISION 1600**
Welded Steel Wire Fabric	**DIVISION 1600**

820.3 CONSTRUCTION REQUIREMENTS

a. Concrete. Construct flume inlets and slope drains as shown in the Contract Documents. Excavate to allow construction of forms and excavate to sufficient depth to obtain the designated thickness, elevation and grade.

Prior to concrete placement, place reinforcement for concrete inlets and drains as shown in the Contract Documents. Support reinforcement on bar chairs.

Unless shown otherwise in the Contract Documents, construct concrete flume inlets and slope drains of Grade 3.0 (AE) concrete. Uniformly consolidate the concrete without voids. Cure and protect concrete according to **DIVISION 700**.

b. Stone and Grouted Stone. Construct stone inlets and slope drains as shown in the Contract Documents. Place stones with ends and sides abutting. Use spalls to fill larger spaces between stones. Offset joints between stones with the joint in the row below. For grouted stone, pour and broom grout into spaces between stones until the spaces are completely filled. Immediately after the grout is placed, cure in the same manner as required for the concrete.

c. Backfill. Place backfill material along the sides of the inlets and slope drains to the top of the outside edges. Compact the backfill to a density of 90% of the standard compaction of the material used. On projects where Type B compaction is required on the adjacent roadway, construct the compaction for flume inlets and slope drains to the requirements for Type B compaction, **SECTION 205**.

820.4 MEASUREMENT AND PAYMENT

The Engineer will measure each flume inlet.

The Engineer will measure slope drains by the linear foot along the flowline of the slope drain.

Payment for "Flume Inlets" and "Slope Drains" at the contract unit prices is full compensation for the specified work.

SECTION 821

FLAPGATES

821.1 DESCRIPTION

Construct the designated flapgate as shown in the Contract Documents.

BID ITEM	**UNITS**
(*) Flapgate	Each
*Size	

821.2 MATERIALS

Provide materials that comply with the applicable requirements.

Cast Iron .... **DIVISION 1600**
Structural Steel .... **DIVISION 1600**

821.3 CONSTRUCTION REQUIREMENTS

Place flapgates as shown in the Contract Documents. Install flapgates to function and operate satisfactorily. Provide shop drawings as specified in **DIVISION 700**.

821.4 MEASUREMENT AND PAYMENT

The Engineer will measure flapgates by the each.
Payment for "Flapgates" at the contract unit prices is full compensation for the specified work.

SECTION 822

UNDERDRAINS

822.1 DESCRIPTION

Construct the designated type of underdrain as shown in the Contract Documents.

BID ITEMS	**UNITS**
*Pipe Underdrains (**)	Linear Foot
Aggregate for Blanket Underdrains	Ton/Cubic Yard

*Size, Diameter
**Type

822.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete and Grout	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTION 1102**
Aggregates for Blanket Underdrains and Backfill	**DIVISION 1100**

Underdrain Pipe

Type Designation		
F	Perforated Corrugated Metal Pipe	**DIVISION 1900**
H	Polyvinyl Chloride Pipe	**DIVISION 1900**
T	High-Density Polyethylene Pipe	**DIVISION 1900**

Underdrain Outlet Pipe

G	Corrugated Metal Pipe	**DIVISION 1900**
K	Polyvinyl Chloride Pipe	**DIVISION 1900**
S	High-Density Polyethylene Pipe	**DIVISION 1900**

If the type is not indicated in the Contract Documents, any of the types listed above are permitted. Provide underdrain pipes with a nominal minimum inside diameter of 6 inches, unless shown otherwise in the Contract Documents. Provide perforated and corrugated underdrain pipe with the same type of outlet pipe.

822.3 CONSTRUCTION REQUIREMENTS

a. Excavation for Pipe Underdrains. Excavate trenches for all lateral and longitudinal interceptor drains as shown in the Contract Documents. In case of conflict, where actual elevation of the strata or stratum to be intercepted is found to vary from designated elevation, the stratigraphy shall govern. When necessary, shore or sheet the trench to provide safe construction and backfilling. Construct trench bottoms for perforated pipe in firm material to permit the placing of aggregate for pipe underdrains underneath the pipe.

If unstable material is encountered in the bottom of the trench, place the drain pipe on an insulating course of aggregate for pipe underdrains of sufficient thickness (maximum 3 inches) to provide proper movement of water without danger of sealing or mudding off the underdrain, and to maintain proper alignment and grade of the pipe. Insulating courses of aggregate are only permitted under perforated pipe. If the unstable material is also permeable to the extent that water is lost through the bottom of the trench as determined by the Engineer, lower the drain into the impermeable material.

The minimum trench width is 8 inches plus the exterior diameter of the underdrain pipe, unless shown otherwise in the Contract Documents. The basedrains shall be placed a minimum of 18 inches below the base of the pavement.

b. Excavation for Blanket Underdrains. Perform excavation according to the Contract Documents. Rest the blanket drain upon the bedrock or other suitable material as shown in the Contract Documents. Shape irregularities on the bedrock surface so undrained pockets are not formed. In suitable material, roll and shape the embankment surface to proper crown. Prior to placing aggregate for blanket underdrains, construct pipe underdrains built in connection with the blanket underdrains, as shown in the Contract Documents.

c. Laying Underdrain Pipe. Lay all pipes on a minimum grade of 1%, unless otherwise shown in the Contract Documents. Close all dead ends of pipe underdrains with a concrete cap.

Join metal pipe by means of approved coupling bands provided by the pipe manufacturer. Make all junctions and turns with wyes, tees and bends. When field cutting is required, cold or flame cut metal pipe as approved by the Engineer. Paint cut surfaces with an approved zinc-rich paint.

Lay perforations down, unless shown otherwise in the Contract Documents.

d. Laying Outlet Pipe. Lay outlet pipe only on stable material with minimum of 1% grade, unless otherwise shown in the Contract Documents. Place metal outlet pipe with ends abutting and join with manufacturer's coupling bands to provide a watertight joint.

e. Backfilling Pipe Underdrains. Do not begin backfill without approval of the Engineer. Place backfill to prevent large cavities in the backfill and walls of the trench. Backfill overbreakage due to blasting of rock in trench excavation and widening due to caving of trench walls or overbreakage at construction outcrops with aggregate for underdrains.

Where a portion of the trench above the underdrain backfill aggregate is to be filled with soil, use a compactable material. Place the material in layers and compact to a density equal to or greater than that required for the adjacent material, with a minimum of 90% of standard compaction of the soil used.

f. Constructing and Backfilling Blanket Underdrains. Construct the blanket underdrain with a minimum thickness of 12 inches.

When blanket underdrains are constructed over lateral or longitudinal underdrains, remove all debris that may have collected in the top portion of the pipe underdrain backfill so that the aggregate of the blanket underdrain will be in direct contact with the aggregate backfill of the lateral or longitudinal underdrains.

Do not begin backfill without approval of the Engineer. Backfill all irregularities of the bedrock surface with aggregate for blanket underdrains.

Backfill the lateral drain trench under the blanket underdrain and round to an elevation of approximately 6 inches above the top of the trench. Maintain the rounded elevation free from mud or other objectionable material until the aggregate for the blanket underdrains is placed thereon.

If necessary, in order to form a stable layer or course, spray the aggregate with water during the process of spreading and rolling. Perform the spraying so the force of the water will not wash the finer material to the bottom of the lift.

When concrete pavement or soil backfill material is to be placed over the blanket underdrain, use fine aggregate (complying with **DIVISION 1100**) in the top 4 inches of the underdrain, or other approved granular aggregate provided these fine aggregates do not have more than 2% passing the No. 200 sieve (wash).

g. Pipe Underdrain Outlets. Use a concrete flume or other approved type of flume, constructed at the outlet end of pipe underdrains as shown in the Contract Documents. Use Grade 3.0 concrete to construct the outlet flume so that the flume is flush with the finished shoulder slope.

h. Underdrain Markers. Erect 1 guidepost to mark each outlet flume for pipe underdrains, at the location shown in the Contract Documents. Use either a 6-inch diameter treated wood post or a 3-pound per foot galvanized or baked on enamel metal channel post. Set guideposts according to **SECTION 827**.

(1) Wood Guideposts. Apply 2 coats of aluminum paint to the upper 18 inches of the wooden post. Apply a third coat of International orange, enamel paint to the upper 12 inches of the wooden post.

(2) Metal Guideposts. Apply 1 coat of International orange, enamel paint to the upper 12 inches of the galvanized or baked-on enamel metal channel post.

i. Video Inspection. When specified in the Contract Documents, inspect completed underdrains according to **subsection 845.3c**. The video inspection of the completed underdrains will be subsidiary to the underdrain.

For the video inspection, provide a video camera complying with the following requirements:
- high resolution, high sensitivity, waterproof and color;
- ability to pan and tilt to a 90° angle with the axis of the pipe and rotate 360°;
- capable of negotiating the various angle fittings used in the edge drain system;
- with sufficient lighting to provide a true color picture of the entire periphery of the diameter of the pipe; and
- with attachments that will maintain the camera's position in the center of the pipe.

Provide a portable control unit of the video camera complying with the following requirements:
- capable of adjusting the iris, focus, and light level intensity;
- has a color monitor (8 inch minimum) with a minimum standard resolution of 720 x 480 pixels to track the camera's progress through the inspections;
- have 2 video input/output jacks for video recording, as well as digital playback verification through the built-in monitor; and
- have audio input to allow for dubbing of the video to incorporate comments as necessary.

Provide a video camera system complying with the following requirements:
- has sufficient cable/push rod to conduct inspections to a length of 500 feet, and a distance counter to monitor the length of the inspection; and
- have a color video printer that will produce color prints of any observations of interest during the course of the inspection;
- include a digital video recorder (minimum quality 4-head industrial grade VHS type) with audio dubbing still frame and slow speed capabilities; and
- has software capable of generating a report that shows each defect, along with its location measured from the inspection entrance, and a still frame image of the fault.

Provide an experienced video technician to operate the video camera system.

822.4 MEASUREMENT AND PAYMENT

The Engineer will measure pipe underdrains by the linear foot.

When aggregate for blanket underdrains is shown in the Contract Documents by the cubic yard, the Engineer will measure the cubic yards of aggregate in the vehicle at the time and place of unloading.

When aggregate for blanket underdrains is shown in the Contract Documents by the ton, the Engineer will measure the tons of aggregate in the vehicle at the time and place of unloading. Deductions will be made for all moisture in the material when measured by the ton. Determine the moisture content according to **DIVISION 2500**.

The Engineer will measure and pay for guideposts used for underdrain markers according to **SECTION 827**, and the quantities will be included in the quantity of guideposts shown in the Contract Documents.

Payment for "Pipe Underdrains" and "Aggregate for Blanket Underdrains" at the contract unit prices is full compensation for the specified work.

SECTION 823

PREFABRICATED INTERCEPTION DEVICES AND SLOTTED DRAINS

823.1 DESCRIPTION

Install steel prefabricated interception devices and steel slotted drains at locations designated in the Contract Documents.

BID ITEMS	**UNITS**
Prefabricated Interception Device (*)	Each
Slotted Drain (**)	Linear Foot

*Type
**Diameter of CMP

823.2 MATERIALS

a. Steel Prefabricated Interception Device. Provide steel interception devices fabricated to the dimensions shown in the Contract Documents and from components that comply with these requirements:

- provide steel bars for concrete reinforcement and steel fasteners that comply with **DIVISION 1600**;
- provide corrugated metal pipe that complies with **DIVISION 1900**;
- provide steel risers fabricated from the same base metal as the corrugated metal pipe;

b. Slotted Drains. Provide steel slotted drains fabricated to the dimensions shown in the Contract Documents and from components that comply with these requirements:

- provide corrugated metal pipe that complies with **DIVISION 1900**;
- provide steel grating and bulkheads fabricated from the same base metal as the corrugated metal pipe;

c. Concrete. Provide Grade 3.0 concrete that complies with **SECTIONS 401, 402** and **1102**.

823.3 CONSTRUCTION REQUIREMENTS

Install the steel prefabricated interception devices and steel slotted drains at the locations and to the grades shown in the Contract Documents according to **DIVISIONS 200** and **700**.

Repair any damage to the galvanized coating according to **DIVISION 1900**.

823.4 MEASUREMENT AND PAYMENT

The Engineer will measure each steel prefabricated interception device.

The Engineer will measure slotted drains by the linear foot.

Any required excavation, backfill or concrete pads are subsidiary to the prefabricated interception device or slotted drain.

Payment for "Prefabricated Interception Device" and "Slotted Drain" at the contract unit prices is full compensation for the specified work.

SECTION 824

CONCRETE SIDEWALK, STEPS AND RAMPS

824.1 DESCRIPTION

Construct concrete sidewalk, steps and sidewalk ramps with detectable warning strips compliant with the Public Rights-of-Way Accessibility Guidelines (PROWAG) and according to the Contract Documents.

Construct sidewalk ramps (detectable warning) compliant with PROWAG on existing sidewalk ramps and according to the Contract Documents.

BID ITEMS	UNITS
Sidewalk Construction (*) (**)	Square Yard
Sidewalk Ramp	Square Yard
Sidewalk Ramp (Detectable Warning)	Square Yard
Grade 3.0 Concrete	Cubic Yard
Reinforcing Steel	Pound

*Thickness
**"AE" denotes air-entrained concrete.
No entry denotes concrete without air.

824.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete and Mortar	**SECTIONS 401 & 403**
Aggregates for On Grade Concrete	**SECTION 1116**
Paving Bricks Compliant with PROWAG	**DIVISION 1300**
Reinforcing Steel	**DIVISION 1600**
Preformed Joints Type B	**DIVISION 1500**
Joint Sealing Compound	**DIVISION 1500**
Mortar sand (FA-M)	**DIVISION 1100**
Silicon joint sealant (Type NS)	**DIVISION 1500**
Ramp Panels Compliant with PROWAG	**DIVISION 1700**

824.3 CONSTRUCTION REQUIREMENTS

a. Excavation. Excavate to the required depth and to a width that will permit the installation and bracing of the forms. Shape the foundation and compact to a firm even surface conforming to the section shown in the Contract Documents. Remove all soft and yielding material and replace with acceptable material.

b. Forms. Extend forms for the full depth of the concrete. Use straight forms, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Brace and stake forms so the forms remain true to line and grade until their removal.

Slipform equipment may be approved by the Engineer and used on a satisfactory performance basis.

c. Placing Concrete. Unless shown otherwise in the Contract Documents, construct concrete sidewalks, steps and ramps in a single course of Grade 3.0 concrete. Thoroughly moisten the foundation immediately prior to the placing of concrete. Place concrete according to **SECTION 401**. Uniformly consolidate the concrete without voids.

Finish the surface with a wooden float. Finish all outside edges of the slab and all joints with a ¼ inch radius edging tool.

d. Reinforcement. Place reinforcing steel for steps, sidewalks or ramps as shown in the Contract Documents. Support bars on metal bar chairs and securely wire to prevent displacement during concrete placement.

e. Sidewalk Ramps with Detectable Warning Strips Compliant with PROWAG – New Construction.

(1) Paving Brick. Set the truncated dome paving bricks in a mortar bed as detailed in the Contract Documents. Construct the surface of truncated dome paving brick between the truncated domes flush with the adjacent sidewalk ramp surface. Fill the joints between the truncated dome paving bricks with broomed-in mortar sand.

The Engineer will check the completed truncated dome paving brick surfaces with a 10-foot straightedge. The completed paving brick surfaces may not deviate more than ⅜ inch, unless the contour of the area exceeds this tolerance.

(2) Cast-In-Place Prestressed Panels. Prior to the concrete achieving initial set, recess areas to receive prestressed panels below finished grade at locations shown in the Contract Documents. Use a wood float or tool recommended by the manufacturer to achieve the proper depth and refinish the disturbed area. Prior to placement, pre-dampen the back side of the panel with clean water. Follow the manufacturer's recommendations for preparing the panel when mortar is specified between the panel and fresh concrete.

Install the panels immediately in recess areas of fresh concrete and lightly tap the panels to grade using a rubber mallet to establish bond and 100% surface contact. Square the edges of the panels to provide a symmetrical alignment. Set the depth flush with the adjacent surfaces. Keep the tolerances between panels and surrounding surfaces within 1/16 inch.

Maintain a 3/16 inch caulk joint between panels and seal with a Type NS silicon joint sealant.

Edge around the panels as shown in the Contract Documents. Clean any concrete residue off of the panels with a damp sponge to provide a clean appearance.

Protect the panels from concrete curing compound overspray.

(3) Hardened Concrete Placement of Prestressed Panels. Recess the area 3/16 inch more than the thickness of the prestressed panels.

Clean the surfaces of all dust, oil, grease, curing or sealing compounds, laitance or other surface contaminants. Mechanically abrade the concrete surface to provide a smooth surface profile.

Fill cracks or voids with compounds that are approved by the panel manufacturer.

Remove any high spots on the substrate by mechanical methods.

Cut a large enough opening to permit expansion joints, when applicable.

Install panels with a high-strength polymer modified concrete according to the manufacturer's installation instructions.

(4) Cast-In-Place Composite Panels. Install according to the manufacturer's instructions. Provide a manufacturer's representative on site to instruct the Contractor and KDOT personnel in the correction installation procedures for the composite panels used.

Prior to the concrete achieving initial set, finish the concrete and recess areas to receive the composite panels below finished grade according to the manufacturer's instructions. Use a wood float or tool recommended by the manufacturer to achieve the proper depth, and refinish the disturbed area. When possible, install a single, standard size panel large enough to comply with the length and width requirements in the Contract Documents. If installation of a single panel will not satisfy the dimensional requirements in the Contract Documents, arrange the installation of standard size panels so the total joint length and panel cutting is minimized. Cut only those prequalified panels listed as used for "all applications".

When cutting panels, utilize auxiliary anchor points, as recommended by the panel manufacturer. Select enough additional anchor points so that no anchor is more than 5 inches from the edge (measured perpendicular to the nearest edge) and adjacent anchors are no more than 24 inches apart.

f. Sidewalk Ramps (Detectable Warning). Construct the detectable warning section on an existing sidewalk ramp, according to the manufacturer's instructions and this specification, including **subsection 824.3e**. Construct according to slopes and tolerances in the Contract Documents. Perform any necessary sidewalk ramp removal required to construct the detectable warning, without damaging the subgrade or sub-base. Install any necessary Grade 3.0 concrete required to construct the detectable warning.

Properly dispose of all waste material, and leave the area in a neat presentable condition.

g. Curing. Immediately after the finishing operation, cure the sidewalk, ramps and steps according to **DIVISION 700**.

h. Contraction, Construction and Expansion Joints. Form contraction joints at intervals shown in the Contract Documents. If not shown, form by placing a metal template having a minimum thickness of ⅛ inch into the concrete a minimum of ⅓ of the depth of the concrete, or by cutting entirely through the fresh concrete with a trowel.

Construct expansion joints as shown in the Contract Documents.

Form construction joints around all appurtenances such as manholes, utility poles, etc., extending into and through the sidewalk, and install ¼ inch Type B preformed joint filler in these joints. Install expansion joint filler of the thickness shown in the Contract Documents between concrete sidewalks and any fixed structures such as a building or bridge. Extend the joint filler or expansion joint material for the full depth of the walk.

Round the edges of contraction, construction and expansion joints with a ¼ inch radius edging tool.

i. Backfilling. Backfill the area adjacent to new sidewalks, ramps or steps and satisfactorily compact with suitable material. Observe adequate precautions to prevent damage to the sidewalks, ramps or steps during the compacting operations.

Dispose of excess excavated material as shown in the Contract Documents or as directed by the Engineer.

824.4 MEASUREMENT AND PAYMENT

Excavation for the construction of sidewalks, ramps and steps will not be measured separately for payment, but will be considered subsidiary work, except when such excavation may be considered as a part of, and may be measured in conjunction with the embankment excavation. In such instances, the excavation will be included in the quantity of embankment excavation computed as a line item on the contract.

The Engineer will measure sidewalk and sidewalk ramps by the square yard of the various thickness indicated.

The Engineer will measure sidewalk ramp (detectable warning) by the square yard when it is a bid item in the contract. When sidewalk ramp (detectable warning) is not a bid item in the contract, the work is subsidiary to the bid item sidewalk ramp.

The Engineer will measure steps by the cubic yard of Grade 3.0 concrete.

The Engineer will measure reinforcement by the pound according to **SECTION 711**.

Payment for "Sidewalk Construction", "Sidewalk Ramp", "Grade 3.0 Concrete" and "Reinforcing Steel" at the contract unit prices is full compensation for the specified work.

Payment for "Sidewalk Ramp (Detectable Warning)" at the contract set unit price includes all excavation, compaction of subgrade or subbase if required, removal of sidewalk ramp, concrete construction, disposal of waste material, and all material, labor, equipment, tools, supplies, incidentals and mobilization necessary to complete the work.

SECTION 825

CURB AND GUTTER

825.1 DESCRIPTION

Construct concrete curb and gutter as shown in the Contract Documents. Repair curb as designated in the Contract Documents, or as directed by the Engineer.

BID ITEMS	UNITS
Curb, Edge (*) (**)	Linear Foot
Curb, Header (**)	Linear Foot
Curb and Gutter, Combined (**)	Linear Foot
Gutters (**)	Linear Foot
Curb, Protection (*) (**)	Linear Foot
Curb, Asphaltic Concrete	Linear Foot
Gutters, Asphaltic Concrete	Linear Foot
Curb and Gutters, Asphaltic Concrete	Linear Foot
Curb Repair	Linear Foot

*Size, height or special.
**"AE" denotes air-entrained concrete.
No entry denotes concrete without air.

825.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete	**SECTIONS 401 & 403**
Aggregates for On Grade Concrete	**SECTION 1116**
HMA	**DIVISION 600**
Reinforcing Steel	**DIVISION 1600**
Structural Steel	**DIVISION 1600**
Expansion Joint Filler	**DIVISION 1500**
Joint Sealing Compound	**DIVISION 1500**
Asphalt Materials	**DIVISION 1200**
Concrete Surface Repair-Shotcrete	**SECTION 826**

Type I or II cement may be used in curb repair concrete.

Unless shown otherwise in the Contract Documents, the aggregate to be used for asphaltic curbs, shall be of the same type as that used on the other bid items in the contract. If there are no other asphalt bid items designated in the Contract Documents, use Commercial Grade HMA Type A or B. Adjust the maximum sizes and gradation of the aggregate and the asphalt content of the mixture to produce a dense workable mix, capable of being molded, pressed through the slip form without tearing or pulling, and produce a dense section with smooth and uniform surfaces free from segregated areas and with clear-cut corners and edges.

825.3 CONSTRUCTION REQUIREMENTS

a. Subgrade. Excavate the subgrade for combined curb and gutter, gutters and protection curb as shown in the Contract Documents. If the section is not shown, excavate to the curb and gutter width plus 12 inches on each side. Compact to uniform density. Excavate rock, shale or soft and yielding material 6 inches below subgrade elevation and replace with suitable backfill material. Compact the backfill material to Type A Compaction, **SECTION 205**. Roll and compact the subgrade to provide a smooth surface.

b. Concrete.

(1) Composition, Consistency, Proportioning and Mixing. Unless shown otherwise in the Contract Documents, construct edge curb, header curb, combined curb and gutter, gutters and protection curb adjacent to

concrete pavement using the grade of concrete specified for the pavement. When concrete curbs are shown to be adjacent to asphalt pavement construct concrete curb and gutters, use and place Grade 3.0 concrete as shown in **DIVISION 400**.

(2) Forms. Use steel forms for edge curb or header curb placed monolithic with concrete pavement. Construct all other types of curb and gutter using steel forms, except, wood may be used for curb or gutter of unusual section or when small quantities are involved, as approved by the Engineer. Use and install forms that will remain true to line and grade. Clean and oil forms before each use.

Use slip form equipment on a satisfactory performance basis and approved by the Engineer.

(3) Reinforcement. Hold reinforcement in the position shown in the Contract Documents by pins, bar chairs or other approved devices.

(4) Expansion. Construct contraction and construction joints for curb and gutter as shown in the Contract Documents. Provide joints and materials of the type and complying with the dimensions shown in the Contract Documents.

Construct planes of weakness in curbs and gutters at locations shown in the Contract Documents.

(5) Placing Concrete. Place concrete according to **DIVISION 400**. Construct edge curb and header curb monolithic with concrete pavement. At locations to be covered with curb, clean all laitance and roughen immediately after finishing. Place and uniformly consolidate concrete without voids, shape with a steel tool to the dimensions shown in the Contract Documents.

Moisten the subgrade before placing concrete for non-monolithic curbs and gutters. Consolidate the concrete with an approved internal type vibrator or by hand spudding and tamping. Shape the surface with a steel tool shaped to produce the cross section shown in the Contract Documents.

Use edgers to round the edges to the designated radii.

(6) Finish. Finish the surfaces of curbs and gutters with a wood float, unless the Contract Documents specifically require a steel trowel or rubbed finish. Light brushing may be required by the Engineer.

(7) Cure. Cure curbs and gutters that are monolithic with concrete pavement in the same manner as specified for the pavement.

Cure all other curbs, gutters and combined curb and gutters immediately after the concrete is finished and hardened sufficiently to prevent detrimental marring, according to **DIVISION 700**.

c. Asphalt. Clean all foreign material from the surface on which curbs and gutters are to be constructed. When placed on an asphalt surface, apply an asphalt tack coat as shown in the Contract Documents.

Form and compact the sections using an automatic mechanical placing machine, except in extremely short radii or through inaccessible areas. When hand placement methods are necessary, form and compact the sections with hand tools and back forms.

The maximum temperature of the asphaltic mixture at the time of placement is 335ºF. The minimum temperature shall be sufficient to allow the material to be placed and compacted, to the specified density and surface tolerance requirements.

When the air temperature is below 50ºF, or the surface temperature is below 55ºF, to obtain an adequate bond between the curb and the surface course, heat the upper portion of the surface course by methods which will not harm the mixture in the surface course.

The Engineer will suspend operations any time that adequate bonding of the section to the surface is not being accomplished. Correct any conditions causing the deficient bonding.

On gutter sections, apply a surface treatment of asphaltic cement in an amount to waterproof the section.

d. Backfilling. Backfill the area adjacent to curbs and gutters with approved material to the top edges of the curbs and gutters or to the cross-sections shown in the Contract Documents. Place and compact the backfill according to **SECTION 204**, except the compaction requirements may be waived where the backfill area falls within the shoulder area which is to be compacted. If the curb and gutter backfill falls within a shoulder or other area which is designated in the Contract Documents to be compacted, backfill the curb and gutter according to the compaction provision for the adjacent material.

e. Curb Repair. Remove old concrete as shown in the Contract Documents, or as directed by the Engineer. Take care to prevent damage to the concrete that is to remain in place. Dispose of broken concrete as approved by the Engineer.

After removing the old concrete in the curb, clean the existing reinforcing steel exposed before the concrete is replaced.

Repair any damage to the existing structure due to the negligence on the part of the Contractor at own expense.

Replace using one of the 2 methods shown below:

(1) Standard, Conventional Method. Repair concrete by standard, conventional procedures as shown in the Contract Documents.

Use Grade 3.0 concrete for repairing curbs unless shown otherwise in the Contract Documents. Apply concrete adhesive to existing surfaces prior to placing new concrete, as designated in the Contract Documents.

(2) Concrete Surface Repair-Shotcrete Method. Repair the concrete, adhering to **SECTION 826**. Either the wet mix or dry mix process may be used.

825.4 MEASUREMENT AND PAYMENT

Excavation for the construction of the various types of curbs and gutters will not be measured separately for payment, but will be considered subsidiary work, except when such excavation may be considered as a part of, and may be measured in conjunction with the roadway excavation. In such instances, the excavation will be included in the quantity of roadway excavation computed as a line item on the contract according to **DIVISION 200**.

The Engineer will measure the various types of curbs and gutters, and combination curb and gutter by the linear foot along the face of the curb.

Type I and II combined curb and gutter will not be measured separately, but the Engineer will measure together as linear feet of combined curb and gutter.

The Engineer will measure gutter by the linear foot along the flowline.

The Engineer will not measure asphalt material or aggregate required to construct the work.

Payment for "Curb, Edge", "Curb, Header", "Curb and Gutter, Combined", "Gutters", "Curb, Protection", "Curb, Asphaltic Concrete", "Gutters, Asphaltic Concrete", "Curb and Gutters, Asphaltic Concrete" and "Curb Repair" at the contract unit prices is full compensation for the specified work.

SECTION 826

CONCRETE SURFACE REPAIR

826.1 DESCRIPTION

Remove the unsound concrete surface and replace the concrete according to the details in the Contract Documents.

BID ITEM	UNITS
Concrete Surface Repair	Square Foot

Note: If this bid item is not included in the Contract Documents, this work is subsidiary to other items in the contract.

826.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTION 1102**
Concrete Curing Materials	**DIVISION 1400**
Reinforcing Steel for Concrete	**DIVISION 1600**
Fibrous Reinforcement for Concrete	**DIVISION 1700**
Shotcrete Concrete	**DIVISION 1700**
Rapid Set Concrete Patching Material*	**DIVISION 1700**

*When specified in the Contract Documents.

a. When specified, provide one of the following types of concrete:

(1) Formed. Use Grade 4.0 (AE)** concrete that complies with **SECTION 401**. Provide concrete with slump that is appropriate for the intended use and acceptable to the Engineer.

(2) Pneumatically Applied. Use Shotcrete concrete that complies with **DIVISION 1700** and has a 28-day compressive strength of 4000 psi**. Wet or dry process is permitted.

(3) Hand packed. Use Grade 3.5 (AE)** with the following exceptions:

(a) Do not include any coarse aggregate (provide a concrete mortar).

(b) Include fibers as specified in **SECTION 1722**.

b. If no type of concrete is specified, provide either material in **subsection 826.2a.(1)** or **(2)**.

** Unless otherwise shown on the plans.

826.3 CONSTRUCTION REQUIREMENTS

Depending on the nature and size of the concrete surface repair, the Engineer will designate the type of concrete used for the repair and the process used for the repair (such as formed and poured, hydraulically applied or hand packed) in the Contract Documents.

- Remove the unsound concrete to the limits designated in the Contract Documents or as directed by the Engineer. The maximum size of chipping hammer allowed for concrete removal is 15 pounds.
- Remove the existing concrete to a depth of 2½ inch (minimum), or deeper if necessary to expose sound concrete. Remove the existing concrete at least ¾ inch beyond any existing steel reinforcement exposed during the removal of the unsound concrete.
- Do not wedge the tip of the chipping hammer between the concrete and reinforcement during concrete removal. Do not impact directly on reinforcement. Debonding of concrete caused by such actions will be repaired at no cost to KDOT.
- Confirm reinforcement bond adjacent to the repair area. Do this by sounding concrete over the reinforcement in the presences of the Engineer prior to placement.
- Chip the perimeter edge of the repair area to near perpendicular (to the concrete surface). Do not feather the edge of the repair area.

- Sandblast, then use compressed air (90 psi min) to clean the prepared repair area and exposed steel reinforcement to remove all bond-inhibiting materials.
- Dampen the clean surface to a surface saturated dry condition just prior to concrete placement.
- Place the repair concrete as specified in the Contract Documents. Match the lines of the existing surface unless shown otherwise in the Contract Documents.
- Cure the concrete as directed by the Engineer.

Additional Requirements for Shotcrete: During the preconstruction meeting, demonstrate competence of the nozzleman by providing a copy of a current ACI Shotcrete Nozzleman certificate for the appropriate application.

Apply the shotcrete according to the manufacturer’s recommendations. Provide the Engineer with a printed copy of the manufacturer’s recommendations.

826.4 MEASUREMENT AND PAYMENT

When shown as a bid item in the contract, the Engineer will measure the concrete surface repairs by the square foot. If the bid item for this work is not included in the Contract Documents, the Engineer will not measure the concrete surface repairs for payment.

Payment for "Concrete Surface Repair" at the contract unit price is full compensation for the specified work.

SECTION 827

GUARDRAIL AND GUIDEPOSTS

827.1 DESCRIPTION

Construct the designated type of guardrail and guidepost as shown in the Contract Documents.

BID ITEMS	UNITS
Guardrail, Steel Plate	Linear Foot
Guardrail, Cable	Linear Foot
Guardrail, Removal of Steel Plate	Linear Foot
Guardrail, Removal of Cable	Linear Foot
Guardrail, Removal of Timber	Linear Foot
Guardrail, Reconstruction of Steel Plate	Linear Foot
Guardrail, Reconstruction of Cable	Linear Foot
Guardrail, Removal and Reconstruction of Steel Plate	Linear Foot
Guardrail, Removal and Reconstruction of Cable	Linear Foot
Guideposts	Each
Guideposts, Removal of	Each
Guideposts, Resetting of	Each
Guideposts, Removal and Resetting of	Each
Guardrail Posts	Each
Guardrail End Terminal (*)	Each
Guardrail, Steel Plate (Temporary)	Linear Foot

*Type

827.2 MATERIALS

Provide materials that comply with the applicable requirements.

Posts	**DIVISION 2300**
Preservative Treatment for Timber	**DIVISION 2300**
Wire Cable and Fittings	**DIVISION 1600**
Metal for Guardrail and Fittings	**DIVISION 1600**
Paint	**DIVISION 1800**

827.3 CONSTRUCTION REQUIREMENTS

a. General. When steel plate guardrail is shown in the Contract Documents, any one of the types of steel plate guardrail shown may be provided, but only one type may be used on a project.

b. Erection of Guardrail and Guideposts. Excavate holes for guardrail posts and guideposts to the required depth. Excavate holes to permit compaction of the backfill around the posts.

Guardrail posts and guideposts may be set by driving. Use post caps that are designed to protect the post from detrimental crushing during the driving operations. If damaged or an unacceptable line and grade is obtained, excavate for the erection of the posts.

Set posts plumb, firm and to lines and grades shown in the Contract Documents. Place backfill around the posts in thin layers and thoroughly compact. For the top of the backfill, use the same material of at least the same thickness as that used in construction of the shoulders at that point.

Place and fasten guardrail cables, plates, shapes and fittings as shown in the Contract Documents.

When guardrail is removed and reused on the project, thoroughly clean guardrail prior to erection. Punch or drill the guardrail to accommodate the revised post spacing as shown in the Contract Documents. When guardrail is required to be cut, make the cut by sawing. Treat all such holes and cuts with zinc dust paint.

Install guardrail end terminals according to the manufacturer's requirements and the Contract Documents.

c. Removal of Guardrail or Guideposts. Carefully disassemble guardrail. Prevent undue injury to the rail, fittings and posts. Remove guardrail posts and guideposts without damage and store according to **subsection 827.3f.** at locations approved by the Engineer. The material will remain the property of the owner.

d. Reconstruction of Guardrail and Resetting of Guideposts. Guardrail and accessories to be reconstructed or guideposts to be reset will be provided by the owners from the project or a storage site as shown in the Contract Documents. Reconstruct the guardrail and reset the guideposts according to the requirements above for new guardrail and guideposts.

e. Removal and Reconstruction of Guardrail and Removal and Resetting of Guideposts. Comply with **subsections 827.3c.** and **d.** except that the Contractor is responsible for all materials and will replace at own expense any missing materials from the removal, material lost or damaged during the removal, storage or reconstruction.

f. Guardrail, Steel Plate (Temporary). Install guardrail according to this specification. Remove guardrail when directed by the Engineer, or as specified in the Contract Documents.

g. Storing Galvanized Guardrail. Store all galvanized rail elements, end sections and accessories to prevent galvanic action. Do not store in direct contact with the soil. The material may be stored in the open, provided it is properly separated, stacked and drained.

Protect galvanized surfaces which have been abraded exposing the base metal, threaded portions of all fittings and fasteners and cut ends of bolts from moisture, soil or other damaging elements.

The Contractor is responsible for the condition of the material in storage.

827.4 MEASUREMENT AND PAYMENT

The Engineer will measure construction, removal, reconstruction or removal and reconstruction of guardrail by the linear foot. Each separate run of rail will be measured from center of end post to center of end post along the rail or may be determined by recording the number of standard length panels installed.

The Engineer will measure each guidepost to be set, removed, reset or removed and reset.

The Engineer will measure each guardrail post provided and set.

The Engineer will measure each guardrail end terminal, including accessories, posts and hardware as a complete system.

The Engineer will measure temporary guardrail by the lump sum.

The Engineer will not measure excavation and backfill for separate payment. These items are subsidiary to other items in the Contract Documents.

Any required treatment shown in the Contract Documents for wood members is subsidiary to the item of reconstruction of steel plate guardrail.

Payment for "Guardrail, Steel Plate", "Guardrail, Steel Plate (Temporary)", "Guardrail, Cable", "Guardrail, Removal of Steel Plate", "Guardrail, Removal of Cable", "Guardrail, Removal of Timber", "Guardrail, Reconstruction of Steel Plate", "Guardrail, Reconstruction of Cable", "Guardrail, Removal and Reconstruction of Steel Plate", "Guardrail, Removal and Reconstruction of Cable", "Guideposts", "Guideposts, Removal of", "Guideposts, Resetting of", "Guideposts, Removal and Resetting of", "Guardrail Posts", and "Guardrail End Terminal" at the contract unit prices is full compensation for the specified work.

SECTION 828

FENCING

828.1 DESCRIPTION

Construct the designated type of fence and gates as shown in the Contract Documents.

BID ITEMS	UNITS
Fence (*) (**) (***)	Linear Foot
Fence (*) (Temporary)	Linear Foot
Fence (*) (Removal and Resetting)	Linear Foot
Fence (Removal of Existing)	Linear Foot
Gate (*) (**)	Each
Posts (Corner) (*)	Each
Posts (End) (*)	Each
Posts (Pull) (*)	Each
Floodgates	Each

*Barbed Wire, Chain Link, Single Wire Cable Woven Wire (Type A, Type B or Type A or B) or other type specified in the Contract Documents.
** Size, when necessary.
*** Special

828.2 MATERIALS

Provide materials that comply with the applicable requirements.

Woven Wire Fence Fabric	**DIVISION 1600**
Chain Link Fence Fabric	**DIVISION 1600**
Barbed Wire	**DIVISION 1600**
Steel Posts and Braces	**DIVISION 1600**
Wood Posts	**DIVISION 2300**
Preservative Treatment for Timber	**DIVISION 2300**
Gates	**DIVISION 1600**
Tension Wire	**DIVISION 1600**
Fittings	**DIVISION 1600**
Wire Cable and Fittings for Highway Fence	**DIVISION 1600**
Floodgates	**DIVISION 1600**
Concrete and Grout	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTION 1102**

When designated in the Contract Documents, use metal "T" section commercial grade posts for barbed wire fence weighing a minimum of 1 ⅓ pounds per foot after galvanizing.

Use material for temporary fence meeting recognized industry standards. Temporary fence material may have been previously used. The Engineer will approve the temporary fencing materials on the basis of condition and compliance with dimensional requirements.

828.3 CONSTRUCTION REQUIREMENTS

a. General. Confine activities and operations to the area immediately adjacent to the right-of-way lines and within the highway right-of-way or as shown in the Contract Documents. The Contractor is responsible for satisfactory arrangements for permits, as required, from adjacent property owners.

When the Contractor's operations create the need for temporary fencing, provide and install temporary fencing and appurtenances until such time that the permanent fence is in place (or until the temporary fence is no longer required). At the discretion of the Engineer, temporary fencing may be erected without concrete footings, pull posts, corner posts, etc. Remove the temporary fencing and appurtenances from the project site, when directed by the Engineer. Temporary fencing materials will remain the property of the Contractor.

(1) Clearing. When necessary, clear the path of the fence line.

(2) Trench Excavation. When necessary, excavate a trench to line and grade in areas of irregular ground to secure clearance between the ground line and the bottom of the fence fabric, or to permit placing steel fence wire below the bottom of the fence fabric at stream crossings. In areas where rock is encountered, excavate the rock as necessary to the required line and grade. Backfill any excavation of rock below the required grade with suitable materials as directed by the Engineer. Construct trenches to provide proper drainage. In general, the bottom of the fence will follow the contour of the ground according to standard industry practice in constructing fence of the types specified.

b. Concrete Footings. When required, construct footings of commercial grade concrete according to the Contract Documents.

Volumetric proportioning and hand mixing of concrete is permitted for concrete footings where small quantities are required.

Extend the top of the footing slightly above the ground line and steel trowel to a smooth finish with a slope to drain away from the post. Center posts, braces and other units in their footings. Set the posts and braces in advance of placing the fence to allow the concrete time to obtain its strength.

c. Posts Set in Rock. Where rock occurs within the required depth to which fence posts are to be erected, drill a hole of a diameter slightly larger than the largest dimension of the post in the rock and grout in the posts. When shown in the Contract Documents, cast in place the concrete footing as specified in **subsection 828.3b.**, between the top of rock and the required grade. At line posts, where top of rock is 8 inches or less below the required grade, remove the anchor plate. At all line posts, backfill the excavation above the top of rock with excavation materials placed in 4 to 6-inch layers. Thoroughly tamp each layer in place.

d. Structure Terminals. Place structure terminal assemblies at all stock passes, crossroad underpasses or overpasses and major drainage structures as shown in the Contract Documents.

e. Floodgates and Channel Crossings. Construct floodgates and channel crossings as shown in the Contract Documents.

f. Intermediate or Line Posts. Erect each post plumb, and horizontally line up all posts between horizontal angle points with no perceptible variation. Erect with line post spacing as uniform as practicable under local conditions, with maximum spacing as shown in the Contract Documents and a tolerance of minus 2 feet.

g. Pull Posts. Construct pull post assemblies (to the approximate spacing shown) in straight runs and at each vertical angle point as described in the Contract Documents.

h. Corner Posts. Place corner post assemblies at all horizontal angle points, and erect to comply with the measurement shown in the Contract Documents.

i. End Posts. Construct end post assemblies in the line of the fence at all terminal points. When gates and flood gates are required, use end posts to attach the gate or flood gate.

j. Identification Signs. Provide and place identification signs as shown in the Contract Documents.

k. Erection of Gates. Provide all materials necessary to complete the installation of pedestrian and vehicular gates as shown in the Contract Documents.

Carefully align all gates with posts vertical. Tightly assemble clamps used for attaching hardware. Construct the bottom of each gate 3 to 5 inches above the ground when closed, and to clear the ground by a minimum of 3 inches at all points in its swing. Modify the existing grade within the area of swing to meet this requirement, as directed by the Engineer. Direction of swing of gates will be shown in the Contract Documents. Install all gate stops as shown in the Contract Documents. For all gates, provide stops with latches, or other approved means for holding gates open, and place to prevent damage to the gate or fence by over-swing. Provide stops to arrest the swing of a closed gate at the centerline of the fence.

l. Removal of Existing Fence. Remove the existing fence and store at locations as directed by the Engineer. Reset existing fence to be removed and reset, as shown in the Contract Documents.

Provide all new materials necessary for resetting fence.

m. Erection of Woven Fence. Unless shown otherwise in the Contract Documents, either type of woven wire fence shown may be provided, but only one type may be used on a project.

Place the bottom of the fabric of woven wire fence a nominal distance of 3 inches above the ground line. However, over irregular ground, a clearance of 1 to 6 inches for a distance less than 8 feet is permitted. Perform any necessary excavation and backfilling required to comply as specified in **subsection 828.3a.(2)**.

Set all metal end, corner, pull and brace posts and all braces in concrete footings as shown in the Contract Documents. The dimensions of the footings may be varied as permitted by the Engineer, but shall provide an equal volume of concrete. Except where rock is encountered, set or drive intermediate or line posts into the ground. Provide metal posts with an approved plate or other anchor device to hold the post plumb and in proper alignment. The plate or anchor shall be satisfactorily welded or riveted (not less than 2 rivets) to the post. Wood posts may be driven or set in pre-bored holds. Remove any posts damaged by driving.

After posts are permanently positioned and concrete footings are fully set, place fabric by securing or fastening one end and applying sufficient tension to remove all slack before making permanent attachments. Fasten the lateral wires to end, corner and pull posts by wrapping the wires around the posts and tying the wire back on itself with a minimum of 5 twists wrapped tightly. Perform tying by using tools designed for the purpose according to the fence manufacturer’s recommendation.

Apply the tension for stretching the fence by use of mechanical fence stretchers and with single wire stretchers, according to the fence manufacturer’s recommendations. Securely make all splices in the fabric according to the fence manufacturer’s recommendations, and using tools designed for that purpose.

Fasten fence fabric to steel intermediate or line posts with ties or clamps, and to wood posts with staples at the bottom and top 2 wires and other alternate intermediate lateral wires. Where the design of the line post incorporates satisfactory provision for supporting and securing the fabric wire to the post, the Engineer may eliminate tie wires or clamps.

n. Erection of Chain Link Fence. Set the posts sufficiently in advance of the placing of the fabric to allow the concrete time to obtain its design strength. Set the bottom of the fabric 3 inches above the finished ground line. Fasten the fabric to the tension wires as shown in the Contract Documents.

(1) Post Spacing and Setting. Set posts with a maximum spacing of 10 feet and set a minimum of 2 ½ feet below the finished surface of the ground in concrete footings as shown in the Contract Documents. Construct the concrete footings of a size and shape shown in the Contract Documents.

(2) Fabric bands with fasteners. Fasten fabric to line posts with aluminum or galvanized fabric bands spaced approximately 14 inches apart. Securely fasten the fabric to the end posts by approved type metal fasteners.

o. Erection of Barbed Wire Fence. Erect the fence as shown in the Contract Documents.

For intermediate or line posts, use either wood or metal posts of the type shown in the Contract Documents, but only one type may be used on the project,

Excavate holes for wooden posts on line and to the depth shown in the Contract Documents, and of sufficient size to permit adequate compaction of the backfill around the post.

Set corner posts and support posts, and securely brace and wire before setting the intermediate posts. Space the intermediate posts equal distances apart, 13 ½ feet maximum. Set the posts plumb, firm and true to designated line and grade. If not set in concrete, place the backfill around the posts in thin layers and thoroughly compact.

If metal posts are used for the intermediate posts, drive with an approved mechanical device to the depth shown in the Contract Documents.

Use brace wire consisting of 2 complete loops of No. 9 smooth, galvanized wire. Twist the loops both above and below the brace post until tight.

Draw barbed wire taut with an approved mechanical device and securely fasten to each post with a minimum of 1 fence staple or approved wire clip. Loop the wire around the end and corner posts, and fasten with sufficient staples to anchor the wire securely.

p. Erection of Single Wire Cable Fence. Construct single wire cable fence as shown in the Contract Documents. Set all required posts as shown in the Contract Documents by driving or drilling and backfilling. Use either metal or wood posts, but only one type may be used on the project

q. Electrical Grounds. Immediately below where a power line crosses a fence, ground the fence with a galvanized or copper coated rod, 8 feet long and a minimum of ⅝ inch in diameter, driven vertically until the top is approximately 6 inches below the top of ground. Braze or attach a No. 6 solid copper conductor with an approved clamp to the rod and to the fence so each element of the fence is grounded. Install the ground rod immediately below the point of crossing.

r. Erection of Chain Link Fence (Special). Erect the Chain Link Fence (Special) as shown in the Contract Documents.

828.4 MEASUREMENT AND PAYMENT

The Engineer will measure various sections of fence, fence to be removed and fence to be removed and reset by the linear foot from center to center of terminal posts, excluding gate length.

The Engineer will measure single wire cable fence by the linear foot, except no measurement will be made for corner posts and end posts for this type of fence.

The Engineer will measure each Post (Corner), Post (Pull) and Post (End). Gate and floodgate posts required will be measured as Post (End).

The Engineer will measure temporary fencing including appurtenances by the linear foot when shown in the Contract Documents or directed by the Engineer. The Engineer will not measure temporary fencing and appurtenances necessitated by the Contractor's operations.

The Engineer will not measure clearing, excavation, backfill, drilling of rock, electrical grounds, structure terminals, channel crossing and line posts for payment. These items are subsidiary to the various fencing items in the Contract Documents.

Payment for various types of "Fence", "Fence (Temporary)", "Fence (Removal and Resetting)", "Fence (Removal of Existing)", "Gates", "Posts (Corner)", "Posts (End)", "Posts (Pull)", and "Floodgates" at the contract unit prices is full compensation for the specified work.

Quantities shown in the Contract Documents for temporary fencing are for estimating purposes only. No adjustment in the contract unit price will be made regardless of the amount of underruns or overruns.

SECTION 829

RIPRAP

829.1 DESCRIPTION

Construct the designated type of riprap as shown in the Contract Documents.

BID ITEM	**UNITS**
Riprap (*) (**)	Square Yard

*Type: light stone, grouted light stone, heavy stone, grouted heavy stone, or reinforced concrete
**Thickness of reinforced concrete riprap

829.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete and Grout	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTION 1102**
Stone	**DIVISION 1100**
Type 2 Liquid Membrane-Forming Compound	**DIVISION 1400**
Type B Preformed Expansion Joint Filler	**DIVISION 1500**
Reinforcing Steel	**DIVISION 1600**
Welded Steel Wire Fabric	**DIVISION 1600**

829.3 CONSTRUCTION REQUIREMENTS

a. General. Grade the locations where the riprap is to be placed as shown in the Contract Documents. Prepare for the riprap by undercutting to the depth required for the riprap. After the riprap is completed, backfill and compact around the structure.

b. Reinforced Concrete Riprap. After the steel reinforcement is in place, place the concrete starting at the lower end and progressing to the upper end of the riprap. Use Grade 3.0 concrete, unless shown otherwise in the Contract Documents. Uniformly consolidate the concrete without voids.

Finish the concrete surface with a wooden float, followed by a light brooming. Do not walk on the concrete surface during placement.

Apply Type 2 liquid membrane-forming compound as the curing medium, immediately after the concrete surface is finished, and before the set takes place. Maintain the cure for 7 days. In cold weather, maintain the concrete temperature above 32°F for the first 4 days of the 7 day cure period.

c. Stone Riprap and Grouted Stone Riprap. Place the riprap stones on edge with the bedding plane at right angles to the slope. Place the stones with ends and sides abutting, as much as the size and shape of the stones will allow. Fill the larger spaces between stones with spalls. The finished riprap shall have an even and uniform surface that complies with the Contract Documents.

When designated in the Contract Documents, fill the spaces between the stones with concrete grout. Brush the grout into the spaces until all voids are filled.

Cure the concrete grout according to the requirements for reinforced concrete riprap **subsection 829.3b**.

829.4 MEASUREMENT AND PAYMENT

The Engineer will measure reinforced concrete riprap, stone riprap and grouted stone riprap by the square yard, measured along the finished surfaces.

Payment for "Riprap" at the contract unit price is full compensation for the specified work.

SECTION 830

SLOPE PROTECTION

830.1 DESCRIPTION

Construct slope protection on bridge berms, fill slopes and channel banks as shown in the Contract Documents.

BID ITEMS	UNITS
Bedding for Slope Protection	Cubic Yard
Slope Protection (*) (**) (***)	Cubic Yard
Slope Protection (Gabion)	Cubic Yard
Slope Protection (Special)	Cubic Yard
Geotextile Fabric	Square Yard

*Type: aggregate, shot rock or riprap stone
**Thickness
***Grouted, when specified

830.2 MATERIALS

Provide materials that comply with the applicable requirements.

Grout	**DIVISION 400**
Aggregate that complies with Stone for Aggregate Ditch Lining	**DIVISION 1100**
Stone	**DIVISION 1100**
Bedding that complies with Type III Stone for Filter Course	**DIVISION 1100**
Type 2 Liquid Membrane-Forming Compound	**DIVISION 1400**
Geotextile Fabric	**DIVISION 1700**

Unless prohibited in the Contract Documents, and when approved by the Engineer, the Contractor may use concrete rubble entirely or in combination with the material designated in the Contract Documents. If concrete rubble is substituted for the aggregate or stone designated in the Contract Documents, the Engineer will waive the quality requirements, and will determine compliance with the gradation requirements by visual inspection. Provide concrete rubble that is broken concrete from existing structures. Remove asphalt overlays and patches on the deck of the structure before the concrete is rubblized. Cut off and remove all protruding reinforcing steel in the concrete rubble.

The maximum dimension of the slope protection or concrete rubble in any direction shall not exceed the thickness shown in the Contract Documents. Large flat pieces of concrete rubble are prohibited.

830.3 CONSTRUCTION REQUIREMENTS

Construct the bridge berms, fill slopes and channels to the lines and grades shown in the Contract Documents. Prepare for the slope protection by undercutting the finished berms, slopes and channels to the depth necessary for the slope protection. After the slope protection is completed, backfill and compact around the structure.

Construct the slope protection to the lines and grades shown in the Contract Documents. A tolerance of +6 inches from the slope lines and grades is allowed.

Underlay the slope protection with geotextile fabric at the locations designated in the Contract Documents. Provide the Engineer with a copy of the manufacturer's recommendation. Install and secure the geotextile fabric as recommended by the manufacturer.

Replace any geotextile fabric damaged or displaced during construction.

Place the bedding for the slope protection at the locations designated in the Contract Documents. Place the bedding in its full course thickness in one operation, using methods of placement that will not segregate the material. The finished surface of the bedding shall be uniform. Compaction of the bedding is not required.

Place the slope protection the full course thickness in one operation. Do not use methods of placing the rocks that will segregate the various sizes of rocks. Do not use heavy equipment (working upon the slope protection) to the spread the rocks. Do not place oversized rocks on the slopes. Place the slope protection to produce a reasonably well-graded mass of rocks with a minimum amount of voids. The finished slope protection shall be free of pockets of small rocks and clusters of larger rocks. Rearrange individual rocks (by hand or mechanical equipment) to the extent necessary to obtain a reasonably well-graded distribution of rock sizes.

When designated in the Contract Documents, pour concrete grout over the slope protection to fill all the voids. Apply Type 2 liquid membrane-forming compound as the curing medium. Apply the curing medium immediately after the concrete surface is finished, and before the set takes place. Maintain the cure for 7 days. In cold weather, maintain the concrete temperature above 32°F for the first 4 days of the 7 day cure period

830.4 MEASUREMENT AND PAYMENT

The Engineer will measure the bedding for slope protection and slope protection by the cubic yard. The Engineer will measure the geotextile fabric by the square yard to the limits of the bedding for slope protection.

Payment for "Bedding for Slope Protection", "Slope Protection" and "Geotextile Fabric" at the contract unit prices is full compensation for the specified work.

SECTION 831

DITCH LINING

831.1 DESCRIPTION

Construct the designated types of ditch lining as shown in the Contract Documents.

BID ITEMS	UNITS
Aggregate Ditch Lining (*)	Ton
Aggregate Backslope Ditch Lining	Ton
Concrete Ditch Lining	Square Yard
Concrete Backslope Ditch Lining	Square Yard
*Size	

831.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete and Grout .... **SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade .... **SECTION 1102**
Stone .... **DIVISION 1100**
Type 2 Liquid Membrane-Forming Compound .... **DIVISION 1400**
Welded Steel Wire Fabric .... **DIVISION 1600**
Fibrous Concrete Reinforcement (macro) .... **DIVISION 1700**

831.3 CONSTRUCTION REQUIREMENTS

a. General. Construct the ditch to the lines and grades shown in the Contract Documents before placing the ditch lining. Prepare for the ditch lining by undercutting the finished ditch to the depth required for the ditch lining. When required, compact the excavated area. The subgrade shall be well compacted prior to placing ditch lining. After the ditch lining is completed, backfill and compact around the structures.

b. Aggregate Ditch Lining and Aggregate Backslope Ditch Lining. Construct the aggregate ditch lining and aggregate backslope ditch lining according to the Contract Documents.

c. Concrete Ditch Lining and Concrete Backslope Ditch Lining. Construct the concrete ditch lining and concrete backslope ditch lining according to the Contract Documents. After the steel reinforcement is in place, place the concrete starting at the lower end and progressing to the upper end of the ditch lining.

Use Grade 3.0(AE) concrete, unless shown otherwise in the Contract Documents.

Fibrous concrete reinforcement may be used in lieu of steel mesh, unless specified otherwise in the Contract Documents. If fibrous concrete reinforcement is used, comply with these requirements:

- Use the macrofibers at the rate specified by the manufacturer. Add the macrofibers to the concrete mixture at the same time the individual concrete components are added and before the mixing revolutions are started at the concrete batch plant.
- Have a technical representative of the macrofiber manufacturer present at the concrete batch plant to obtain proper proportioning and mixing of the product. The Engineer will waive this requirement if the Contractor can provide evidence of previously satisfactorily using the product.

Uniformly consolidate the concrete without voids. Finish the concrete surface with a wooden float, followed by a light brooming. Do not walk on the concrete surface during placement.

Apply Type 2 liquid membrane-forming compound as the curing medium. Apply the curing medium immediately after the concrete surface is finished, and before the set takes place. Maintain the cure for 7 days. In cold weather, maintain the concrete temperature above 32°F for the first 4 days of the 7 day cure.

831.4 MEASUREMENT AND PAYMENT

The Engineer will measure aggregate ditch lining and aggregate backslope ditch lining by the ton.

The Engineer will measure concrete ditch lining by the square yard, measured along the finished surfaces.

Payment for "Aggregate Ditch Lining", "Aggregate Backslope Ditch Lining", "Concrete Ditch Lining" and "Concrete Backslope Ditch Lining" at the contract unit prices is full compensation for the specified work.

SECTION 832

GABIONS

832.1 DESCRIPTION

Construct gabions according to the details shown in the Contract Documents.

BID ITEM	**UNITS**
Gabions	Cubic Yard/Square Yard

832.2 MATERIALS

To fill the gabions, provide stone for riprap (of the size shown in the Contract Documents) that complies with **DIVISION 1100**.

Provide gabions that comply with **DIVISION 1700**.

832.3 CONSTRUCTION REQUIREMENTS

Provide the Engineer with a copy of the manufacturer's instructions for installation of gabion. Before erecting the gabion baskets, grade the subgrade to the lines and grades (±1 inch) shown in the Contract Documents.

Assemble the gabion baskets according to the manufacturer's instructions. Do not damage the wire coatings on the baskets during assembly, structure erection, cell filling or backfill. Repair damaged wire coating as recommended by the manufacturer.

Erect the gabion baskets on the prepared subgrade, and interconnect the adjacent baskets according to the manufacturer's instructions. Stagger the vertical joints between baskets of adjacent rows and layers by a minimum of ½ the cell length. Anchor gabion baskets as recommended by the manufacturer.

Remove all kinks and folds in the wire mesh, and align the baskets before filling the cells with stones. Carefully place the stones in baskets to prevent bulging of the baskets, and to minimize voids between the stones. Place internal connecting wires (as recommended by the manufacturer) concurrently with the placement of the stones. Fill the baskets and secure the basket lids as recommended by the manufacturer. Make all exposed basket surfaces smooth and neat with no sharp stone edges projecting through the wire mesh.

Backfill the structure according to **SECTION 204**.

832.4 MEASUREMENT AND PAYMENT

When units are shown in the Contract Documents as cubic yard, the Engineer will measure the quantity of stone used to fill the gabions by the cubic yard.

When units are shown in the Contract Documents as square yard, the Engineer will measure the gabion by the square yard.

Payment for "Gabions" at the contract unit price is full compensation for the specified work.

SECTION 833

PAVEMENT PATCHING

833.1 DESCRIPTION

a. General. Patch the existing PCCP pavement as shown in the Contract Documents or at locations directed by the Engineer. Patches will be either full depth or partial. The purpose is to repair surface spalls at joint and cracks or repair joints and slabs that are cracked or shattered.

b. Asphalt Pavement Patching of PCCP. This procedure is for the repair of PCCP pavement. This should be considered temporary in nature.

c. PCCP Patching (Full Depth). This procedure is for patching full depth deterioration of PCCP at joints and cracks.

d. PCCP Edge Joint Patching.

1. PCCP Edge Joint Patching (Partial Depth). This procedure is for repair of longitudinal joints or pavement edges with shallow spalls or honeycombing that are in the upper half of the pavement.
2. PCCP Edge Joint Patching (Full Depth). This procedure is for patching full depth deterioration or honey-combed pavement edges.

e. PCCP Joint and Crack Patching.

1. PCCP Joint and Crack Patching (Partial Depth). This procedure is for the repair of joint spalls, midpanel cracks and interior surface spalls (high steel).
2. PCCP Joint and Crack Patching (Full Depth). This procedure is for patching of full depth deterioration of transverse and longitudinal joints and their intersections.

f. Extra Work Saw Cuts. Make additional saw cuts, when required, to expand a patch, or to change a partial depth patch to a full depth patch.

BID ITEMS	UNITS
Asphalt Pavement Patching of PCCP	Ton
PCCP Patching (Full Depth) (*) (**)	Square Yard
PCCP Edge Joint Patching (***)	Square Yard
PCCP Joint and Crack Patching (***)	Square Yard
Extra Work Saw Cuts (Set Price)	Linear Foot

*Thickness
**Sound or Unsound
***Partial Depth or Full Depth

833.2 MATERIALS

Provide materials that comply with the applicable requirements.

HMA-Commercial Grade	**SECTION 611**
Emulsified Asphalt (SS-1H and CSS-1H)	**DIVISION 1200**
Concrete (AE)	**SECTIONS 401 & 403***
Aggregates for Concrete On Grade	**SECTION 1116***
Concrete Curing Materials	**DIVISION 1400**
Joint Sealer and Filler Material	**DIVISION 1500**
Reinforcing Steel	**DIVISION 1600**
Rapid-Set Concrete Patching Material	**DIVISION 1700**
Cement	**DIVISION 2000**
Grade 2 Calcium Chloride	**DIVISION 1700**
Bond Breaker	**DIVISION 1700**

*Unless specified otherwise in the Contract Documents.

833.3 CONSTRUCTION REQUIREMENTS

a. General. Prepare the areas for patching according to the Contract Documents. Unless otherwise provided in the Contract Documents, restrict the pavement patching operations to 1 traffic lane at all times.

Schedule the patching operations so that the areas prepared for patching are patched the same day the deteriorated pavement is removed. If unavoidable delays prevent patching the same day, and traffic will be routed back onto the lane, fill the excavated areas with a compacted (temporary) asphalt mixture before nightfall. If there are safety issues with adjacent traffic encroaching on the prepared patch areas, fill the excavated areas before nightfall with a compacted (temporary) material such as AB-3, reclaimed concrete or asphalt millings, or as approved by the Engineer

Delineate the limits of the patch by sawing the existing pavement to the depth indicated before removing the deteriorated pavement. Use a saw that will produce a smooth cut for the required depth. Coordinate the pavement sawing and patching operations so that the sawed areas are patched within 3 working days.

Prepare the areas for patching by removing the deteriorated pavement to the limits designated in the Contract Documents. If the removal of the deteriorated pavement to the designated limits reveals further deterioration in the existing pavement, extend the limits of the patch to include the exposed deficient pavement, as directed by the Engineer.

When removing the deteriorated pavement, do not damage the remaining pavement. Repair or replace any damaged, remaining pavement. Do not disturb the base or subgrade while preparing the areas for patching, except to accommodate the thickness of pavement patching shown in the Contract Documents. If the base or subgrade is disturbed, adjust and re-compact the base or subgrade to the required lines and grades.

- If the subgrade is crushed stone subgrade, bring back to line and grade with Aggregates for Backfill.
- If the base is cement treated base or aggregate base, bring back to line and grade with AB-3.
- If the base is granular base, bring back to line and grade with Aggregate for Granular Base.
- If the base is asphaltic treated base, bring back to line and grade with HMA.
- If the base is bound drainable base, bring back to line and grade with Coarse Aggregate for Structural Concrete SCA-4, **TABLE 1102-2**.

Adjusting, re-compacting and bringing back base or subgrade to the required lines and grades is subsidiary to the patching item.

When consecutive multiple slabs are being replaced and lane closure time needs to be limited, at the Contractor’s option and with the Engineer’s approval, concrete may be used to fill the removed base material. Concrete used to fill the base is subsidiary to the patching item.

Remove all waste materials the same day they are excavated.

b. Asphalt Pavement Patching of PCCP. After the location of the patch is defined, saw and remove the deteriorated pavement. Then, clean the exposed edges of the existing pavement. Before placing the HMA patch, apply a thin tack coat of emulsified asphalt to the clean edges of the existing pavement.

Place the HMA in uniform layers of 3 inches or less in thickness. Compact each layer until no further consolidation is observed. Clean the surface of the preceding layer of compacted HMA before the succeeding layer of asphalt material is placed.

c. PCCP Patching Location. Reference the location of the existing joints in the concrete pavement before removing the deteriorated pavement. During the patching operations, establish new joints at the same locations as the original joints.

d. PCCP Patching Removal.

(1) Full Depth Patches. Define and saw the limits of full depth patches the full depth of the existing concrete pavement. If the existing concrete pavement will receive an overlay the same construction season, a rock saw is allowed for the sawing. If the boundaries of consecutive areas to be repaired are less than 6 feet apart, also remove and replace the areas between the patches.

(2) Partial Depth Patches. The minimum patch size for partial depth patches is 4 inches by 12 inches. Delineate the limits of partial depth patches a minimum of 2 inches beyond the area of deteriorated pavement. If areas defined for partial depth patches are less than 12 inches apart, include the areas into a single patch.

(a) Removal (Longitudinal Joint).

- **Saw and Jackhammer.** Saw the limits of partial depth patches according to the Contract Documents. Use jackhammers to remove the deteriorated pavement to the depth shown in the Contract Documents. Cut out or chip away the connecting edges below the sawed portion to as near true lines with vertical faces, as possible; or
- **Saw, Mill and Jackhammer.** Saw the limits of partial depth patches according to Contract Documents. Mill within the limits of the sawcut without damaging the vertical edges of the patch. Carefully, jackhammer any material left at the edges; or
- **Mill.** The Engineer may approve a milling process based on the satisfactory performance of the equipment and the Contractor's process. The operation shall result in minimal edge spalling at the surface.

(b) Removal (Transverse Joint).

- **Saw and Jackhammer.** Saw the limits of partial depth patches according to contract documents. Use jackhammers to remove the deteriorated pavement to the depth shown in the Contract Documents. Cut out or chip away the connecting edges below the sawed portion to as near true lines with vertical faces as possible; or
- **Saw, Mill and Jackhammer.** Saw the limits of partial depth patches according to Contract Documents. Mill within the limits of the sawcut without damaging the vertical edges of the patch. Carefully, jackhammer any material left at the edges.

Use jackhammers (30 pounds maximum size) to remove the deteriorated pavement to the depth shown in the Contract Documents.

Use only self-propelled milling machines designed to perform only milling operations. Mills attached to other equipment are prohibited, except in small irregular areas.

After the deteriorated pavement is removed to the saw or mill depth, use a steel-faced hammer or steel chain drag to check for unsound concrete below this depth. If unsound concrete is detected, use jackhammers (30 pounds maximum size) to remove the deteriorated pavement below the saw or mill depth.

If the unsound concrete encountered is more than 4 inches deep and constitutes more than 50% of the surface area of the patch, the Engineer will determine if the patch should be repaired according to **subsection 833.3d.(1)** Full Depth Patches.

If the pavement patch is started according to the details for Joint and Crack Patching (Partial Depth) and the Engineer changes the patch to a full depth patch, construct the full depth patch according to the details for Full Depth Joint and Crack Patching. See PCCP Joint and Crack Patching standard details.

If the pavement patch is started according to the details for Edge Joint Patching (Partial Depth) and the Engineer changes the patch to a full depth patch, construct the full depth patch according to the details for Full Depth Edge Joint Patching. See PCCP Edge Joint standard details.

e. PCCP Patch Preparation. Clean the partial depth patches using compressed air or a stiff rotary broom. Sandblast the cavities of the partial depth patches to expose aggregate and mortar. Clean with compressed air as the final preparation prior to placing the grout and concrete.

When required, place edge forms and joint fillers before concrete placement.

Apply bondbreaker to exposed dowel bars.

If required, drill holes and grout the specified steel reinforcement into the existing concrete pavement according to **SECTION 842**.

f. PCCP Patch Concrete Placement. For partial depth patches, apply concrete grout (1 part cement, 3 parts water by weight) to the prepared surfaces of the patch just prior to concrete placement. If the grout dries before the concrete is placed, remove the dried grout by sandblasting and re-apply fresh grout. Place and consolidate the specified concrete in the areas prepared for patching, strike-off the concrete flush with surface of the existing pavement, and finish the surface with a wooden float or another method approved by the Engineer. Provide a broom or burlap drag surface texture to the plastic concrete.

Remove the backer board from formed joints or flush sawed joints with water. Sand blast the vertical faces of the joints to be sealed. Clean the sand blasted joints with compressed air and seal the joints according to the Contract Documents.

Do not place concrete patches if the ambient air temperature is below 40ºF. If the ambient air temperature is below 60°F when the concrete patches are placed, the Engineer may require additional curing time. Uniformly consolidate the concrete without voids. Apply the curing materials before the undue loss of moisture occurs.

g. Finishing. Secure a smooth surface, correcting surface variations exceeding ⅛ inch in 10 feet by use of an approved profiling device, or other method approved by the Engineer. Check variations of the pavement patch and 5 feet into the abutting, existing pavement.

h. PCCP Patch Curing. Unless directed otherwise by the Engineer, cure the concrete patches by applying liquid membrane-forming compound at the rate of 1 gallon per 100 square feet to the finished patch. If the existing concrete pavement will be overlaid with HMA in the near future, the Engineer may require that concrete patches are cured with emulsified asphalt.

i. Joints. When repairs include joints in existing pavement, re-establish the joint in the plastic concrete, or saw when the concrete has reached sufficient strength according to the Contract Documents. "Early entry" saws may be required to cut joints in green concrete to match existing joints.

(1) Patches to be overlaid. Do not seal joints.

(2) Patches not overlaid. See KDOT standard drawing.

j. Opening to Traffic. Perform testing to determine when the patch can be opened to traffic.

- When a minimum flexural strength of 380 psi or minimum compressive strength of 1800 psi is obtained from properly cured specimens.
- If the temperature falls below 60°F during the cure period, use the Schmidt rebound hammer to determine when the patch can be opened to traffic. The patch may be opened to traffic when the results of the rebound hammer test equal or exceed results obtained on materials previously tested and known to meet the strength requirements or 60% of the rebound on adjoining pavement.
- When maturity is used to determine when the patch is opened to traffic, make cylinders from the same mix to be used. Cure and break the cylinders under a time and temperature plan to develop a concrete maturity curve. Use the concrete maturity curve to determine when the patch has gained the strength to be opened to traffic.
- If Grade 2 calcium chloride is used, see **subsection 401.3i.(1)**.
- When approved by the Engineer, other methods may be used to determine when the patch has gained the strength to be opened to traffic.

833.4 MEASUREMENT AND PAYMENT

The Engineer will measure asphalt pavement patching of PCCP by the ton of HMA used.

The Engineer will measure the various types of concrete pavement patching by the square yard.

Removal of the existing pavement for either asphalt or concrete pavement will not be measured for separate payment.

If the Contractor chooses to use a milling machine to remove the deteriorated pavement, and the area removed is greater than the area originally defined for the partial depth patch, the Engineer will base the measurements of the partial depth patch on the dimensions originally defined for the patch.

The Engineer will measure a patch started as partial depth patch, but completed as a full depth patch, as a full depth patch.

A patch started according to the details for Joint and Crack Patching (Partial Depth) and completed as a full depth patch is measured and paid as Joint and Crack Patching (Full Depth).

A patch started according to the details for Edge Joint Patching (Partial Depth) and completed as a full depth patch is measured and paid as Joint and Crack Patching (Full Depth).

Patches started according to Partial Depth, but completed as Full Depth due to Contractor's negligence will be measured as Partial Depth patches.

If additional saw cuts are required to expand a patch, or to change a partial depth patch to a full depth patch, the Engineer will measure the additional saw cuts by the foot.

Payment for "Asphalt Pavement Patching of PCCP", "PCCP Patching (Full Depth)", "PCCP Edge Joint Patching" and "PCCP Joint and Crack Patching" at the contract unit prices and "Extra Work Saw Cuts (Set Price)" at the contract unit set price is full compensation for the specified work.

SECTION 834

UNDERSEALING

834.1 DESCRIPTION

Fill existing voids under portland cement concrete pavement (PCCP) by drilling injection holes and pumping a cement/fly ash grout under the pavement slab as shown in the Contract Documents.

BID ITEMS	UNITS
Fly Ash (Undersealing)	Ton
Injection Holes	Each

834.2 MATERIALS

Provide materials that comply with the applicable requirements.

Water .... **DIVISION 2400**
Portland Cement (Type I or II) .... **DIVISION 2000**
Fly Ash .... **DIVISION 2000**
Admixtures .... **DIVISION 1400**

Mix the water, portland cement (not less than 25% by volume of solids) and fly ash (not less than 50% by volume of solids) into a cement/fly ash grout complying with the following requirements:

Fluidity (efflux time)	ASTM C939	9 to 15 seconds
7-Day Compressive Strength	ASTM C942	600 psi minimum

Use admixtures only with written approval from the Engineer.

834.3 CONSTRUCTION REQUIREMENTS

a. Weather and Seasonal Limitations. Do not underseal the PCCP if the pavement surface temperatures are below 35°F, if the subgrade or base course is frozen, or if the subgrade is saturated from recent rainfall, as evidenced by standing water on the pavement or in the joints or cracks.

Undersealing operations may start when the pavement surface temperature is above 35ºF, the ambient air temperature is 35ºF and rising and is expected to exceed 40ºF. Discontinue paving when the ambient air temperature falls below 40ºF. Do not place when it is raining or snowing.

b. Drilling Holes. Submit a hole pattern and pumping sequence to the Engineer for approval. Do not damage the existing reinforcing steel in the pavement. Before drilling the holes, determine the location of reinforcing steel.

Drill holes vertically and round a maximum of 2 inches in diameter to a depth sufficient to penetrate the base and into the subgrade material. Holes may be washed to create a small cavity, allowing initial spread of grout. Drill the holes in a manner preventing breakout at the bottom of the pavement. Do not put downward force on the drill that exceeds 200 lbf.

c. Pavement Undersealing. Use monitoring equipment capable of accurately measuring pavement slab movement of 0.001 inch. Do not allow vertical movements exceeding ⅛ inch in the slabs. Replace all slabs raised more than ½ inch. Unless the pavement is to be overlaid, grind (at the Contractors expense) all slabs raised more than ⅛ inch and less than ½ inch. Grade tolerances are applicable to both transverse and longitudinal grades.

Begin the grout injection as soon as practicable after mixing the grout. Do not use material held in the mixer or injection sump pump for more than 1 hour after mixing. Do not add water to the grout after the initial mixing.

Connect an expanding rubber packer, or other approved device, to the end of the grout plant discharge hose. Place the expanding rubber packer in the injection hole, being careful not to extend the discharge end of the rubber packer below the lower surface of the PCCP.

Inject the grout in the pre-approved pattern, and in the quantity required to fill voids under the PCCP.

Produce grout slurry to a 12 second flow cone time. Pump the grout into the holes using an injection pump with a pressure capability of 250 to 300 psi when pumping grout slurry mixed to a 12 second flow cone time.

Cease injection of grout when grout appears at any joint, crack or adjacent hole, or when monitoring devices indicate slab movement.

Cease injection at a hole when grout flow does not occur after 7 seconds of sustained 150 psi gauge pressure, and there is no indication of slab movement.

Prevent grout from being injected into any drainage facility or other open structure.

Prevent excessive loss of grout through cracks, joints, other drilled holes or back pressure. KDOT will not pay for wasted material.

Prior to grout drying on the drilled holes, fill the holes with a fast setting sand/cement mixture or other patching material approved by the Engineer

Replace slabs in which cracks emanate radially from the grout injection holes and in slabs where cracks develop between adjacent grout injection holes at no additional cost to KDOT. The Engineer may approve cross-stitching of the cracks if the cracking is minor.

d. Deflection Testing. KDOT may use the Falling Weight Deflectometer (FWD) at sample locations to determine the effectiveness of the undersealing operation. Voids detected under the slabs using this procedure will be filled a second time by the Contractor at no additional cost to KDOT.

834.4 MEASUREMENT AND PAYMENT

The Engineer will measure fly ash by the ton.

The Engineer will measure each injection holes. Monitoring for pavement lift is subsidiary to the injection holes.

"Fly Ash (Undersealing)" and "Injection Holes" will be paid for at the contract unit prices which is full compensation for the specified work. No adjustment in contract unit prices will be made regardless of the amount of underruns or overruns.

835 - RESEALING JOINTS AND SEALING CRACKS IN EXISTING PCCP AND HMA PAVEMENTS

SECTION 835

RESEALING JOINTS AND SEALING CRACKS IN EXISTING PCCP AND HMA PAVEMENTS

835.1 DESCRIPTION

Concrete Pavement. Re-saw the longitudinal and transverse joints, and saw or rout the random cracks in the PCCP at the locations designated in the Contract Documents or as required by the Engineer. Clean and fill the sawed or routed joints and cracks with hot type joint sealing compound.

Asphalt Pavement and Concrete Pavement with Spalled Joints and Cracks. Prepare the existing cracks and joints at the locations designated in the Contract Documents or as required by the Engineer. Fill the cracks and joints with the specified materials.

Asphalt Shoulder Adjacent to Concrete Pavement. Clean the existing longitudinal joint between PCCP and asphalt shoulder at the locations designated in the Contract Documents or as required by the Engineer. Fill the joint with hot fiber-reinforced asphalt.

The bid items in this section are exempt from **SECTION 104**. There will be no price adjustments due to quantity changes for these items.

BID ITEMS	UNITS
Sealing PCCP Joints (Longitudinal)	Linear Foot
Sealing PCCP Joints (Transverse)	Linear Foot
Sealing PCCP Cracks (>⅛" <2")	Linear Foot
Sealing Spalled PCCP Joints & Cracks (>2" ≤3")	Linear Foot
Sealing Spalled PCCP Joints & Cracks, Type A or B (>2" ≤3")	Linear Foot
Sealing Asphalt Cracks (>⅛" ≤ ½")	Linear Foot
Sealing Asphalt Cracks (> ½" <2")	Linear Foot
Sealing Longitudinal Asphalt Shoulder Joint	Linear Foot

835.2 MATERIALS

a. Hot Type Joint Sealing Compound. When required, provide hot type joint sealing compound that complies with **DIVISION 1500**. When required, provide backer rod intended for use with the hot type joint sealing compound.

b. Fiber-Reinforced Asphalt. When required, provide a mixture of performance graded asphalt binder and polypropylene fibers. Provide a mixture that has not less than 8% fiber content by weight.

Provide PG 64-22 asphalt binder that complies with **DIVISION 1200**.

Provide polypropylene fibers suitable for the intended use that have a denier of 15 ± 3. The Engineer will accept the polypropylene fibers based on a Type D Certification according to **DIVISION 2600**, and visual inspection of the mixture.

c. Rapid-Set Concrete Patching Material. When required, provide rapid-set concrete patching material that complies with **DIVISION 1700**. Provide foam core backer board intended for use with the rapid-set concrete patching material.

835.3 CONSTRUCTION REQUIREMENTS.

a. Concrete Pavement, Joints and Cracks.

(1) Transverse Joints. Saw the existing transverse joints with a saw blade wide enough to clean both surfaces of the cut removing the existing sealant. Configure the transverse joints according to **FIGURE 835-1**.

FIGURE 835-1: PCCP SAWED TRANSVERSE JOINT DETAIL

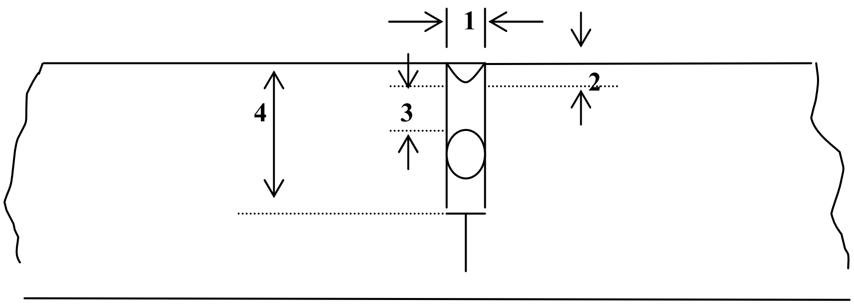


TABLE 835-1: PCCP SAWED JOINT DIMENSIONS*				
1 Joint Width	2 Recess Below Surface	3 Sealant Thickness	Backer Rod Diameter	4 Total Joint Depth
¼"	⅛" to ¼"	⅜"	⅜"	1"
⅜"	⅛" to ¼"	⅜"	½"	1⅛"
½"	⅛" to ¼"	⅜"	⅝"	1¼"
⅝"	⅛" to ¼"	½"	¾"	1½"
¾"	⅛" to ¼"	½"	⅞"	1⅝"
⅞"	⅛" to ¼"	½"	1"	1¾"
1"	⅛" to ¼"	½"	1⅛"	1⅞"
1½ "	⅛" to ¼"	¾"	1¾"	2⅜"
2"	⅛" to ¼"	1"	2½"	3⅝"

*All dimensions are nominal.

Clean, and fill the transverse joints according to **subsections 502.3g.(8)** and **(9)**.

(2) Longitudinal Joints. Saw the existing longitudinal joints with a saw blade ⅛" to ¼" wider than the joint, cleaning both surfaces of the cut, and, removing all existing sealant Configure the longitudinal joints to the width in column 1 in **TABLE 835-1**, with the depth equal to the original depth of the longitudinal joint. Clean and fill the longitudinal joints according to **subsections 502.3g.(8)** and **(9)**. Fill the longitudinal joint with hot type joint sealant compound to within ⅛ to ¼ inch of the surface. Do not use backer rods in the longitudinal joints.

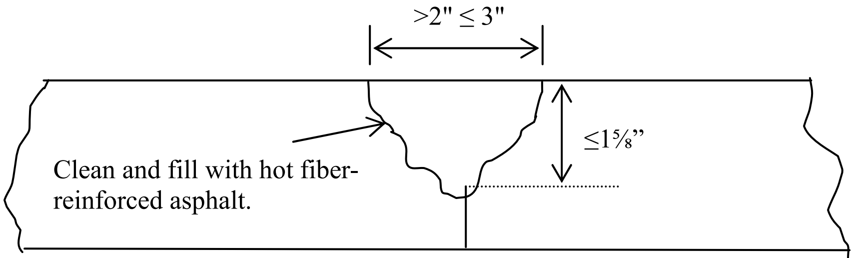
(3) Random Cracks. Rout or saw random cracks greater than ⅛ inch wide with a blade ⅛ to ¼ inch wider than the crack and to a depth equal to the full width of the blade to produce a cut on each side of the crack for the full length of the crack. Clean, and fill the random cracks according to **subsections 502.3g.(8)** and **(9)**. Fill the random cracks (routed or sawed reservoir) with a hot type joint sealing compound to within ⅛ to ¼ inch of the surface. Do not use backer rods in the random cracks.

b. Concrete Pavement, Spalled Joints and Cracks. Clean the full depth of the spalled joints and cracks. Remove all foreign material that will prevent bonding of the sealant. Clean the joints and cracks by sandblasting. Remove loose material on the surface immediately adjacent to the joints and cracks.

Do not seal PCCP spalled joints or cracks greater than 3 inches wide.

If the PCCP joints and cracks are 3 inches or less wide and 1⅝ inches or less deep, fill the joints and cracks with hot fiber-reinforced asphalt. See **FIGURE 835-2**. Fill the joints and cracks to a level slightly recessed from the pavement surface.

FIGURE 835-2: SEALING PCCP, SPALLED JOINTS AND CRACKS
(>2" ≤ 3" wide, ≤1⅝" deep)



If the PCCP joints and cracks are 3 inches, or less, wide and greater than 1⅝ inches deep, use either the Type A option (**FIGURE 835-3**) or the Type B option (**FIGURE 835-4**) to fill the joints and cracks:

FIGURE 835-3: TYPE A, SEALING PCCP, SPALLED JOINTS AND CRACKS
(>2" ≤ 3" wide, >1⅝" deep)

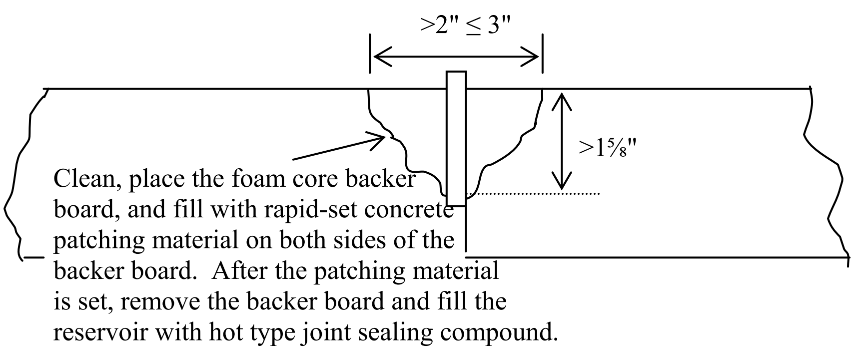
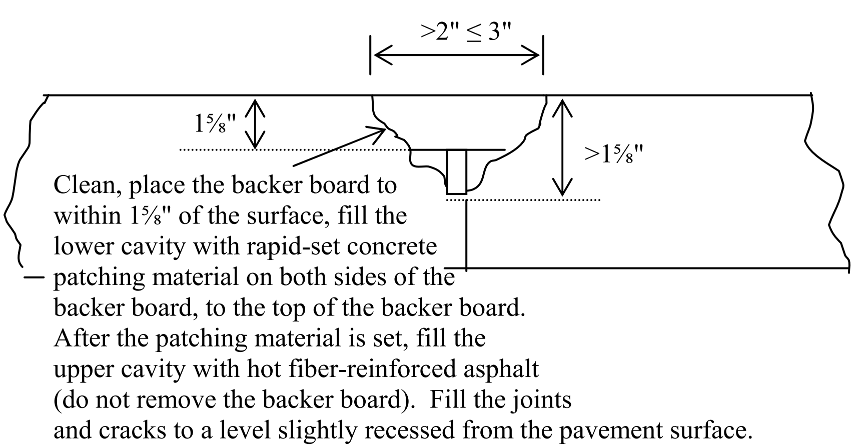


FIGURE 835-4: TYPE B, SEALING PCCP, SPALLED JOINTS AND CRACKS
(>2" ≤ 3" wide, >1⅝" deep)



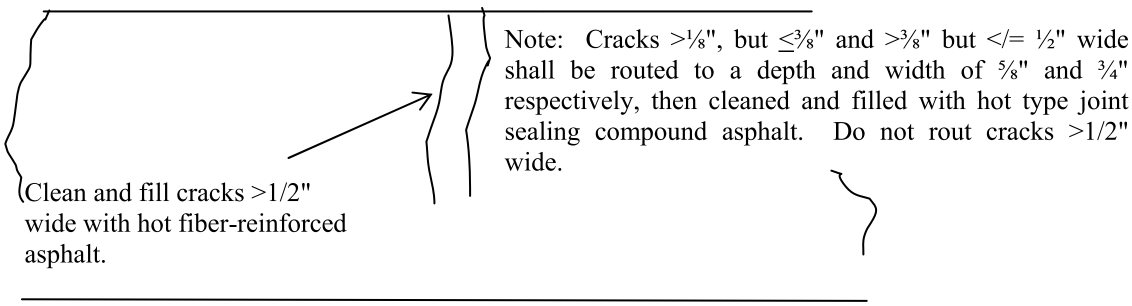
c. Asphalt Pavement Cracks. Seal cracks in asphalt pavement that are equal to or greater than ⅛ inch wide. Do not seal cracks less than ⅛ inch wide. Do not seal cracks wider than 2 inches. See **FIGURE 835-5**.

Rout all the cracks that are ⅛ to ½ inch wide following the existing crack. Route cracks ⅛ to ⅜ inch with a ⅝ inch router head, ⅜ to ½ inch with a ¾ inch router head and to a depth equal to or greater than the router head width. Cracks wider than ½ inch do not require routing.

Clean the full depth of the cracks. Remove all foreign material that will prevent bonding of the sealant. Remove loose material on the surface immediately adjacent to the joints and cracks. Clean and dry the cracks with a heat lance. Do not burn the pavement (indicated by smoke) with the heat lance.

Fill the routed cracks (⅛ to ½ inch) with hot type joint sealing compound. Fill un-routed cracks wider than ½ inch with hot fiber-reinforced asphalt. Fill all cracks to a level slightly recessed from the pavement surface.

FIGURE 835-5: SEALING ASPHALT PAVEMENT CRACKS) (>⅛"<2")



d. Asphalt Shoulder Adjacent to Concrete Pavement. Saw the concrete pavement to asphalt shoulder joint a minimum of ½ inch by 1inch or ⅛ inch greater than the width of the existing crack 1 inch deep Clean the joints as required in **subsection 502.3g.(8)**. Fill the joint with hot fiber-reinforced asphalt. Fill the joint with sealant to within ⅛ to ¼ inch of the surface. Do not use backer rods in the joints.

e. Manufacturer's Representative. Notify the sealant manufacturer's technical representative of the starting date of the initial installation. Demonstrate competence in applying sealant to the Engineer and the manufacturer's representative. Do not perform operations or procedures that would be detrimental to the sealing of joints and cracks.

This requirement will be waived for experienced Contractor's crews. Submit waiver request, along with a list of joint sealant crews successfully completed joint and crack sealing projects, to the Engineer for consideration.

f. Preparation of Asphalt for Crack Sealing. Heat the material to the temperature recommended by the manufacturer.

g. Weather Limitations. Do not place sealant when:

- the ambient air temperature is below 40°F, or
- the pavement temperature is above 105°F.

835.4 MEASUREMENT AND PAYMENT

The Engineer will measure sealing of joints and random cracks by the linear foot along the center of the joint or crack.

The bid items in this section are exempt from **SECTION 104**. There will be no price adjustments due to quantity changes for these items.

Payment for "Sealing PCCP Joints (Longitudinal)", "Sealing PCCP Joints (Transverse)", "Sealing PCCP Cracks (>⅛" <2")", "Sealing Spalled PCCP Joints & Cracks (>2" ≤3")", "Sealing Spalled PCCP Joints & Cracks, Type A or B (>2" ≤3")", "Sealing Asphalt Cracks (>⅛" ≤ ½")", "Sealing Asphalt Cracks (> ½" <2")" and "Sealing Longitudinal Asphalt Shoulder Joint" at the contract unit prices is full compensation for the specified work.

SECTION 836

SURFACING FOR SIDE ROADS AND ENTRANCES

836.1 DESCRIPTION

Place the designated surfacing material on side roads, entrances and other locations as shown in the Contract Documents.

BID ITEM	UNITS
Surfacing Material (*)	Ton
*Type	

836.2 MATERIALS

Provide aggregate for surfacing or resurfacing that complies with **DIVISION 1100**.

836.3 CONSTRUCTION REQUIREMENTS

Unless shown otherwise in the Contract Documents, grade the roadbed or subgrade to the lines and grades shown in the Contract Documents.

Apply surfacing material uniformly at the rate and locations shown in the Contract Documents.

Do not haul and place material if the Engineer determines that weather or road conditions are such that the hauling and placing operations will damage the roadbed or subgrade.

836.4 MEASUREMENT AND PAYMENT

The Engineer will measure surfacing material by the ton.

Payment for "Surfacing Material" at the contract unit price is full compensation for the specified work.

837 - PAVEMENT WIDENING, SHOULDERING AND PAVEMENT EDGE WEDGE FOR HMA OVERLAY PROJECTS

SECTION 837

PAVEMENT WIDENING, SHOULDERING AND PAVEMENT EDGE WEDGE

837.1 DESCRIPTION

Widen the existing pavement, construct shoulders or construct the transition from the pavement edge to the ditch as shown in the Contract Documents.

BID ITEMS	UNITS
Shoulders (Earth) (HMA Widening)	Station
Shoulders (Aggregate) (HMA Widening)	Station
Pavement Edge Wedge (Earth)	Station
Pavement Edge Wedge (Rock)	Ton
Aggregate for Shoulders (AS-1)	Ton
Common Excavation (Contractor-Furnished)	Cubic Yard
Water for Earthwork Compaction (Set Price)	M Gallon

837.2 MATERIALS

a. Material for Earth Shoulders and Pavement Edge Wedge (Earth). Use earthen material obtained from the locations shown in the Contract Documents. Do not use material containing roots, sod and other perishable and deleterious matter.

When required, provide Contractor-Furnished earthen material that complies with Contractor-Furnished Common Excavation, **SECTION 205**.

Earthen material will be accepted by the Engineer on the basis of visual inspection at the point of usage.

b. Material for Aggregate Shoulders and Pavement Edge Wedge (Aggregate). Use existing aggregate that is free of roots, sod and other perishable and deleterious matter.

If the project does not have existing aggregate for reuse, or if additional material is required, provide aggregate that complies with aggregate for shoulder construction (AS-1), **DIVISION 1100**.

The Engineer will accept this material on the basis of visual inspection at the point of usage.

c. Water for Earthwork Compaction. Provide water that complies with **DIVISION 2400**.

d. HMA Materials. Provide the designated HMA that complies with **DIVISION 600**.

837.3 CONSTRUCTION REQUIREMENTS

a. Excavation for HMA Pavement Widening. Excavate along the edge of the existing pavement to the depth and width shown in the Contract Documents. Compact the bottom of the trench according to Type B (MR-90) compaction, **SECTION 205**. If material unsuitable for proper compaction is encountered in the bottom of the trench, remove the unsuitable material and replace it with suitable earthen material. Dispose of the unsuitable material by scattering it at locations on the right-of-way as directed by the Engineer.

Before placing any HMA material in the trench, clean the trench of all loose material.

Provide for drainage of the trench, as necessary.

b. Placing the Asphalt Material Pavement Widening.

(1) Plant Mix HMA Construction. Clean the edge of the existing pavement. Paint or spray a thin coat of asphalt tack on the pavement edge. Place the HMA in the trench in 2 or more lifts. Place and compact the HMA by the method that produces the best results. Place the top lift of the HMA widening concurrently with the roadway surfacing. Compact the top lift of HMA to comply with the density requirements of HMA Overlay, **SECTION 602**.

(2) Cold Recycled Asphalt Construction. Place the cold recycled asphalt material in 1 lift. Place the material in the widening concurrently with the roadway material. Place and compact the cold recycled asphalt material by the method that produces the best results. Compact the mixture to comply with the density requirements specified for the Cold Recycled Asphalt Construction, **DIVISION 600**.

c. Shouldering the Asphalt or Concrete Pavement Widening. After the surface course is in place, construct the shoulders as shown in the Contract Documents. Do not damage the pavement surfaces. Do not dump or mix material on the pavement surfaces.

(1) Earth Shoulders. Use material obtained from the widening trench excavation, or Contractor-furnished material, if required, to construct the earthen shoulders.

Dispose of excess earthen material (obtained from the widening trench excavation), if any, at locations on the right-of way as directed by the Engineer.

Construct the earth shoulders according to **SECTION 205**.

(2) Aggregate Shoulders. Use existing aggregate obtained from the project, or aggregate provided by the Contractor, when required, to construct the aggregate shoulders.

Stockpile any excess aggregate (obtained from the widening trench excavation at locations shown in the Contract Documents or locations on the project as directed by the Engineer.

Construct the aggregate shoulders according to **SECTION 305**, except the compaction shall comply with Type B compaction and MR-3-3 Moisture Content, **SECTION 205**.

d. Earthen and Aggregate Pavement Edge Wedge. After the surface course is in place, construct edge wedges as shown in the Contract Documents. Do not damage the pavement surfaces. Do not dump or mix material on the pavement surfaces.

Use the type of material indicated in the Contract Documents to construct the wedges.

Place the material for the pavement edge wedge in a uniform layer. The maximum compacted thickness of any layer of earthen or aggregate pavement edge wedge is 6 inches. If the thickness is greater than 6 inches, spread and compact the aggregate base in multiple lifts of equal thickness with a maximum lift thickness of 6 inches.

Compact the wedges to comply with Type B (MR-90) Compaction, **SECTION 205**.

837.4 MEASUREMENT AND PAYMENT

The Engineer will measure shoulder for asphalt widenings on each side of the roadway by the station.

The excavation for the asphalt widenings is not measured for separate payment. The HMA quantities for the HMA widenings are included in the roadway surfacing quantities.

The Engineer will measure earth pavement edge wedge on each side of the roadway by the station.

The Engineer will measure the aggregate pavement edge wedge by the ton.

The Engineer will measure the aggregate for shoulders by the ton.

The Engineer will measure Contractor-furnished common excavation according to **SECTION 205**.

The Engineer will measure water for earthwork compaction according to **SECTION 205**.

Payment for "Shoulders (Earth) (HMA Widening)", "Shoulders (Aggregate) (HMA Widening)", "Pavement Edge Wedge (Earth)", "Pavement Edge Wedge (Rock)", "Aggregate for Shoulders (AS-1)" and "Common Excavation (Contractor-Furnished)" at the contract unit prices, and for "Water for Earthwork Compaction" at the contract unit set price is full compensation for the specified work.

SECTION 838

GRINDING REHAB CONCRETE PAVEMENT

838.1 DESCRIPTION

Grind the existing concrete pavement roadway surface to eliminate joint faulting and restore cross slope drainage, surface texture and riding characteristics.

BID ITEM	UNITS
Grinding Concrete Surface	Square Yard

838.2 MATERIALS - None specified.

838.3 CONSTRUCTION REQUIREMENTS

a. Equipment.

(1) Profilograph. Use a California type profilograph, prequalified by the Bureau of Construction and Materials, to determine the pavement profile. If approved by the Bureau of Construction and Materials, other types of profilographs that produce results compatible to the California type profilograph may be used. If the profilograph has a mechanical recorder, provide a ProScan electronic scanner with motorized paper transport to reduce the trace. Use the motorized paper transport when scanning the profilograph traces. The Bureau of Construction and Materials can provide the information necessary for the Contractor to obtain a ProScan electronic scanner. If approved by the Bureau of Construction and Materials, other types of automated trace reduction equipment may be used. If the profilograph has a computerized recorder, the trace produced is evaluated without further reduction.

(2) Grinding Machine. Provide a self-propelled grinding machine specifically designed to grind and texture portland cement concrete pavement using diamond blades mounted on a multi-blade arbor.

The arbor must contain enough blades to provide at least a 36-inch wide cutting head and provide 55 to 60 evenly spaced grooves per foot.

Do not use equipment that causes excessive ravels, aggregate fractures or spalls. Use equipment that provides a flat plane surface without crown and a uniform texture for the full width of the lane. Grind a nominal depth of 3/16 inch. Transverse grooving is not required.

Use vacuum equipment or other continuous methods to remove grinding slurry and residue. Remove from the project and properly dispose of the material. Do not allow the grinding slurry to flow across lanes being used by traffic, onto shoulder slopes, into streams, lakes, ponds or other bodies of water, or gutters or other drainage facilities. Do not place grinding slurry on foreslopes.

Bush hammers or other impact devices are prohibited.

b. Profilograph Operation. Provide an operator for the profilograph certified according to KT-46, Part V.

Determine the pavement profiles for each lane according to the procedures for 1 lane shown in Kansas Test Method KT-46. Additional profiles may be taken only to define the limits of an out-of-tolerance surface variation. The Engineer may use a 10-foot straightedge (or other means) to detect irregularities outside the required trace paths. The Engineer may also use the straightedge to delineate the areas that require corrective action.

A pavement section is a continuous area of pavement surface 0.1 mile long by 1 lane wide (12 feet nominal). A partial pavement section resulting from an interruption (such as a bridge) of the continuous pavement surface is subject to the same testing and evaluation as a whole section.

On surfaces excluded from profilograph testing, the Engineer will determine the pavement smoothness using a 10-foot straightedge. The Engineer will select the locations to be tested. The variation of the surface from the testing edge of the straightedge shall not exceed ⅛ inch between any 2 contacts, longitudinal or transverse.

c. Finish Requirements.

(1) Provide a control profilograph prior to performing any grinding work. This control trace will be used to identify the required smoothness for the project. If other repairs are performed on the project prior to grinding, such as pavement patching, perform the control trace, prior to that construction commencing.

(2) Grind and texture the entire surface of the pavement in the longitudinal direction. Grind at least 95% of the surface area in each 100-foot section and both sides of the transverse joints and cracks in the same plane. Provide positive lateral drainage by maintaining a constant cross slope between grinding passes in each lane. Maintain a uniform transverse slope that matches the existing cross slope to the extent possible with no depressions or humps greater than 0.25 inch in 12 feet when tested with a string line or straightedge. Do not exceed by more than 0.0625 inch the vertical alignment between adjacent passes of the cutting head. Begin and end grinding lines normal to the direction of vehicle travel. Grind the surface so corrugations are parallel to the pavement edge with ridges 0.0625 inch, ±0.03125 inch higher than the valleys of the corrugations.

Finish-grind the surface so that each segment has a final profile index a maximum of 35% of the control profilograph trace or 30 inches per mile whichever is greater. Correct all deviations in excess of 0.30 inch in a length of 25 feet within each section regardless of the profile index value.

(3) After completing the pavement grinding, profile the pavement with the same California type profilograph used to establish control profilograph trace. Run 2 traces in each corrected lane. Run a trace 36 inches from the longitudinal joint between the lanes, and another trace 36 inches from the shoulder edge of the lane.

Determine a profile index in inches/mile for each section of corrected pavement surface. A pavement section is defined as a continuous area of finished pavement 0.1 mile in length and one 12-foot lane (nominal) in width. A partial section resulting from an interruption of the continuous pavement surface is subject to the same evaluation as a whole section. Within 2 days after the corrections to the roadway surface are made, provide the Engineer with the profilogram and its evaluation.

(4) Perform additional grinding to attain the required profile index provided the maximum depth of removal does not exceed 0.75 inch.

(5) The Engineer may perform profilograph testing on the surface for monitoring and comparison purposes. The Engineer may test the entire project length if determined the Contractor's test results are inaccurate. If the Engineer performs profilograph testing on the project and determines the Contractor's results are inaccurate, the Contractor will be charged $640.00 per mile per trace (minimum charge is $800.00).

(6) Correct all irregularities exceeding the specified tolerance using equipment and methods approved by the Engineer. After the irregularities are corrected, the Engineer will retest the area to verify compliance with the specified tolerance.

838.4 MEASUREMENT AND PAYMENT

The Engineer will measure grinding of concrete pavement surface by the square yard.

A Grinding Concrete Surface Smoothness pay adjustment per 0.1 mile section per lane will be based on the average of the profile index of the 2 traces per 0.1 mile section per lane. Payment will be made according to **TABLE 838-1**.

TABLE 838-1: SCHEDULE FOR ADJUSTING PAYMENT FOR GRINDING EXISTING PAVEMENT

Average Profile Index Inch per mile per 0.1 mile section	Contract Price Adjustment Per 0.1 mile section per lane
10.0 or less	$135.00
10.1 to 15.0	$95.00
15.1 to 18.0	$50.00
18.1 to 30.0	0.00

Payment for "Grinding Concrete Surface" at the contract unit price is full compensation for the specified work. Payment for ″Grinding Concrete Surface Smoothness″ will be shown as an added item to the contract.

SECTION 839

RUBBLIZING PORTLAND CEMENT CONCRETE PAVEMENT

839.1 DESCRIPTION

Rubblize the existing PCCP, and compact the broken PCCP in place as shown in the Contract Documents.

BID ITEMS	**UNITS**
Crushed Stone for Backfill	Cubic Yard
Removal of Asphalt Material	Square Yard
Rubblized Concrete	Square Yard

839.2 MATERIALS

Provide crushed stone for backfill that complies with **DIVISION 1100**.
Provide HMA that complies with **DIVISION 600**.

839.3 CONSTRUCTION REQUIREMENTS

Before starting the rubblizing of the PCCP, remove and dispose of all asphalt overlays and patches. Replace the asphalt patches with crushed stone for backfill.

Use an impact hammer, resonant breaker or other equipment to break the pavement into the specified sizes without displacing the rubblized material into the base or subgrade. Use equipment capable of delivering enough energy to rubblize the PCCP. Where needed, use a breaker with a plate-type shoe designed to prevent penetration into the existing surface. Provide a watering system to suppress dust generated by the rubblizing operation. Provide a shield to prevent flying chips of pavement produced by the rubblizing operation.

Rubblize the PCCP full depth and full panel width to produce broken reinforcement, or the loss of concrete to steel bond. The majority of the rubblized PCCP shall be:

- 12 inches or smaller in size, with 80 to 100% less than 12 inches.
- 95% of the fragments greater than 6 inches.
- The maximum size is 15 inches.

Do not displace the concrete vertically (before rolling) more than ±1 inch.

Construct a test section to demonstrate compliance with the rubblizing specification. The Engineer will determine the location of the test section. Provide equipment to verify compliance with the sizing requirements. Vary the energy and striking patterns of the pavement breaker, and, when necessary, make repeated passes with the equipment until the specified rubblization is achieved.

Seat and uniformly compact the rubblized concrete. Use a steel wheel roller (10 tons) or a steel wheel vibratory roller to seat and compact the rubblized PCCP. Make a minimum of 2 one-way passes with the roller. Do not roll in a manner that will disperse the outside edge of the rubblized PCCP. Do not cause rutting, pumping or de-densification of the rubblized PCCP by over-compaction. If compaction is not achieved with the steel wheel roller, the Engineer may allow the use of a larger pneumatic roller.

The Engineer will determine, by visual inspection, if satisfactory rubblization is achieved.

Use the procedures established in the test section to rubblize, seat and compact the existing PCCP. If during the course of the work, the rubblizing requirements are not achieved, the Engineer may require another test section be constructed.

If soft spots are detected during the compaction operations, remove the unstable subgrade material and backfill with suitable material to the top of the subgrade. Fill from the subgrade to the top of the adjacent rubblized PCCP with crushed stone for backfill.

After the PCCP is rubblized and compacted, the Engineer may designate areas that require leveling. If the leveling course is placed directly on the rubblized and compacted PCCP, use either crushed stone for backfill or HMA base material. If HMA base material is used for leveling between succeeding lifts of the HMA base, complete the leveling before the final lift of the HMA base is placed. The material used for leveling (HMA or crushed stone for backfill) may be spread with a motor grader.

Overlay the rubblized and compacted PCCP with a HMA base course as soon as possible, within 24 hours of the rubblizing operations. If the rubblized PCCP is not covered with the HMA base within 24 hours, the Engineer will direct the Contractor to suspend all rubblizing operations until the previously rubblized PCCP is overlaid.

Do not allow traffic (other than necessary construction traffic) on the rubblized PCCP until a minimum of 4 inches of HMA base is placed on the rubblized PCCP.

839.4 MEASUREMENT AND PAYMENT

The Engineer will measure the crushed stone for backfill by the cubic yard.

The Engineer will measure the removal of asphalt material by the square yard.

The Engineer will measure rubblized PCCP by the square yard. The Engineer will measure the actual width of the existing PCCP, along the centerline of the roadway or ramp.

Payment for "Crushed Stone for Backfill", "Removal of Asphalt Material" and "Rubblized Concrete" at the contract unit prices is full compensation for the specified work.

Measurement and payment for HMA materials are as provided in the Contract Documents.

SECTION 840

TEMPORARY SURFACING

840.1 DESCRIPTION

Place and maintain temporary surfacing material to provide temporary access (ingress and egress) for residences and places of businesses. Remove and dispose of material when no longer needed.

BID ITEMS	**UNITS**
Temporary Surfacing Material (Aggregate) (Set Price)	Cubic Yard
Temporary Surfacing Material (HMA) (Set Price)	Ton

840.2 MATERIALS

Provide aggregate for temporary surfacing suitable for the intended purpose. The Engineer will accept the aggregate based on the performance of the material.

Provide HMA for temporary surfacing that is a commercial mix in general use in the local area. Provide a mixture of materials from recognized producers, mixed in a recognized type of hot mix plant. Provide emulsified asphalt for tack, when necessary. The Engineer will accept the HMA based on performance of the material.

840.3 CONSTRUCTION REQUIREMENTS

Place and spread the temporary surfacing material at the locations determined by the Engineer. Place and spread the temporary surfacing material to a smooth, reasonable cross-section. Shape the section to prevent ponding of water.

When placing HMA, use recognized equipment and techniques to weigh, haul, spread and compact the mixture. Complete the compaction operations while the temperature of the mixture is above 175°F. Do not place HMA on wet or frozen surfaces, or when the weather conditions will prevent proper handling and finishing of the mixture. The Engineer may waive the weather limitations when warranted.

Maintain the temporary surfacing to provide ingress and egress in all types of weather. Place additional material as necessary.

Remove and dispose of the material when no longer necessary.

840.4 MEASUREMENT AND PAYMENT

The Engineer will measure the aggregate temporary surfacing material by the cubic yard in the vehicle at the place of unloading.

The Engineer will measure the HMA temporary surfacing material by the ton. The Engineer will accept commercial scale tickets completed by the producer of the material.

Payment for "Temporary Surfacing Material (Aggregate) (Set Price)" and "Temporary Surfacing Material (HMA) (Set Price)" at the contract unit set prices is full compensation for the specified work. The contract unit set prices will govern regardless of the accepted quantity provided.

SECTION 841

LIGHT TYPE SURFACING

841.1 DESCRIPTION

Haul the material shown in the Contract Documents to the roadway and windrow the material for surfacing.

BID ITEM	**UNITS**
Light Type Surfacing (*)	Cubic Yard
Type: SA- or SS-*	

841.2 MATERIALS

Provide the specified type of aggregate that complies with **DIVISION 1100**.

841.3 CONSTRUCTION REQUIREMENTS

When shown in the Contract Documents, prepare the embankment or subgrade as detailed in the Contract Documents. When not shown in the Contract Documents, others will prepare the embankment or subgrade.

The rate of application for the light type surfacing is shown in the Contract Documents.

Do not haul material to the road when weather or road conditions are such that the hauling operations will damage the roadbed or subgrade.

Windrow the material hauled to the road along one shoulder of the road. Place the windrow on the roadway and parallel to the edge of the roadway, approximately 1 foot from the edge of the roadway or as directed by the Engineer. Construct a uniform windrow to a maximum width of 6 feet.

When not shown in the Contract Documents, others will spread the light type surfacing. When shown in the Contract Documents, spread the light type surfacing to the dimensions shown in the Contract Documents.

841.4 MEASUREMENT AND PAYMENT

The Engineer will measure the light type surfacing by the cubic yard.

Payment for "Light Type Surfacing" at the contract unit price is full compensation for the specified work.

SECTION 842

DRILLING AND GROUTING

842.1 DESCRIPTION

Drill holes and grout anchor bolts, dowel bars, tie bars and reinforcing steel into the existing concrete as shown in the Contract Documents.

BID ITEMS	UNITS
Drilling and Grouting	Each
Drilling and Grouting (Repair) (Set Price)	Each

842.2 MATERIALS

Provide materials that comply with the applicable requirements.

Reinforcing Steel	**DIVISION 1600**
Anchor Bolts	**DIVISION 1600**
Dowel Bars and Tie Bars	**DIVISION 1600**
Cementitious Grout	**DIVISION 1700**
Type IV Epoxy-Resin Bonding System for Concrete	**DIVISION 1700**

842.3 CONSTRUCTION REQUIREMENTS

a. Drilling Holes. Provide the Engineer with a copy of the grout (cementitious or Type IV epoxy-resin bonding system for concrete) manufacturer's instructions. Drill the holes into the existing concrete to the diameter recommended by the grout manufacturer. When drilling for new reinforcing steel, use a pacometer to avoid drilling into the existing reinforcing steel. In the absence of recommendations from the grout manufacturer, drill the holes approximately ¼ ± 1/16 inch larger than the diameter of the anchor bolts, dowel bars, tie bars and reinforcing steel without damaging adjacent concrete. Maintain proper vertical and horizontal alignment while drilling the holes.

b. Preparing Holes.

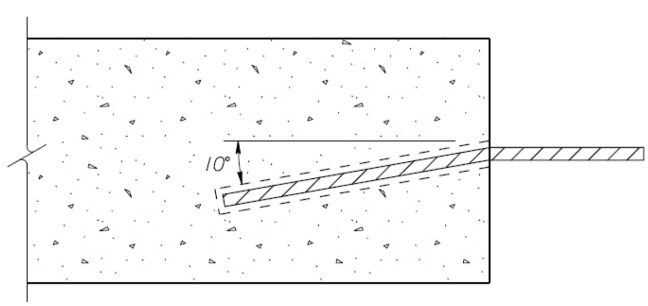
(1) General.

- Use compressed air to blow out the hole.
- Use a brush to clean the hole.
- Use compressed air to blow out and dry the hole.

(2) Vertical Holes. Do not leave ungrouted vertical holes overnight and exposed to freezing temperature.

(3) Horizontal Holes. Drill holes at an angle of 10º (minimum) from the horizontal plane as shown in **FIGURE 842-1**. When a conflict is encountered (such as reinforcement), a hole angle less than 10º may be drilled provided that a pre-qualified self-contained grouting system is used.

FIGURE 842-1



c. Grouting Holes. Mix, apply and cure the grout according to the manufacturer's instructions. Fill the dry, clean holes with an approved grout. Insert the bolt, bar or reinforcing steel into the freshly grouted hole so that no voids exist between the bolt, bar or reinforcing steel and the concrete. Clean overflow and center the bar or bolt in the hole.

d. Testing. When designated in the Contract Documents, proof load 20% of the installed anchorages to 90% of the design load according to the procedures in the Contract Documents.

842.4 MEASUREMENT AND PAYMENT

The Engineer will not measure the drilling and grouting of bars and bolts that are included in other items of work (such as the erection of structural steel and concrete pavement patching).

When shown as a bid item in the contract, the Engineer will measure each drilled and grouted hole.

Payment for "Drilling and Grouting" at the contract unit price, and "Drilling and Grouting (Repair) (Set Price) at the contract unit set price, is full compensation for the specified work.

SECTION 843

FLOWABLE FILL

843.1 DESCRIPTION

Backfill the designated structures or excavations with flowable fill.

BID ITEM	UNITS
Flowable Fill (*)	Cubic Yard

*Low Strength or High Strength

843.2 MATERIALS

a. General. Provide materials that comply with the applicable requirements.

Fine Aggregate .... **DIVISION 1100**
Cement and Fly Ash (approved for stabilization & cold recycle) .... **DIVISION 2000**
Water .... **DIVISION 2400**

The Engineer will approve the use of admixtures to achieve flowability and acceptable set time, based on performance.

b. Mix Design. Design a flowable fill mixture that possesses adequate flow characteristics to fill all voids, and complies with the compressive strength and unit weight requirements shown in **TABLE 843-1**.

TABLE 843-1: REQUIREMENTS FOR FLOWABLE FILL MIXTURE

	LOW-STRENGTH MIXTURE	HIGH-STRENGTH MIXTURE
3 Day Compressive Strength (minimum)	20 psi	-
7 Day Compressive Strength (minimum)	-	50 psi
28 Day Compressive Strength	100 psi (max)	1500 psi
Unit Weight (maximum)	120 pcf	-

Obtain approval from the District Materials Engineer for the job mixture. Supply 3 and 28 day compressive strength information for low-strength mixtures, or 7 and 28 day compressive strength information for high-strength mixtures, along with the mix design.

c. KDOT Assurance and Acceptance. The Engineer will make test cylinders for each 100 cubic yards of flowable fill placed, and whenever the mixture is changed. The cylinders will be made and tested according to **DIVISION 2500**.

- For the low-strength mixture, 3 cylinders will be made. The 1st cylinder will be tested on the 3rd day. The 2nd cylinder will be laboratory cured and tested on the 28th day. The 3rd cylinder will be laboratory cured and held in reserve to verify any questionable cylinder breaks.
- For the high-strength mixture, 3 cylinders will be made. The 1st cylinder will be tested on the 7th day. The 2nd cylinder will be laboratory cured and tested on the 28th day. The 3rd cylinder will be laboratory cured and held in reserve to verify any questionable cylinder breaks.
- The Engineer will test the unit weight a minimum of every 50 cubic yards of flowable fill placed.
- The Engineer will accept the flowable fill based on the results of the compressive strength and unit weight tests, and visual inspection of the mixture placed on the project.

843.3 CONSTRUCTION REQUIREMENTS

Place the flowable fill in the excavation so all voids around the structure or in the excavation are filled.
Place the flowable fill around structures in lifts preventing the buildup of excess hydrostatic pressure.
Observe the weather limitations specified in **DIVISION 400** when placing the flowable fill.

843.4 MEASUREMENT AND PAYMENT

The Engineer will measure flowable fill placed in the specified locations by the cubic yard.
Payment for "Flowable Fill" at the contract unit price is full compensation for the specified work.

844 - SLURRY GROUT

SECTION 844

SLURRY GROUT

844.1 DESCRIPTION

Fill cavities of existing structures, mines or voids under pavements and slabs on grade with a slurry grout as shown in the Contract Documents.

BID ITEM	**UNITS**
Slurry Grout (*)	Cubic Yard
* Low Strength, High Strength or Underseal	

844.2 MATERIALS

a. Materials. Provide materials that comply with the applicable requirements.

Fine Aggregate .... **DIVISION 1100**
Cement and Fly Ash (approved for stabilization & cold recycle) .... **DIVISION 2000**
Water .... **DIVISION 2400**

The Engineer will approve the use of admixtures to achieve flowability and acceptable set time, based on performance. Provide foaming agents approved by the Engineer.

b. Approval of Mix Design. Design a slurry grout that complies with **TABLE 844-1**.

TABLE 844-1: REQUIREMENTS FOR SLURRY GROUT MIXTURE			
	LOW-STRENGTH MIXTURE	**HIGH-STRENGTH MIXTURE**	**UNDERSEALING MIXTURE**
3 Day Compressive Strength (minimum)	20 psi	-	100 psi
7 Day Compressive Strength (minimum)	-	125 psi	600 psi
28 Day Compressive Strength	100 psi (max.)	200 psi (min.)	
Unit Weight (minimum)		92 lbs/cu. ft.	
Flow, seconds (ASTM C939)			10 - 16

Submit the slurry grout mix design and results of the required compressive strength testing (conducted by a testing laboratory) to the DME for approval. The DME will approve or reject the mix design within 2 weeks of the submittal.

c. KDOT Assurance and Acceptance. The Engineer will make a set of test cylinders for each 100 cubic yards of slurry grout placed on the project, and when the mix design or source of fly ash is changed. The Engineer will make and test the cylinders according to **DIVISION 2500**. The Engineer will make a set of 3 cylinders for each 100 cubic yards produced.

- For underseal mixture, test the 1st cylinder on the 3rd day
- For low strength, test the 1st cylinder on the 3rd day
- For high-strength mixture, test the 1st cylinder on the 7th day
- The Engineer will laboratory cure the remaining 2 cylinders.
- For underseal mixture, test the 2nd cylinder on the 7th day
- For low and high strength mixture, test the 2nd cylinder on the 28th day
- The Engineer will hold the 3rd cylinder in reserve to verify any questionable cylinder breaks.

The Engineer will test the unit weight a minimum of every 50 cubic yards of slurry grout placed on the project.

The Engineer will test the flow of the underseal slurry grout 2 times per day. The ratio of the water to cementitious material will be adjusted to comply with the requirements.

The Engineer will accept the slurry grout based on the results of the compressive strength, unit weight tests, and visual inspection of the mixture placed on the project.

844.3 CONSTRUCTION REQUIREMENTS

Pump the slurry grout into the structures to fill all the voids.

Bulkhead each end of the structure to be filled. Provide a minimum of 2 vent pipes to monitor the pumping. If necessary to fill the structure, pump additional grout through the vent pipes.

If filling voids under pavements and slabs on grade, place the slurry grout as shown on the Contract Documents.

Observe the weather limitations specified in **DIVISION 400** when placing the slurry grout.

844.4 MEASUREMENT AND PAYMENT

The Engineer will measure slurry grout by the cubic yard.

Payment for "Slurry Grout" at the contract unit price is full compensation for the specified work.

SECTION 845

CLEANING EXISTING STRUCTURES AND UNDERDRAINS

845.1 DESCRIPTION
Clean the designated existing structures and underdrains as shown in the Contract Documents.

BID ITEMS	UNITS
Cleaning Existing Structures	Lump Sum
Cleaning Existing Underdrains	Linear Foot

845.2 MATERIALS - None specified.

845.3 CONSTRUCTION REQUIREMENTS

a. Cleaning Existing Structures. Remove all foreign material from the structures designated in the Contract Documents. Use hand, mechanical, pressurized water or a combination of methods to expose all inside surfaces of the designated structures.

Do not move the existing structure out of position or damage the structure. Correct structures moved out of position, and repair or replace structures damaged because of the Contractor's operations.

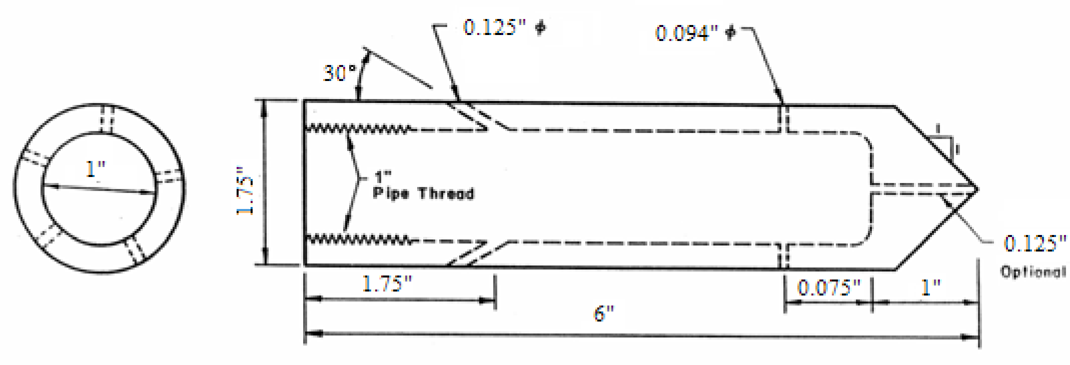
Dispose of the material removed from the structure. The Engineer may allow placement of suitable material on the embankment slopes adjacent to the structures.

Grade the structure channel to provide drainage before cleaning the structure. Schedule the cleaning of the structures so that drainage is provided during the project construction operations. Maintain the cleaned structures until the project is accepted.

b. Cleaning Existing Underdrains. Clean the underdrains designated in the Contract Documents before completing any extensions or replacements of outlet sections. The Engineer will observe the cleaning operations.

Clean the underdrains using pressurized water. Use a cleaning unit consisting of a high-pressure pump (100 gallons per minute at 500 psi, minimum) connected to a hose (1 inch minimum) with a cleaning nozzle. Use a hose that is capable of traversing and cleaning up to 600 feet of underdrain. Use a cleaning nozzle similar to **FIGURE 845-1**.

FIGURE 845-1



Dimensions of the High Pressure Pipe Cleaning Nozzle.
FHWA/RD-81/078

Do not damage the underdrains. Repair or replace underdrains damaged because of the Contractor's operations.

c. Video Inspection of Cleaned Underdrains. In the presence of the Engineer, perform a video inspection of all underdrains shown in the Contract Documents.

For the video inspection, provide a video camera complying with the following requirements:

- high resolution, high sensitivity, waterproof and color;
- capable of negotiating the various angle fittings used in the edge drain system;
- with sufficient lighting to provide a true color picture of the entire periphery of the diameter of the pipe; and
- with attachments that will maintain the camera's position in the center of the pipe.

Provide a portable control unit of the video camera complying with the following requirements:

- capable of adjusting the iris, focus, and light level intensity;
- have a color monitor (8 inch minimum) to track the camera's progress through the inspections;
- have 2 video input/output jacks for video recording, as well as tape playback verification through the built-in monitor; and
- have audio input to allow for dubbing of the video to incorporate comments as necessary.

Provide a video camera system complying with the following requirements:

- have sufficient cable/push rod to conduct inspections to a length of 500 feet, and a distance counter to monitor the length of the inspection;
- have a color video printer that will produce color prints of any observations of interest during the course of the inspection; and
- include a video recorder (minimum quality 4-head industrial grade VHS type) with audio dubbing, still frame and slow speed capabilities.

Provide an experienced video technician to operate the video camera system.

Using the same equipment noted above, re-clean any underdrains found to still contain soils and not working as intended.

Acceptance by the Engineer of the cleaned underdrain will be based on observations made during the video inspection.

845.4 MEASUREMENT AND PAYMENT

The Engineer will measure cleaning of the designated structures by the lump sum.

The Engineer will measure cleaning of the designated underdrains by the linear foot. The Engineer will measure the length of hose and nozzle inserted into the underdrain.

Payment for "Cleaning Existing Structures" and "Cleaning Existing Underdrains" at the contract unit prices is full compensation for the specified work.

SECTION 846

TRANSPORTING SALVAGEABLE MATERIAL

846.1 DESCRIPTION

Transport salvaged material to locations either on or off the project as shown in the Contract Documents.

BID ITEM	UNITS
Transporting Salvageable Material	*

* Unit of Measurement shown in the Contract Documents

846.2 MATERIALS - None specified.

846.3 CONSTRUCTION REQUIREMENTS

Transport the salvaged materials to the locations designated in the Contract Documents. Do not damage the salvaged material while loading, transporting and unloading at the storage area.

When the Contractor damages material designated as salvage, 60% of the current quoted price for new material delivered to the project will be charged to the Contractor. This amount will be deducted from payments due the Contractor.

846.4 MEASUREMENT AND PAYMENT

The Engineer will measure transportation of salvaged material by the units shown in the Contract Documents.

Payment for "Transporting Salvageable Material" at the contract unit price is full compensation for the specified work.

SECTION 847

MAILBOX ADJUSTMENTS

847.1 DESCRIPTION

Remove existing mailboxes and mailbox supports. When required by construction sequencing, relocate mailboxes at locations agreeable to owner and U.S. Postal Service. Reinstall acceptable mailboxes and mailbox supports.

BID ITEM	**UNITS**
Mailbox Installation (Set Price)	Each

847.2 MATERIALS

When necessary, provide commercially available mailbox supports constructed of a single 4-inch by 4-inch wooden post, a single 4-inch diameter wooden post or a single metal post. Use metal posts with a maximum strength of a 2-inch diameter standard strength steel pipe. Anti-twist devices (that extend a maximum of 10 inches below ground) are permitted on metal posts. Anchor plates are prohibited on metal posts.

Provide commercially available post-to-mailbox assemblies.

The Engineer will accept the mailbox supports and post-to-mailbox assemblies based on compliance with the specified requirements and visual inspection for condition at the point of usage.

847.3 CONSTRUCTION REQUIREMENTS

Remove the existing mailboxes and supports, and lay the mailboxes and supports on the owner's property.

The Engineer will inform the mailbox owners that only mailboxes and mailbox supports that comply with the requirements of the U.S. Postal Service will be reinstalled. If the owner's mailbox is unacceptable, it is the owner's responsibility to provide an acceptable mailbox for reinstallation. If the owner's mailbox support is unacceptable, the Contractor will provide an acceptable mailbox support for reinstallation. The Contractor will reinstall the mailbox owner's original mailbox if said mailbox complies with U.S. Post Office requirements. If the mailbox owner provides a lightweight newspaper delivery box, the Contractor will install the newspaper box below the mailbox (on the side of the mailbox support) when the mailbox is reinstalled.

If the mailbox owner chooses to reinstall their own mailbox, the Engineer will inform the owner of highway permit procedures, and advise the owner that the reinstallation must be approved by KDOT.

When the mailboxes are reinstalled, use these guidelines for installation:

- Locate the mailboxes on the right-hand side of the roadway in the direction of the delivery route. Mailboxes may be located on the left-hand side of the roadway on one-way streets.
- Embed the mailbox support post into the ground a maximum of 24 inches. Do not embed the post in concrete unless the mailbox support design is shown to be NCHRP 350 compliant when so installed.
- Set the mailbox according to the Mailbox Guidelines established by the U.S. Postal Service.
- If there is a question as to the proper location of the mailbox, contact the U.S. Postal Service (local Post Office) for guidance.

For roads not on the state highway system, e.g, roads under city, county or township jurisdiction, the mailbox offset may be less than the distances outlined above and will be determined on a case-by-case basis in consultation with the owner of the facility. Items to be considered include, but are not limited to, roadway width, shoulder width, traffic volumes, presence of sight distance constraints, right of way impacts, etc.

847.4 MEASUREMENT AND PAYMENT

The Engineer will measure each mailbox installation.

The Engineer will not measure for separate payment temporary mailbox relocations required due to construction sequencing.

Payment for "Mailbox Installation (Set Price)" at the contract unit set price is full compensation for the specified work.

SECTION 848

ANTI-GRAFFITI COATING

848.1 DESCRIPTION

Prepare and apply the anti-graffiti coating to the surfaces to be protected, as designated in the Contract Documents.

BID ITEM	UNITS
Anti-Graffiti Coating	Square Yard

Note: If this bid item is not included in the Contract Documents, this work is subsidiary to other items in the contract.

848.2 MATERIAL REQUIREMENTS

Provide anti-graffiti coating that complies with **DIVISION 1700**.

848.3 CONSTRUCTION REQUIREMENTS

Provide copies of the manufacturer's material safety and technical data sheets. The technical data must include detailed application instructions, minimum and maximum application temperatures and recommended time between coats.

Prepare the surfaces that will receive the anti-graffiti coating in accordance with the manufacturer's recommendations before applying the coating.

Store, mix, apply and cure the anti-graffiti coating as recommended by the manufacturer.

848.4 MEASUREMENT AND PAYMENT

When shown as a bid item in the contract, the Engineer will measure the anti-graffiti coating by the square yard. If the anti-graffiti work is shown in the Contract Documents, but the bid item for this work is not included in the Contract Documents, the Engineer will not measure the anti-graffiti coating for separate payment.

Payment for "Anti-Graffiti Coating" at the contract unit price is full compensation for the specified work.

SECTION 849

GEOMEMBRANE

849.1 DESCRIPTION

Place geomembrane to form an impermeable barrier at the locations designated in the Contract Documents.

BID ITEM	UNITS
Geomembrane	Square Yard

Note: If this bid item is not included in the Contract Documents, this work is subsidiary to other items in the contract.

849.2 MATERIALS

Provide materials that comply with the applicable requirements.

Geomembrane .... **DIVISION 1700**
Cushioning material FA-A .... **DIVISION 1100**

849.3 CONSTRUCTION REQUIREMENTS

Do not remove the geomembrane from its package and expose it to sunlight or the elements more than 10 days before it is placed and covered.

Place the geomembrane as shown in the Contract Documents, with the longitudinal axis of the roll perpendicular to the centerline of the roadway. Overlap the geomembrane with a minimum of 24 inches at the joints, with the uphill layer placed on top of the downhill layer of geomembrane.

If the geomembrane is damaged by tears, punctures, or contamination from hydrocarbon spill, do not patch the damaged areas, replace the entire section of the geomembrane.

Place the cushioning material (sand) in a manner that does not puncture or tear the geomembrane.

849.4 MEASUREMENT AND PAYMENT

When shown as a bid item in the contract, the Engineer will measure the geomembrane by the square yard. If the geomembrane work is shown in the Contract Documents, but the bid item for this work is not included in the Contract Documents, the Engineer will not measure the geomembrane for separate payment. Quantities shown in the Contract Documents are based on the width of select granular backfill plus 6 feet for wrapping.

Payment for "Geomembrane" at the contract unit price is full compensation for the specified work.

SECTION 850

SEPARATION GEOTEXTILE

850.1 DESCRIPTION

Install the separation geotextile at the locations designated in the Contract Documents.

BID ITEM	**UNITS**
Separation Geotextile	Square Yard

850.2 MATERIALS

Provide a non-woven geotextile that complies with **SECTION 1710** and is contained on PQL-48 as a Class 1 geotextile.

850.3 CONSTRUCTION REQUIREMENTS

Place the separation geotextile as shown in the Contract Documents. Overlap the geotextile a minimum of 10 inches.

Place the initial lift of backfill 12 to 24 inches thick (loose measurement) so the construction traffic is not directly upon the separation geotextile.

850.4 MEASUREMENT AND PAYMENT

The Engineer will measure the separation geotextile by the square yard. Material placed beyond the neat lines indicated in the Contract Documents is not measured for payment unless authorized by the Engineer.

Payment for "Separation Geotextile" at the contract unit price is full compensation for the specified work.

SECTION 851

PAVEMENT WATERPROOFING MEMBRANE

851.1 DESCRIPTION

Install the pavement waterproofing membrane at the locations designated in the Contract Documents.

This product is primarily used over localized pavement failures, over joints and cracks, and on bridge decks before an overlay.

BID ITEMS	UNITS
Pavement Waterproofing Membrane	Square Yard
Pavement Waterproofing Membrane (*)	Linear Foot
* width	

851.2 MATERIALS

Provide pavement waterproofing membrane that meets **DIVISION 1700**.

When the unit of measure is square yards, the minimum width of material is 36 inches. When the unit of measure is linear foot, the width of material is that specified in the Contract Documents.

851.3 CONSTRUCTION REQUIREMENTS

Provide the Project Engineer with a copy of the fabric manufacturer's recommendations for installation.

Before placing the pavement waterproofing membrane, clean the existing pavement or bridge deck of any dirt, debris or deteriorating pavement materials, according to the manufacturer's recommendations. Clean milled surfaces with compressed air to remove all dust and files.

Before placing the pavement waterproofing membrane on existing pavement, fill all holes and cracks wider than ½ inch in the existing pavement with approved crack filler. Remove and fill spalled areas greater than 3 inches in width with hot/cold-mix asphalt or a suitable crack filler.

Before placing the pavement waterproofing membrane on an existing bridge deck, if necessary, place concrete patches on the existing bridge deck according to the details in the Contract Documents.

Do not place the pavement waterproofing membrane unless the ambient and pavement temperatures are at least 50°F and rising. The pavement surface or bridge deck must be dry prior to installation.

Apply a prime coat (at the rate recommended by the manufacturer of the fabric) when recommended by the fabric manufacturer. In addition, apply a prime coat on the existing pavement if the surface has been milled, if the dry pavement temperature is below 70ºF, or if the application is on a bridge deck.

Place the pavement waterproofing membrane according to the manufacturer's recommendations.

Overlap the pavement waterproofing membrane joints as recommended by the fabric manufacturer.

When possible, construct the succeeding overlay as soon as recommended by the manufacturer, without allowing any traffic on the membrane.

When the succeeding overlay can not be immediately placed, open the roadway to traffic as recommended by the manufacturer. Construct the succeeding overlay within 10 calendar days of placing the pavement waterproofing membrane. On slopes greater than 5%, construct the overlay within 48 hours.

Remove and replace all pavement waterproofing membrane that is damaged before it is covered with the overlay.

851.4 MEASUREMENT AND PAYMENT

When the unit of measure specified in the Contract Documents is linear foot, the Engineer will measure each individual strip of pavement waterproofing membrane placed by the linear foot.

When the unit of measure specified in the Contract Documents is square yard, the Engineer will measure the pavement waterproofing membrane by the square yard.

Payment for "Pavement Waterproofing Membrane" at the contract unit price is full compensation for the specified work.

SECTION 852

PAVING FABRIC

852.1 DESCRIPTION

Install the paving fabric at the locations designated in the Contract Documents and according to the manufacturer's instructions. Minimum overlay thickness of 2 inches above the fabric is recommended.

BID ITEM	UNITS
Paving Fabric	Square Yard
Tack (Paving Fabric)	Ton

852.2 MATERIALS

Provide a paving fabric that complies with **SECTION 1710** and is contained on PQL-48 as a Paving Fabric. Protect the paving fabric from wetness during storage and transportation. Elevate the product above the ground and cover and protect from ultraviolet radiation, sunlight, strong acids or strong bases, and fire or flames.

Provide PG 70-22, PG 67-22, PG 64-22, PG 58-10 or PG 58-28 for tack that meets **DIVISION 1200**.

852.3 CONSTRUCTION REQUIREMENTS

a. General. Provide the Engineer with a copy of the paving fabric manufacturer's installation instructions.

b. Surface Preparation. Power broom, sweep or vacuum the pavement before installing the pavement fabric. The pavement surface should be dry, free of dirt, oil, and loose aggregate, prior to installation.

c. Asphalt Tack. Apply the asphalt tack according to the paving fabric manufacturer's instructions.

d. Paving Fabric Installation. Install the clean, dry paving fabric with the untreated side placed into the asphalt tack according to the manufacturer's requirements. Overlap the paving fabric a minimum of 4 inches. Transverse overlaps should run in the direction of the paving operation. Tack all overlaps together.

Repair any wrinkles 1 inch or larger, by slitting and lapping in the direction of paving, and pressed down into the tack coat.

Turning of paving equipment, trucks, or other vehicles on the paving fabric must be gradual and kept to a minimum. Do not park vehicles on the paving fabric.

e. HMA Overlay. Do not exceed 24 hours between the time the fabric is placed and the next lift of HMA is placed.

852.4 MEASUREMENT AND PAYMENT

The Engineer will measure the paving fabric by the square yard. Material placed beyond the neat lines indicated in the Contract Documents is not measured for payment unless authorized by the Engineer.

The Engineer will measure tack (paving fabric) by the ton.

Payment for "Paving Fabric" and "Tack (Paving Fabric)" at the contract unit prices is full compensation for the specified work.

SECTION 853

RETAINING WALL SYSTEM

853.1 DESCRIPTION

The scope of work for wall erection includes; excavation, grading, and compaction of the wall foundation, general and local dewatering as required for proper execution of the work, construction of leveling pads, erection of precast panels or modular block wall elements, placement of soil reinforcing, and placement and compaction of select backfill material within the reinforced soil volume. The scope of work also includes providing and placing cast-in-place concrete coping. Include in the wall foundation all area underlying the leveling pad and the reinforced soil volume.

BID ITEM	**UNITS**
Retaining Wall (*)	Square Foot
*Type	

853.2 MATERIALS

a. General. Provide the complete retaining wall system (engineering design, geogrid, MBW, MSEW precast panels, reinforcing mesh and attachment device, joint filler, and all necessary accessories) from an approved manufacturer in accordance with the acceptable alternates for each particular structure as listed in the Contract Documents.

The Bureau of Construction and Materials will maintain a list of approved systems. Products will remain on the prequalified list as long as Field Performance is satisfactory.

b. Retaining Wall System.

(1) Concrete. Use cement complying with **DIVISION 2000**. Use air entrained concrete with a minimum compressive strength at 28 days of 4000 psi. Retarding admixtures may be used with prior approval of the Engineer. Accelerating agents or any admixture containing chlorides are prohibited.

Provide the MBW elements with a maximum absorption rate of 5% by weight and a minimum face shell thickness of 2 inch and complies with ASTM C1372.

For SSL MSE PLUS face panel 6 inches thick, provide a minimum compressive strength at 28 days of 4000 psi and is normally connected to a W8, W11, W15, W20, and W24 longitudinal wire.

Set in place void formers, tie strips, PVC sleeves, reinforcing steel, laps, galvanized reinforcing mesh, connecting pins, or lifting devices to the dimensions and tolerances shown on the shop plans prior to casting.

(2) Testing and Inspection. MSEW precast panel units will be accepted on the basis of compression tests and visual inspection. The compression testing and sampling for MBW will comply with ASTM C 140-91, Sampling and Testing Concrete Masonry Units, except as noted elsewhere in this specification. The MSEW precast panel units or MBW will be considered acceptable, regardless of curing age, if compression test results comply with the 28-day strength specifications, and if the visual inspection is satisfactorily completed. Provide facilities and perform all necessary sampling and testing. Notify the Engineer a minimum of one week in advance so that he may be present during all sampling and testing.

(3) Casting. Cast the MSEW precast panels in metal forms on a flat area, the front face at the bottom, the back face at the top. Set embed loops, void formers, or connectors in the rear face. Place the concrete in each form without interruption and consolidate by the use of an approved vibrator, supplemented by such hand tamping as may be necessary to force the concrete into the corners of the forms and prevent the formation of stone pockets or cleavage planes. Use clear form oil of the same manufacture throughout the casting operation.

Cast the MBWs in a standard manner acceptable to the National Concrete Masonry Association and in accordance with the testing and inspection.

(4) Curing. Cure the MSEW precast panels in compliance with **SECTION 710** for the concrete to develop the specified compressive strength. Cure the MBW units in a manner acceptable to the National Concrete Masonry Association. Any production lot which does not comply with **subsection 853.2b.(1)**, Compressive Strength, will be rejected.

(5) Removal of Forms. Do not remove the forms until they can be removed without damage to the unit.

(6) Finish. Finish the front face of MSEW precast panel units in a formed finish complying with **DIVISION 700** and approved by the Engineer. Finish the MBW as specified in the Contract Documents. Screed the rear face of the MSEW precast panel or the non-exposed faces of the MBW to eliminate open pockets of aggregate and surface distortions in excess of 1/4 inch.

(7) Tolerances.

- MSEW Precast Panel: Manufacture all units within the following tolerances:
  - Dimensions: Lateral position of tie strips, within 1 inch.
  - All other dimensions, within 3/16 inch.
  - Squareness: As determined by the difference between the two diagonals, not exceeding ½ inch.
  - Surface defects of formed surfaces measured on a length of 5 feet: not exceeding 1/8 inch.

- MBW: Manufacture all units within 1/8 inch of the length and width plan dimension. Manufacture the units within 1/16 inch of the specified height and connection slots within 3/16 inch of plan dimension. Provide MBW units with a minimum of:
  - 1.0 sq ft of face area each for full units.
  - 0.5 sq ft of face area for each cap unit.

Provide a MBW system with angled sides capable of concave or convex alignment curves with minimum radius of 4.5 to 6 feet.

(8) Compressive Strength. Acceptance of the concrete MSEW precast panels or MBW with respect to compressive strength will be determined on a production lot basis. A lot consists of each 40 production panels or 10,000 production blocks or fraction thereof produced in 1 day.

MSEW: Prepare a minimum of 6 standard 6 x 12-inch cylinders from samples selected at random from concrete used in the production lot and in accordance with Kansas Test Methods. Cure 3 cylinders in accordance with Kansas Test Methods and test at 28 days. Cure at least 3 of the cylinders in the same manner as the panels and test at 7 days or later. Additional sets of 3 cylinders cured in the same manner as the panels may be tested at other dates beginning at 7 days. A test result will be the average compressive strength of a set of cylinders. Acceptance of the lot will be made if the average of any set of 3 is greater than 4,000 psi and no single cylinder has a compressive strength less than 3600 psi.

MBW: Select no less than 3 units at random from each lot to represent the production lot. Acceptance of the lot for compressive strength will be made if the average of any set of 3 is greater than 4000 psi and no single unit has a compressive strength less than 3600 psi.

(9) Rejection. Units will be rejected because of failure to comply as specified above, or any of the following defects:

- Defects that indicate imperfect molding
- Honeycombed or open texture concrete surfaces
- Any damage that would prevent making a satisfactory joint
- Chipped facing panel/unit edges
- Discolored panels or blocks beyond reasonable variances in the opinion of the Engineer.

(10) Marking.

- MSEW Precast Panel: Prominently scribe the date of manufacture on the rear face of each panel.
- MBW: Prominently display the date of manufacture and lot number on each production lot stored at the casting plant in a manner acceptable to the Engineer.

(11) Handling, Storage, and Shipping. Handle, store and ship all units in a manner as to eliminate the danger of staining, chipping, cracks, fractures, and excessive bending stresses. Support blocks or panels in storage on firm foundations in a manner that will protect the exposed exterior finish.

(12) Basis of Acceptance. The Retaining Wall System will be accepted on the basis of satisfactory results of materials test, compliance with dimensional requirements and visual inspection at the point of usage.

c. Backfill. Provide aggregates for backfill complying with **DIVISION 1100**.

d. Concrete for Leveling Pads. Provide the following:

- Leveling pads. Commercial Grade (AE) concrete complying with **SECTIONS 401, 402** and **1102**.

e. Coping. Provide the following:

- Cast-in-Place copings. Grade 3.0 (AE) concrete complying with **SECTIONS 401, 402** and **1102**.
- Pre-cast Cap Blocks for MBW. Meet the requirements of **subsection 853.2b.** of this specification.

f. Soil Reinforcing. Use soil reinforcing shown in the Contract Documents.

(1) Reinforcing Strips and Tie Strips. (Reinforced Earth Company)

Use tie strips of shop fabricated hot rolled steel that complies with the minimum requirements of ASTM A570, Grade 50, or equivalent.

Use reinforcing strips that complies with the following:

- hot rolled from bars to the required shape and dimensions.
- Physical and mechanical properties that complies with ASTM A572, Grade 65, or equivalent.
- Cut to lengths and tolerances shown in the Contract Documents.
- Punch holes for bolts in the locations shown.

Galvanize the reinforcing and tie strips to comply to ASTM A123 after fabrication is completed. Inspect all reinforcing and tie strips so that they are true to size and free from defects that may impair their strength and durability. The reinforcing and tie strips will be accepted on the basis of a Type A Certification and visual inspection.

(2) Soil Reinforcing Mesh. Provide shop fabricated reinforcing mesh of cold drawn steel wire complying with the minimum requirements of ASTM A82 and weld into the finished mesh fabric in accordance with ASTM A185. Form loops or weld connection plates so the variation in length between the longest and the shortest longitudinal wire in a reinforcing mesh panel is no more than 1/8 inch when measured from the cross-wire nearest the end of the reinforcing mesh panel. Loop fabrication must permit a 5/8 inch diameter rod to pass through all loops on each piece of mesh. Galvanize reinforcing mesh in accordance with ASTM A123. The mesh will be accepted on the basis of a Type A Certification and visual inspection.

(3) Soil Reinforcing Geogrid. Use soil reinforcing geogrid of oriented, drawn, long chain high density polyethylene or polypropylene containing stabilizers and inhibitors added to the base plastic for resistance to ultraviolet and heat degradation. Use the geogrid material as designated in the approved wall system. The designated soil reinforcing geogrid will be accepted on the basis of a Type A Certification.

(4) Soil Reinforcing Geosynthetic. Use soil reinforcing of woven, high tenacity polyester yarns coated with polyvinyl chloride to maintain the integrity of the geosynthetic during handling and placement and to protect it during construction. Use the geosynthetic material as designated in the approved wall system. The designated soil reinforcing geosynthetic will be accepted on the basis of a Type A Certification.

(5) SINEstrips and Connectors (Sine Wall). Use connectors embedded in the concrete panel that comply with the minimum requirements of ASTM A 1011, Grade 50 or equivalent. Galvanize connectors after fabrication in accordance with ASTM A123.

Use configured reinforcing strips (SINEstrips) that comply with the following:

Cold formed from coils to the required shape and dimensions. Depict the strip widths and dimensions on the shop drawings.

Physical and mechanical properties that comply with ASTM A 1011, Grade 65, or equivalent.

Bolt strips to the connectors using ASTM A325 bolts and ASTM A563 nuts galvanized in accordance with ASTM A153.

Galvanize reinforcing strips after fabrication in accordance with ASTM A123. The strips will be accepted on the basis of a Type A Certification and visual inspection.

g. Reinforcing Steel. Use Grade 60 reinforcing steel that complies with **DIVISION 1600**.

h. Fasteners. Use high strength, hexagonal cap screw bolts and nuts complying with ASTM A325 (Type I) or equivalent, and hot-dip galvanized in accordance with ASTM F 2329. Provide fasteners 1/2 inch in diameter, 1-1/4 inch in length with 3/4 inch thread length. The specified fasteners will be accepted on the basis of a Type A Certification.

i. Attachment Devices.

(1) Connectors. Use clevis connectors and connector rods fabricated of cold drawn steel wire complying with ASTM A82 and welded in accordance with ASTM A185 and galvanized in accordance with ASTM A153, or

approved equal. Place connectors within 1/2 inch from the dimensions shown on the Contract Documents or approved shop drawings.

(2) Tie Bar. Use tie bars fabricated of cold drawn steel wire complying with ASTM A82 and galvanized in accordance with ASTM A153.

(3) Connection Pins. Use Connection Pins fabricated of cold drawn steel wire complying with ASTM A82 and galvanized in accordance with ASTM A153.

(4) Devices will be accepted on the basis of receipt and approval of a Type A Certification and visual inspection.

j. Joint Materials: Use joint material where required and as shown in the Contract Documents.

(1) Vertical Joints. Use a plastic filter fabric cover for horizontal and inclined joints between panels. Use adhesive to temporarily attach the fabric material to the rear of the facing panels as approved by the retaining wall system manufacturer. Cover each side of the joint with a minimum of 6 inches of filter fabric.

(2) Horizontal Joints. Use filler for horizontal joints between panels as shown in the Contract Documents and approved by the Engineer.

(3) Bearing Pads. Use bearing pads made of high-density polyethylene LR73400 with a shore hardness of 66 or as approved by the retaining wall system manufacturer.

Cover for horizontal and vertical joints between panels with a Fiber Bond filter fabric complying with AASHTO M 288 surface drainage with less than 15% soil passing No. 200 square mesh sieve, or equal as approved by the retaining wall system manufacturer. Use adhesive to temporarily attach the fabric material to the rear of the facing panels as approved by the retaining wall system manufacturer.

853.3 CONSTRUCTION REQUIREMENTS

a. Technical Representative. Provide a manufacturer's technical representative to be on the project during initial erection and be available during construction of all retaining walls at no additional cost to KDOT. The representative must spend sufficient time with both the Contractor and the Engineer so they are familiar with the proper erection procedures.

b. Wall Excavation. Remove all materials encountered without regard to classification. Coordinate excavation for the wall with the underdrain construction so that drainage pipes will be constructed as specified. Maintain stable sides at all excavations by providing reasonable cut back slopes or shoring where necessary.

c. Foundation Preparation. Grade the foundation for the retained earth volume, reinforced earth volume, strengthened earth or MSE structure volume level with the top of the leveling pad for a width equal to or exceeding the length of the reinforcing mesh, reinforcing strips or geogrid plus 12 inches or to the limits shown in the Contract Documents. Compact the foundations prior to wall construction, with a smooth wheel vibratory roller with a minimum static weight of 8 tons to recompact any loose material the excavation process created to Type AA, MR 3-3 requirements. Remove and replace any foundation soils found to be unstable or unsatisfactory.

Construct an unreinforced concrete leveling pad at foundation level as shown in the Contract Documents. Cure the pad for a minimum of 12 hours before placement of wall panels or blocks. Install the wall drainage system concurrently with the bottom layer of reinforcement and select granular backfill. Do not proceed past the bottom layer of reinforcement until the drainage system is installed and outletted away from the wall.

d. Leveling Pad. No gap between a panel and the vertical step in the leveling pad greater than 4 inches is allowable. If one gap is more than 4 inches, remove the leveling pad and re-cast in that location. If there are more than 3 gaps greater than 4 inches in a wall, remove the leveling pad and re-cast in all locations that have gaps regardless of the width of the gap. Cover gaps less than 4 inches in width with a separation geotextile on the inside of the wall face. No gaps between the leveling pad and a modular block is allowed.

e. Wall Erection. Check the plumbness and tolerances of each panel/modular block row at the face prior to erection of the next panel or modular block row. Should any panels/modular blocks be out of tolerance, remove the fill and reset the panels/modular blocks to their proper tolerances. Do not drape geosynthetic reinforcement over the face of the wall. Do not place more than one row of blocks at one time.

(1) MSEW precast Panel. Place MSEW precast panels vertically with the aid of a light crane. For erection, handle panels by means of a lifting insert precast into the upper edge of the panels. Place panels in successive

horizontal lifts in the sequence shown in the Contract Documents as backfill placement proceeds. Maintain in vertical position as fill material is placed behind a panel, by means of temporary wooden wedges placed on the external side of the wall in the joint between adjacent panels. External bracing is required for the initial lift. Vertical tolerances and horizontal alignment tolerance shall not exceed ¾-inch when measured with a 10-foot straight edge. Offset each panel from the panel below it as shown in the Contract Documents, with a maximum allowable offset of ¾-inch. The maximum vertical overall tolerance of the wall is ½-inch per 10 feet of wall height. Remove the wedges as the erection proceeds.

Make horizontal and vertical joint openings between panel's uniform, and between ½-inch and 1 ¼-inch.

Check the plumbness and tolerances of each panel row at the face prior to erection of the next panel row. Should any panels be out of tolerance, remove the fill and reset the panels to their proper tolerances.

(2) MBW. Place modular blocks at locations shown in the Contract Documents with the use of small lifting devices or by hand. Place blocks in successive horizontal lifts in the sequence shown in the Contract Documents as backfill placement proceeds. Leave modular block unit cores void unless drainage fill material is specifically called for in the Contract Documents. Take care when placing material behind the blocks to prevent the blocks from moving outward. Vertical tolerances and horizontal alignment tolerance shall not exceed 1 ½-inch when measured with a 10-foot straight edge. Offset each block from the block below it as shown in the Contract Documents with a maximum allowable offset of 1-inch. The maximum vertical overall tolerance of the wall is 1-inch per 10 feet of the wall height.

Construct uniform horizontal and vertical joint openings between modular blocks a maximum of ⅛ inch.

Extend the Mesa Connector into adjoining courses with 2 Mesa standard connectors per unit.

Place Anchor Lock Bar continuously only at elevations where geosynthetic reinforcement is required.

Place KeySystem I steel connection pins at soil reinforcing connection locations only and fiberglass alignment pins at all other pin locations.

Handle and store all geogrids, geomembranes, geotextiles, and geosynthetics according to the manufacturer's recommendations.

Do not remove any geogrid, geomembrane, geotextile, or geosynthetic from its packaging and expose it to the sunlight and the elements for a period exceeding 10 days before it is placed and covered.

Place a geomembrane horizontally above all select granular backfill that contains reinforcing strips or soil reinforcing mesh or any other metallic soil reinforcement. Extend the geomembrane 2 feet beyond the limits of the select granular backfill.

Place a Class 2 geotextile for subsurface drainage above all select granular backfill that contains soil reinforcing geogrid or soil reinforcing geosynthetic or any other polymeric reinforcement. Extend the geotextile 2 feet beyond the limits of the select granular backfill.

f. Backfill Placement. Closely follow the erection of each lift of facing with backfill. At each reinforcing level, roughly level backfill before placing and or attaching the reinforcement. Place reinforcing as shown in the Contract Documents normal to the face of the wall. For geosynthetic reinforcing, the end of the geogrid sheet will terminate with a transverse element at the retained soil limit to prevent curling of the sheet and aid in construction. Tightly draw the reinforcing against the connections at the connectors and stake the end of the geogrid sheet at the retained soil limit before backfilling is allowed, and maintain tautness during backfilling operations. Place backfill in maximum loose lift thickness of 10 inches or less as may be necessary to obtain the specified density.

Construct the MSE wall lifts and reinforcement without deflecting any nearby appurtenances, such as piles, pile casings, etc.

For MBW systems using sand and sand-gravel combinations, provide a 3-foot wide zone immediately behind the facing composed of crushed stone backfill. Separate the crushed stone backfill from the sand or sand-gravel backfill with the use of a Class 2 geotextile for separation.

Compact the entire retained earth volume to 95% of maximum laboratory dry density at a moisture requirement of MR 3-3, **SECTION 205**. For backfills containing more than 30% retained on the ¾-inch sieve, use a method compaction consisting of at least 4 passes of a heavy roller. Accomplish compaction without disturbance or displacement of reinforcing and facing. Begin compaction from the area nearest the wall face to the back of the reinforcing, except for a strip 3 feet wide adjacent to the backside of the facing. Compact this 3-foot strip with light mechanical tampers after compaction of the remainder of the layer. Soil density tests will not be required within this 3-foot area.

Maintain a maximum elevation difference of 3 feet between the retained fill and the select granular backfill.

No shale or weathered shale is permitted in the retained fill zone.

At the end of each day's operations, shape the last level of backfill to permit runoff of rainwater away from the wall face.

Remove and replace any wall materials that become damaged during backfill placement at the Contractor's expense.

Trim excess geogrid protruding from the face of the wall for MBWs to match the modular block's face. Seal any geogrid permanently exposed from exposure to the elements with the use of epoxy grout, grout, or other methods as approved by the Engineer.

No construction traffic is permitted on galvanized steel reinforcing. Use only rubber tired vehicles going less than 5 mph with no turning on geosynthetic reinforcement.

853.4 MEASUREMENT AND PAYMENT

The Engineer will measure Retaining Wall by the square foot. The Engineer will use the neat lines shown in the Contract Documents to compute the quantities.

Payment for "Retaining Wall (*)" at the contract unit price is full compensation for the specified work.

SECTION 854

LANDSCAPE RETAINING WALL SYSTEM

854.1 DESCRIPTION

Landscape retaining walls as defined by KDOT consist of systems meeting all of the following requirements:

- a total height less than 6 feet measured from top of footing to top of wall cap at the highest point;
- the maximum live load surcharge of 100 pound per square foot;
- the backslope is level;
- is not a multiple tiered wall; and
- is not a critical structure whose failure would cause loss of life, serious loss of function or access to adjacent necessary services/structures, or result in significant property damage.

For systems meeting these criteria, National Concrete Masonry Association Design Standards for Segmental Retaining Walls may be utilized. The scope of work for wall erection includes; excavation, grading and compaction of the wall foundation, general and local dewatering as required for proper execution of the work, construction of leveling pads, erection of modular block wall (MBW) elements, placement of soil reinforcing and placement and compaction of select backfill material as required. The scope of work also includes providing and placing cast-in-place concrete coping, if specified.

Include in the wall foundation all area underlying the leveling pad and the reinforced soil volume.

BID ITEM	**UNITS**
Landscape Retaining Wall	Square Foot

854.2 MATERIALS

a. General. Provide the complete landscape retaining wall system (engineering design, geosynthetic reinforcing, MBW and all necessary accessories) from an approved manufacturer according to the acceptable alternates for each particular structure as listed in the Contract Documents.

The Bureau of Materials and Research will maintain a list of approved systems. Products will remain on the prequalified list as long as Field Performance is satisfactory. Prequalification is attained upon submittal of a HITEC review and successfully addressing all issues and concerns raised by the HITEC review and KDOT. Alternately, the Mechanically Stabilized Earth supplier provides documentation in accordance with Section 8.2 of the Federal Highway Administration Publication titled "Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines", publication number FHWA-NHI-00-043, and then subsequently addresses all issues and concerns raised by KDOT.

b. Retaining Wall System.

(1) Concrete. Use cement complying with **DIVISION 2000**. Use air entrained concrete with a minimum compressive strength at 28 days of 4000 psi. Retarding admixtures may be used with prior approval of the Engineer. Accelerating agents or any admixture containing chlorides are prohibited.

Provide the MBW elements with a maximum absorption rate of 5% by weight and a minimum face shell thickness of 2 inch and complies with ASTM C 1372.

(2) Testing and Inspection. The compression testing and sampling for MBW will comply with ASTM C 140, Sampling and Testing Concrete Masonry Units, except as noted elsewhere in this specification. The MBW will be considered acceptable, regardless of curing age, if compression test results comply with the 28-day strength specifications, and if the visual inspection is satisfactorily completed. Provide facilities and perform all necessary sampling and testing. The Engineer may observe sampling and testing. Give notice a minimum of 1 week in advance of sampling and testing.

(3) Casting. Cast the MBWs in a standard manner acceptable to the National Concrete Masonry Association.

(4) Curing. Cure the MBW units in a manner acceptable to the National Concrete Masonry Association. Any production lot which does not comply with **subsection 854.2b.(2)**, Compressive Strength, will be rejected.

(5) Removal of Forms. Do not remove the forms until they can be removed without damage to the unit.

(6) Finish. Finish the MBW as specified in the Contract Documents. Screed the non-exposed faces of the MBW to eliminate open pockets of aggregate and surface distortions in excess of ¼ inch.

(7) Tolerances.

- MBW: Manufacture all units within 1/8 inch of the plan dimension and connection slots within 3/16 inch of plan dimension. Provide MBW units with a minimum of:
  - 0.83 square feet of face area each for full units.
  - 0.5 square feet of face area for each cap unit.

Provide a MBW system with angled sides capable of concave or convex alignment curves with minimum radius of 4 ½ to 6 feet.

(8) Compressive Strength. Acceptance of the MBW with respect to compressive strength will be determined on a production lot basis as specified in ASTM C 140.

(9) Rejection. Units will be rejected because of failure to comply as specified above, or any of the following defects:

- Defects that indicate imperfect molding
- Honeycombed or open texture concrete surfaces
- Any damage that would prevent making a satisfactory joint
- Chipped facing panel/unit edges
- Discolored panels or blocks beyond reasonable variances in the opinion of the Engineer.

(10) Marking. Prominently display the date of manufacture and lot number on each production lot of MBW stored at the casting plant in a manner acceptable to the Engineer.

(11) Handling, Storage, and Shipping. Handle, store and ship all units in a manner that eliminates the danger of staining, chipping, cracks, fractures and excessive bending stresses. Support blocks in storage on firm foundations in a manner that will protect the exposed exterior finish.

(12) Basis of Acceptance. The Retaining Wall System will be accepted on the basis of satisfactory results of materials test, compliance with dimensional requirements and visual inspection at the point of usage

c. Backfill. Provide aggregates for backfill complying with **DIVISION 1100** if required.

d. Aggregate Leveling Pads. Provide aggregates for leveling pads that meet the requirements for crushed stone listed in **TABLE 1107-6**, or SB-1 or SB-2 in **TABLE 1107-1**, if required.

e. Concrete for Leveling Pads and Coping. Provide the following:

- Leveling pads. Commercial Grade (AE) concrete complying with **SECTIONS 401, 402** and **1102**.
- Cast-in-Place copings. Grade 4.0 (AE) concrete complying with **SECTIONS 401, 402** and **1102**.

f. Soil Reinforcing. Use soil reinforcing shown in the Contract Documents

(1) Soil Reinforcing Mesh. Provide shop fabricated reinforcing mesh of cold drawn steel wire complying with the minimum requirements of ASTM A82 and weld into the finished mesh fabric in accordance with ASTM A185. Form loops or weld connection plates so the variation in length between the longest and the shortest longitudinal wire in a reinforcing mesh panel is no more than ⅛ inch when measured from the cross-wire nearest the end of the reinforcing mesh panel. Loop fabrication must permit a 5/8 inch diameter rod to pass through all loops on each piece of mesh. Galvanize reinforcing mesh in accordance with ASTM A123M. The mesh will be accepted on the basis of a Type A Certification and visual inspection.

(2) Soil Reinforcing Geogrid. Use soil reinforcing geogrid of oriented, drawn, long chain high density polyethylene or polypropylene containing stabilizers and inhibitors added to the base plastic for resistance to ultraviolet and heat degradation. The geogrid material will be listed on the approved list for Geogrid Mechanically Stabilized Embankment/Earth Slopes on Firm Foundations, and according to the Contract Documents.

(3) Soil Reinforcing Geosynthetic. Use soil reinforcing of woven, high tenacity polyester yarns coated with polyvinyl chloride to maintain the integrity of the geosynthetic during handling and placement and to protect it during construction. The geosynthetic material will be listed on the approved list for Geogrid Mechanically Stabilized Embankment/Earth Slopes on Firm Foundations, and according to the Contract Documents.

g. Attachment Devices.

(1) Connection Pins. Use Connection Pins fabricated of cold drawn steel wire complying with ASTM A 82 and galvanized in accordance with ASTM A 153.

(2) Devices will be accepted on the basis of receipt and approval of a Type A Certification and visual inspection.

h. Joint Materials. Use joint material as shown in the Contract Documents.

854.3 CONSTRUCTION REQUIREMENTS

a. Wall Excavation. Remove all materials encountered without regard to classification. Coordinate excavation for the wall with the underdrain construction so that drainage pipes will be constructed as specified.

Maintain stable sides at all excavations by providing reasonable cut back slopes or shoring where necessary.

b. Foundation Preparation. Grade the foundation for the retaining system volume level with the top of the leveling pad for a width equal to or exceeding the length of the soil reinforcing (if used) plus 6 inches or to the limits shown in the Contract Documents. Compact the foundation prior to wall construction, with a smooth wheel vibratory roller with a minimum static weight of 8 tons to recompact any loose material the excavation process created to Type AA, MR 3-3 requirements. Remove and replace any foundation soils found to be unstable or unsatisfactory.

Construct an unreinforced concrete or aggregate leveling pad at foundation level as shown in the Contract Documents. Cure the concrete pad for a minimum of 12 hours before placement of blocks.

c. Wall Erection. Check the plumbness and tolerances of each modular block row at the face prior to erection of the next row. Should any modular blocks be out of tolerance, remove the fill and reset to their proper tolerances.

(1) MBW. Place modular blocks at locations shown in the Contract Documents with the use of small lifting devices or by hand. Place blocks in successive horizontal lifts in the sequence shown in the Contract Documents as backfill placement proceeds. Leave modular block unit cores void unless drainage fill material is specifically called for in the Contract Documents. Take care when placing material behind the blocks to prevent the blocks from moving outward. Vertical tolerances and horizontal alignment tolerance shall not exceed 1 ½ inch when measured with a 10-foot straightedge. Offset each block from the block below it as shown in the Contract Documents, with a maximum allowable offset of 1 inch. The maximum vertical overall tolerance of the wall is 1 inch per 10 feet of the wall height.

Construct uniform horizontal and vertical joint openings between modular blocks a maximum of ⅛ inch thickness.

Extend the Mesa Connector into adjoining courses with 2 Mesa standard connectors per unit.

Place Anchor Lock Bar continuously only at elevations where geosynthetic reinforcement is required.

Place KeySystem I steel connection pins at soil reinforcing connection locations only and fiberglass alignment pins at all other pin locations.

d. Backfill Placement. Closely follow the erection of each lift of facing with backfill. At each reinforcing level, roughly level backfill before placing and or attaching the reinforcement. Place reinforcing as shown in the Contract Documents, normal to the face of the wall. For geosynthetic reinforcing, the end of the geogrid sheet shall terminate with a transverse element at the retained soil limit to prevent curling of the sheet and aid in construction. Tightly draw the reinforcing against the connections at the connectors and stake the end of the geogrid sheet at the retained soil limit before backfilling is allowed, and maintain tautness during backfilling operations. Place backfill in maximum loose lift thickness of 10 inches or less as may be necessary to obtain the specified density.

Compact the entire retained earth volume to 95% of maximum laboratory dry density at a moisture requirement of MR 3-3, **SECTION 205**. For backfills containing more than 30% retained on the ¾ inch sieve, use a method compaction consisting of at least 4 passes of a heavy roller. Accomplish compaction without disturbance or displacement of reinforcing and facing. Begin compaction from the area nearest the wall face to the back of the reinforcing, except for a strip 3 feet wide adjacent to the backside of the facing. Compact this 3-foot strip with light mechanical tampers after compaction of the remainder of the layer. Soil density tests will not be required within this 3-foot area.

At the end of each day's operations, shape the last level of backfill to permit runoff of rainwater away from the wall face.

Remove and replace any wall materials that become damaged during backfill placement at the Contractor's expense.

Trim excess geogrid protruding from the face of the wall for MBWs to match the modular block's face. Seal any geogrid permanently exposed from exposure to the elements with the use of epoxy grout, grout or other methods as approved by the Engineer.

854.4 MEASUREMENT AND PAYMENT

The Engineer will measure Landscape Retaining Wall by the square foot. The Engineer will use the neat lines shown in the Contract Documents to compute the quantities.

Payment for "Landscape Retaining Wall" at the contract unit price is full compensation for the specified work.

SECTION 855

SOLID INTERLOCKING PAVING UNITS (PAVING BRICKS)

855.1 DESCRIPTION

Install solid interlocking paving units (paving bricks) at the locations designated in the Contract Documents.

BID ITEM	UNITS
Paving Brick	Square Yard

855.2 MATERIALS

Provide paving bricks that comply with **DIVISION 300**.

855.3 CONSTRUCTION REQUIREMENTS

Unless otherwise shown in the Contract Documents, construct the base to the lines and grades shown in the Contract Documents.

If edge restraints are specified, install the edging as recommended by the manufacturer. Provide the Engineer with a copy of the manufacturer's recommendations for installation.

Unless otherwise shown in the Contract Documents, spread an uncompacted sand bedding course over the base. Level the sand bedding course approximately one inch thick or as specified in the Contract Documents. Do not disturb the sand bedding course after it is leveled to the desired elevation.

If shown in the Contract Documents, remove and reset paving bricks in good condition salvaged from the project or provided by the owner. If no bricks are provided or salvaged, provide new paving bricks.

When specified lay the paving bricks in the pattern shown in the Contract Documents. Unless otherwise shown in the Contract Documents, lay the paving bricks with joints approximately ⅛ inch wide. If necessary at the edge of the paved surface, cut the paving bricks to fit. Cut paving bricks must have a clean, straight edge. Do not use bricks cut to less than ⅓ of their original dimension.

If the paving bricks are set on a sand bedding course, use 2 or 3 passes with a vibrating compactor to vibrate the paving bricks into the sand bedding to their final elevation. The surface of paving bricks adjacent to drainage inlets, concrete collars, or channels must be ⅛ to ¼ inch above the adjacent structure. Do not vibrate the paving bricks within 3 feet of an unrestrained edge. Spread joint sand over the compacted paving brick surfaces, and allow the sand to dry. Use a vibrating compactor to vibrate the dry sand into the joints and compact the sand joints. Fill and compact the joints the same day the paving bricks are laid. Do not fill the joints and vibrate the paving bricks within 3 feet of an unrestrained edge. Protect the uncompacted edge of the laying face and the sand bedding course from the weather.

Correct deviations after the final rolling in excess of ¼ inch using a 10-foot straightedge unless the contour of the area exceeds this tolerance. Advance the straightedge along the surface, parallel and transverse to the centerline of the pavement, in successive stages of not more than half the length of the straightedge.

855.4 MEASUREMENT AND PAYMENT

The Engineer will measure the paving brick by the square yard. The Engineer will measure to the neat lines shown in the Contract Documents.

Payment for "Paving Brick" at the contract unit price is full compensation for the specified work.

SECTION 856

PRECAST CONCRETE PARKING BLOCK

856.1 DESCRIPTION

Provide and install precast concrete parking blocks of the type and size as shown in the Contract Documents.

BID ITEM	**UNITS**
Concrete Parking Block	Each

856.2 MATERIALS

Use commercially available precast concrete parking blocks complying with the details shown in the Contract Documents.

The Engineer will accept the parking blocks on the basis of compliance with dimensional requirements, condition, and visual inspection at the point of usage.

Reinforcing steel bars used to secure the parking blocks to the parking lot will be accepted by the Engineer on the basis of compliance with dimensional requirements, condition, and visual inspection at the point of usage.

856.3 CONSTRUCTION REQUIREMENTS

Install the precast concrete parking blocks as shown in the Contract Documents.

856.4 MEASUREMENT AND PAYMENT

The Engineer will measure the precast concrete parking blocks by the unit.

Payment for "Precast Concrete Parking Blocks" at the contract unit price is full compensation for the specified work.

SECTION 857

PLUGGING WELLS

857.1 DESCRIPTION

Plug the types of wells as shown in the Contract Documents.

BID ITEMS	**UNITS**
Plugging (*) Wells	Each
*Type: Oil, Gas, and Input Water	

857.2 MATERIALS

Provide grouts for plugging wells that comply with these requirements:

(1) Neat cement grout: a mixture of 94 pounds (1 sack) of portland cement and 5 to 6 gallons of water.

(2) Cement grout: a mixture of 94 pounds (1 sack) of portland cement, an equal quantity of fine sand (by weight), and 5 to 6 gallons of water.

(3) Bentonite clay grout: a mixture of a commercial sodium bentonite clay and water.

- Use high solids sodium bentonite clay. Mix the grout according to the manufacturer's recommendations such that its weight is not less than 9.4 pounds per gallon of mixture. Use agents to increase the weight of the mixture according to the manufacturer's recommendations.
- Use sodium bentonite pellets or tablets, or granular sodium bentonite that complies with K.A.R. 28-30-2(k)(3).
- Do not use sodium bentonite products that contain low solids.
- Or other products that meet or exceed the K.A.R. 28-30-7 requirements.

857.3 CONSTRUCTION REQUIREMENTS

a. Plugging Oil, Gas and Input Wells. Before starting work, notify the Kansas Corporation Commission KCC), Wichita, Kansas of the intended well plugging. The KCC will advise KDOT or the Contractor of one or more local representatives to contact.

The Contractor/subcontractor performing the work shall be licensed by the KCC to plug oil, gas and input wells. Plug the well(s) according to K.A.R. 82-3-113 (Intent to Plug), K.A.R. 82-3-114 (Plugging Methods and Procedure) and any other regulatory requirements applicable to the plugging of oil, gas or input wells. Perform the plugging procedure under the supervision of the KCC. The final plugging record shall be accepted and approved in writing by the KCC.

b. Plugging Water Wells. Before plugging any water well, notify and comply with all regulations set by the Kansas Department of Health and Environment (KDHE). The Contractor/subcontractor plugging the water well(s) shall be a KDHE Licensed Water Well Contractor. Plug all wells according to K.A.R. 28-30-7 and any other applicable regulatory requirements. Perform all plugging procedures under the supervision of KDHE. The final plugging record (Form WWC-5P) shall be accepted and approved in writing by KDHE.

857.4 MEASUREMENT AND PAYMENT

The Engineer will measure each plugged well.

Payment for "Plugging Wells" at the contract unit prices is full compensation for the specified work.

SECTION 858

BRIDGE APPROACH SLAB FOOTING

858.1 DESCRIPTION

Construct bridge approach slab footings at the locations designated in the Contract Documents.

BID ITEM	UNITS
Bridge Approach Slab Footing	Cubic Yard

858.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete and Grout	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTION 1102**
Reinforcing Steel	**DIVISION 1600**
Concrete Curing Materials	**DIVISION 1400**

858.3 CONSTRUCTION REQUIREMENTS

Excavate to the neat lines shown in the Contract Documents. Place reinforcing steel at the locations shown in the Contract Documents. Use a sufficient number of approved metal bar chairs and secure to prevent displacement during concrete placement. Place and cure the concrete according to the Contract Documents and according to **DIVISION 700**.

858.4 MEASUREMENT AND PAYMENT

The Engineer will measure the bridge approach slab footing by the cubic yard to the neat lines shown in the Contract Documents.

Payment for "Bridge Approach Slab Footing" at the contract unit price is full compensation for the specified work.

SECTION 859

INTELLIGENT TRANSPORTATION SYSTEM (ITS)

859.1 DESCRIPTION

Install Intelligent Transportation System (ITS) including KDOT supplied materials as shown in the Contract Documents.

BID ITEM	**UNITS**
Intelligent Transportation System	Lump Sum

859.2 MATERIALS

a. Provide the specified materials that comply with the materials' divisions (**SECTION 1000 – 2500**).

For concrete foundations, use Grade 3.0 concrete that complies with **SECTIONS 401, 402** and **1102**, and steel reinforcement that complies with **DIVISION 1600**, unless shown otherwise in the Contract Documents.

b. ITS. Provide and install all materials necessary for the complete and satisfactory operation of the ITS whether specifically mentioned or not. Provide material that is new, the best standard product of a manufacturer regularly engaged in the production of this type of material, the manufacturer's latest approved design and of best quality and workmanship.

859.3 CONSTRUCTION REQUIREMENTS

a. Codes and Regulations. Perform all ITS work according to:

- National Electric Code.
- National Electric Safety Code.
- Rural Utility Service (RUS).
- Illumination Engineers Society (IES).
- Standards of the American Society for Testing and Materials (ASTM).
- American Association of State Highway and Transportation Officials (AASHTO).
- Regulations of the National Board of Fire Underwriters.
- Local ordinances.
- KDOT Utility Accommodation Policy
- Details in the Contract Documents.

Whenever reference is made to any of the standards mentioned, the reference shall be considered to mean the code, ordinance, or standard that is in effect at the time of the bid advertisement.

b. General. Provide and install all incidental parts not shown in the Contract Documents which are necessary to complete the ITS system or modify existing systems as shown in the Contract Documents.

All utility hookups and utility transformers are subsidiary.

c. Removals and Excavations. Perform removals of existing structures and excavations to minimize damage to existing structures and right-of-way.

Limit the excavation for the conduits, foundations and other appliances to that necessary for the installation of the materials. Do not excavate until immediately before installing the materials.

Place excavated material where the least damage and obstruction to vehicles and pedestrian traffic will occur. Do not impede surface drainage.

Assume ownership and dispose of removed concrete and soil off of the right of way.

At the end of each day's work and at all times when construction operations are suspended, remove all equipment and other obstructions from the portion of the roadway open for use by public traffic.

d. Backfill. Place the backfill material in uniform layers (maximum 6 inches compacted) evenly on all sides of the structure. Compact the backfill using pneumatic tampers, vibratory compactors or other equipment approved by the Engineer. Compact the backfill to comply with the Contract Documents. If backfill requirements are not specified, compact each layer until no further consolidation is observed.

Remove surplus excavated material, including concrete and soil from the project and dispose on sites approved by the Engineer or assume ownership and dispose of off of the right of way. Reseed and mulch the areas disturbed by the excavations. Hand seeding methods may be used.

Do not use cinders, broken concrete, broken rock or other hard or undesirable material for backfilling.

e. Replacing Damaged Improvements. Replace all sidewalks, curbs, gutters, pavements and other improvements removed or damaged during installations of the Intelligent Transportation System. Replace or reconstruct the removed or damaged improvements with the same type and quality of materials originally used. If part of an existing slab of concrete pavement or square of sidewalk is removed or damaged, replace the entire slab or square. Replace damaged improvements as soon as practicable.

Completely repair the ditch and replace the disturbed aggregate ditch liner if construction activities disturb any aggregate ditch. Do not let rocks or aggregate fall into the trench prior to backfill.

f. Foundations.

(1) Concrete Foundations. Form the foundations and place the concrete according to **DIVISION 700**. Hold conduit ends and anchor bolts securely in the proper position when the concrete is placed.

Cure the concrete foundations with wet burlap or polyethylene for a period of 72 hours. Prevent concrete temperatures from falling below 32ºF.

Do not attach poles or cabinets until the concrete has cured for 14 days.

Construct foundations in one pour.

If a foundation cannot be constructed as shown in the Contract Documents because of an obstruction, Contractor will submit to the Engineer for approval, an alternate method to construct the foundation.

The top of the pole foundations shall be 2 inches above the finished grade if located in a non-paved area. Concrete work aprons around equipment cabinet foundations shall be 1 inch above the finished grade if located in a non-paved area.

(2) Screw-In Foundation Anchors. If screw-in foundations are required in the Contract Documents, pre--drilling holes for screw-in foundation anchors is prohibited. As the foundation anchors are screwed into the ground, make sure they are plumb. The pole base of the screw-in foundation anchor shall be level when the installation is complete.

Use the connectors to make minor leveling adjustments on poles with breakaway connectors. Use galvanized or cadmium plated shims or washers (maximum thickness ¼ inch) to make minor leveling adjustments on other types of poles. Only 1 shim or washer is allowed on any 1 anchor bolt, with a maximum of 2 shims or washers on any pole.

(3) Removal of Existing Foundations. Remove the designated existing foundations to the depth shown in the Contract Documents. Backfill the resulting holes according to **DIVISION 200**. Dispose of the removed foundations and anchor bolts.

g. Conduit. Install electric conduit as shown in the Contract Documents and **subsection 814.3g**.

h. Electric Service Boxes. Install electric service boxes as shown in the Contract Documents.

i. Pull Boxes. Install pull boxes as shown in the Contract Documents.

j. Expansion Fittings. If expansion fittings are required in the Contract Documents, install expansion fittings as shown in the Contract Documents, where conduit crosses an expansion joint in the structure. Provide each expansion fitting with a bonding jumper of No. 6 A.W.G. copper wire or equal.

k. Wiring. Neatly arrange and lace up wiring within junction boxes, transformer bases and on standards, etc.

Do not splice cable in conduit or outside of pull boxes, splice boxes or standards, unless shown in the Contract Documents. When not fastened to existing structure or carried through conduit, lay conductor cable to the depth shown in the Contract Documents.

Use powdered soapstone, talc or other approved lubricant when inserting conductors in conduit. Pencil, trim to conical shape and roughen conductor insulation before applying splice insulation.

When conductors and cables are pulled into the conduit, tape all ends to exclude moisture until the splices are made or terminal appliances are attached.

l. Bonding and Grounding. When a closed system enclosed in conduit is used, bond metallic cable sheaths, conduit and metal standards to form a continuous system, and effectively ground. When an open system such as an overhead wiring or direct burial underground is used, effectively ground only standards and service points, except where conduit runs used under pavement cross a water system.

Install ground electrodes as shown in the Contract Documents.

m. Communication Link Tests. After all the connections have been completed, test communications as noted in Contact Documents.

n. Documentation. Provide documentation as noted in Contract Documents.

859.4 MEASUREMENT AND PAYMENT

The Engineer will measure the Intelligent Transportation System by the Lump Sum.

All utility hookups, utility transformers, excavation, backfilling, Grade 3.0 concrete and testing for the Intelligent Transportation System are subsidiary.

Payment for "Intelligent Transportation System" at the contract unit price is full compensation for the specified work.

SECTION 860

BASEDRAINS

860.1 DESCRIPTION

Construct the designated type of basedrain as shown in the Contract Documents.

BID ITEMS	UNITS
*Pipe Basedrains (**)	Linear Foot

*Size, Diameter
**Type

860.2 MATERIALS

Provide materials that comply with the applicable requirements.

Concrete and Grout	**SECTIONS 401 & 402**
Aggregates for Concrete Not On Grade	**SECTION 1102**
Aggregates for Backfill	**DIVISION 1100**

Basedrain Pipe

Type Designation		
F	Perforated Corrugated Metal Pipe	**DIVISION 1900**
H	Polyvinyl Chloride Pipe	**DIVISION 1900**
T	High-Density Polyethylene Pipe	**DIVISION 1900**

Basedrain Outlet Pipe

G	Corrugated Metal Pipe	**DIVISION 1900**
K	Polyvinyl Chloride Pipe	**DIVISION 1900**
S	High-Density Polyethylene Pipe	**DIVISION 1900**

If the type is not indicated in the Contract Documents, any of the types listed above are permitted. Provide basedrain pipes with a nominal minimum inside diameter of 6 inches, unless shown otherwise in the Contract Documents. Provide perforated or corrugated basedrain pipe with the same type of outlet pipe.

860.3 CONSTRUCTION REQUIREMENTS

a. Excavation for Pipe Basedrains. Excavate trenches for all lateral and longitudinal interceptor drains as shown in the Contract Documents. Construct trench bottoms for perforated pipe in firm material to permit the placing of aggregate for pipe underdrains underneath the pipe.

If unstable material is encountered in the bottom of the trench, place the drain pipe on an insulating course of aggregate for pipe basedrains of sufficient thickness (maximum 3 inches) to provide proper movement of water without danger of sealing off the drain, and to maintain proper alignment and grade of the pipe. Insulating courses of aggregate are only permitted under perforated pipe.

The minimum trench width is 8 inches plus the exterior diameter of the underdrain pipe, unless shown otherwise in the Contract Documents. Basedrains shall be place a minimum of 18 inches below the base of the pavement.

b. Laying Basedrain Pipe. Lay all pipes on a minimum grade of 1%, unless otherwise shown in the Contract Documents. Close all dead ends of pipe underdrains with a cap of the same material as the pipe.

Join metal pipe by means of approved coupling bands provided by the pipe manufacturer. Make all junctions and turns with wyes, tees and bends. When field cutting is required, cold or flame cut metal pipe as approved by the Engineer. Paint cut surfaces with an approved zinc-rich paint.

Lay perforations down, unless shown otherwise in the Contract Documents.

c. Laying Outlet Pipe. Lay outlet pipe only on stable material with minimum of 1% grade, unless otherwise shown in the Contract Documents. Place metal outlet pipe with ends abutting and join with manufacturer's coupling bands to provide a watertight joint.

d. Backfilling Pipe Basedrains. Do not begin backfill without approval of the Engineer. Place backfill to prevent large cavities in the backfill and walls of the trench.

Where a portion of the trench above the basedrain backfill aggregate is to be filled with soil, use a compactable material. Place the material in layers and compact to a density equal to or greater than that required for the adjacent material, with a minimum of 90% of standard compaction of the soil used.

e. Pipe Basedrain Outlets. Use a concrete flume or other approved type of flume, constructed at the outlet end of pipe underdrains as shown in the Contract Documents. Use Grade 3.0 concrete to construct the outlet flume so that the flume is flush with the finished shoulder slope.

f. Construction Near Guardrails. Where a basedrain will be constructed in a section of highway with guardrail, adjust the placement of the outlet pipe so that guardrail posts will not be driven within 1 foot of the outlet pipe. Conduct a mandrel test after driving the guardrail posts by pushing a piece of flexible pipe through the outlet pipes to ensure the outlet was not damaged. Replace all damaged outlets.

g. Basedrain Markers. Erect 1 guidepost to mark each outlet flume for pipe basedrains, at the location shown in the Contract Documents. Use either a 6 inch diameter treated wood post or a 3 pound per foot galvanized or baked-on enamel metal channel post. Set guideposts according to **SECTION 827**.

(1) Wood Guideposts. Apply 2 coats of aluminum paint to the upper 18 inches of the wooden post. Apply a third coat of International Orange enamel paint to the upper 12 inches of the wooden post.

(2) Metal Guideposts. Apply 1 coat of International Orange enamel paint to the upper 12 inches of the galvanized or baked on enamel metal channel post.

h. Video Inspection. When specified in the Contract Documents, inspect completed basedrains immediately before placing final surfacing. Use a pipeline inspection camera to determine if the basedrain is functioning properly. Beginning at the rodent screen, push the camera through the outlet pipe and into the drain system. Push the camera into the drain until there is resistance against further movement, the end of the pipe segment is reached, or for 200 feet, and record this distance. Use the camera as a mandrel for determining locations of compressed pipes where they are found. Document all observed failures, including blockages, rips, separations, backfill in the pipe, crushed pipe, and any other flaws that could prevent the basedrain from functioning properly. Record all digital observations and data and submit a report to the Engineer. Correct any deficiencies at the Contractor's expense.

Provide certification that the installed basedrain system is functioning properly before formal acceptance of the project.

For the video inspection, provide a video camera complying with the following requirements:

- high resolution, high sensitivity, waterproof and color;
- ability to pan and tilt to a 90° angle with the axis of the pipe and rotate 360°;
- capable of negotiating the various angle fittings used in the edge drain system;
- with sufficient lighting to provide a true color picture of the entire periphery of the diameter of the pipe; and
- with attachments that will maintain the camera's position in the center of the pipe.

Provide a portable control unit of the video camera complying with the following requirements:

- capable of adjusting the iris, focus, and light level intensity;
- has a color monitor (8-inch minimum) with a minimum standard resolution of 720 x 480 pixels to track the camera's progress through the inspections;
- have 2 video input/output jacks for video recording, as well as digital playback verification through the built-in monitor; and
- have audio input to allow for dubbing of the video to incorporate comments as necessary.

Provide a video camera system complying with the following requirements:

- has sufficient cable/push rod to conduct inspections to a length of 500 feet, and a distance counter to monitor the length of the inspection; and
- have a color video printer that will produce color prints of any observations of interest during the course of the inspection;
- include a digital video recorder (minimum quality 4-head industrial grade VHS type) with audio dubbing still frame and slow speed capabilities; and
- has software capable of generating a report that shows each defect, along with its location measured from the inspection entrance, and a still frame image of the fault.

Provide an experienced video technician to operate the video camera system.

860.4 MEASUREMENT AND PAYMENT

The Engineer will measure pipe basedrains by the linear foot.

The Engineer will measure and pay for guideposts used for basedrain markers according to **SECTION 827**, and the quantities will be included in the quantity of guideposts shown in the Contract Documents.

Payment for "Pipe Basedrains" at the contract unit prices is full compensation for the specified work.

SECTION 901

STORMWATER POLLUTION MANAGEMENT

901.1 DESCRIPTION

Design, implement, inspect and maintain appropriate best management practices to minimize or eliminate erosion, sediment and other pollutants in stormwater runoff from the project.

BID ITEMS	UNITS
SWPPP Design	Lump Sum
SWPPP Inspection	Each
Water Pollution Control Manager	Each
Stormwater Compliance Disincentive Assessment	Lump Sum

901.2 MATERIALS

None Required.

901.3 CONSTRUCTION REQUIREMENTS

a. Permits.

(1) Projects with 1.0 acre or more of erodible surface: KDOT (or the local governmental agency) will submit the Notice of Intent (NOI) for authorization to discharge stormwater runoff from construction activities in accordance with the Kansas Water Pollution Control General Permit. This authorization does not cover Contractor plant sites and Contractor-Furnished borrow and waste sites outside the project limits.

(2) Projects with less than 1.0 acre of erodible surface: Kansas General Permit coverage is not required. The Contractor is required to comply with **subsection 901.3b.** and use appropriate Best Management Practices (BMPs) to minimize stormwater pollution.

A Storm Water Pollution Prevention Plan (SWPPP) (**subsection 901.3c.)** is not required.

Inspection and Maintenance Reports (**subsection 901.3e.)** are not required.

A Water Pollution Control Manager (**subsection 901.3d.**) is not required.

Stormwater Erosion Control Conferences (**subsection 901.3f.**) are not required.

b. General. When Contractor-furnished borrow or plant sites are outside the project limits, obtain all required permits and clearances required for compliance, **SECTION 107**. Provide copies of all such permits and clearances to the Engineer.

Take all measures necessary to minimize or eliminate erosion, sediment and other pollutants in stormwater runoff from the project and project related borrow areas.

Assume responsibility for inspection and maintenance of all erosion and sediment control measures within the project limits, whether originally implemented by the Contractor, KDOT or a third party. Obtain information regarding the SWPPP and active Best Management Practices (BMPs) from the Area Engineer. Maintenance or removal of BMPs not installed by the Contractor may be considered Extra Work, **SECTION 104**, unless addressed by other items of the contract (e.g. sediment removal).

Install devices to establish a perimeter control of the project in areas where it is anticipated that stormwater runoff will leave the project. Install perimeter control devices prior to or simultaneously with the clearing and grubbing operations. Do not perform grading until perimeter control devices are in place and approved by the Engineer.

Unless requested in writing from the Contractor, and approved in writing by the Engineer, or specified otherwise in the Contract Documents, do not exceed 750,000 square feet of surface area of erodible earth material per equipment spread at one time. The Engineer will limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow (within right-of-way) and embankment operations. Limit the exposed erodible earth material according to the capability and progress, and in keeping with the approved schedule.

Areas will not count toward the 750,000 square feet limit, when the following conditions are met:

For areas that will not be disturbed again due to project phasing:

- Finish grade the completed area;

- Stabilize and maintain stabilization according to **SECTION 902**; and
- Do not disturb the area again without a written request from the Contractor and written approval from the Engineer;

For areas that will be disturbed again due to project phasing:

- Rough grade; and
- Stabilize and maintain stabilization according to **SECTION 902**.

DO NOT clear and grub areas unless work will actively be performed in the exposed area (or portions of the exposed area) within 7 calendar days on exposed steep slope areas (40% or greater) or within 14 calendar days for all other exposed areas.

If areas are cleared and grubbed and not finish graded, not part of project phasing and no meaningful work toward the completion of the bid item is performed within the exposed area (or portions of the exposed area) for 7 calendar days on exposed steep slope areas (40% or greater) or 14 calendar days for all other exposed areas, stabilize and maintain stabilization of the exposed areas according to **SECTION 902** at no cost to KDOT.

If on-site or state-furnished off-site borrow areas are to be excavated below the ground water elevation, construct a temporary berm around the borrow area to prevent stormwater runoff from entering the excavated area.

Do not ford live streams with construction equipment.

Restrict construction operations in rivers, streams and other water impoundments to those areas that must be entered for the construction of temporary or permanent structures. Only use clean aggregate fill for temporary crossing, work platforms, etc. When no longer required, promptly remove all falsework, piling, temporary crossings and other obstructions caused by the construction.

Where practical, do not store equipment or materials (including soil stockpiles) within 50 feet of rivers, streams or other surface waters. Avoid storing equipment or materials (including soil stockpiles) in flowlines of ditches or other drainage courses. Where such storage is necessary, obtain the Engineer's written approval and include in the project SWPPP appropriate best management practices for the storage area.

Install and maintain temporary erosion and pollution control devices as shown in the Contract Documents, **SECTION 902**, the SWPPP and as directed by the Engineer.

Implement temporary erosion and pollution control with best management practices (BMPs) as described in the SWPPP.

At a minimum, perform the following:

- Use temporary best management practices to minimize or eliminate pollutant discharge resulting from the construction of the project;
- Use temporary best management practices to prevent contamination of adjacent streams or other watercourses, lakes, ponds or other areas of water impoundment;
- Coordinate temporary best management practices with the construction of permanent erosion control features to provide continuous erosion control;
- Schedule construction of drainage structures and permanent erosion control features as soon as practicable; and
- Immediately initiate placement of appropriate erosion control Best Management Practices (BMPs) in any exposed steep slope areas (40% or greater) where construction activities have permanently or temporarily ceased, and will not resume for a period exceeding 7 calendar days. For vegetative cover areas, in addition to seeding, watering, mulching, and any other required activities related to the planting and establishment of vegetation, utilize other appropriate erosion control practices such as geotextiles or erosion control mats.
- Immediately initiate temporary stabilization on areas that have been disturbed after construction activities have permanently ceased on that portion of the project site. Immediately initiate temporary stabilization measures on areas that have been disturbed after construction activities have temporarily ceased on that portion of the project site if construction activities will not resume for a period exceeding 14 calendar days. Temporary stabilization may include temporary seeding, geotextiles, mulches or other techniques to reduce or eliminate erosion until either final stabilization can be achieved or until further construction activities take place to re-disturb the area.

Notify the Engineer in writing within 24 hours of any chemical, sewage or other material spill which is required to be reported to the KDHE under part 10 of the NPDES permit. The notification shall include at a minimum the material spilled, location of the spill, and a description of containment or remediation actions taken. This notice to the Engineer does not relieve the Contractor of responsibility to report to the KDHE or to any other agency.

If temporary erosion and pollution control is not implemented and maintained according to this specification, the approved SWPPP, or the NPDES permit, the Area/Metro Engineer may suspend all or part of the work on the project until conditions are brought into compliance, as determined by the Area/Metro Engineer.

KDOT will not issue the Notice of Acceptance, **SECTION 105**, until all necessary maintenance, corrective actions, removal of unnecessary devices and temporary stabilization is completed for the project. Failure to complete this work within the contract time may result in liquidated damages, **SECTION 108**.

All SWPPP related documentation including the original SWPPP, all revisions/amendments, and inspection reports shall be retained by the Engineer upon Acceptance of the project.

c. Project Storm Water Pollution Prevention Plan (SWPPP). Before the preconstruction conference, submit to the Field Engineer a minimum of 3 original copies of the SWPPP. No contract work may begin until the Field Engineer has approved the SWPPP.

Design the SWPPP to comply with the NPDES permit for the project. At a minimum, the project SWPPP shall include:

- the SWPPP Inspection and Maintenance Report Forms (KDOT Form No. 247);
- The planned sequence of major construction activities;
- the Contractor's Erosion Control Site Plan;
- the SWPPP Contractor Certification Form 246. The Contractor and all subcontractors are required to certify that they understand the terms and conditions of the general NPDES permit. The Engineer will provide the SWPPP Certification Form (Form No. 246), or it can be found on the KDOT Internet;
- a copy of the Project Notice of Intent Form (NOI) for Stormwater Runoff from Construction Activities. (obtained from KDOT);
- An acknowledgement that State and Local requirements have been included in the SWPPP. Review all applicable permits (Corps of Engineers, Department of Agriculture, etc.) for special conditions affecting stormwater pollution control;
- Reference Contract Documents pertaining to temporary erosion and water pollution control. KDOT standard specifications, contractual special provisions and the policy on Storm Water Discharges can be found on the KDOT Internet at www.ksdot.org;
- A detailed description of Best Management Practices (BMPs) which will be used one or more times at the site for erosion and sediment control. Design, install and maintain BMPs to:
  - Control stormwater volume and velocity within the site;
  - Control stormwater discharges;
  - Minimize the amount of soil exposed during construction activity;
  - Minimize the disturbance of steep slopes (slopes of 40% or greater);
  - Minimize sediment discharges from the site;
  - Control discharges from sediment or soil stockpiles;
  - Minimize the generation of dust;
  - Minimize off-site tracking of soils;
  - Provide storm drain inlet protection for inlets down gradient of sites not fully stabilized or where construction will soon be started;
- Design, install, implement and maintain additional BMPs to minimize or eliminate contamination of stormwater runoff to:
  - Minimize discharge of pollutants from equipment and vehicle washing;
  - Minimize the exposure of construction waste, trash, pesticides, herbicides, detergents, sanitary waste and other materials present on the site to precipitation and to stormwater;
  - Minimize the discharge of pollutants from spills and leaks and implement chemical spill and leak prevention and response procedures;
  - BMPs in this category include but are not limited to:
    - Waste management including trash containers and regular site cleanup for proper disposal of solid waste such as scrap material, product/material shipping waste, food containers and cups;
    - Containers and proper disposal for waste paints, solvents, and cleaning compounds;

- Portable toilets for proper disposal of sanitary waste;
- Storage for construction materials away from drainage courses and low areas.

Update the erosion control site plan as work progresses to show changes due to revisions in work schedules or sequence of construction, or as directed by the Engineer. Update the site map to reflect erosion control devices that have been installed or removed.

d. Water Pollution Control Manager. Designate a Water Pollution Control Manager (WPCM) who shall visit the project during normal work hours on a frequent basis and in no instance less than once per week until all physical work is complete and the Engineer issues the Notice of Acceptance or a partial Notice of Acceptance. The required 180 day observation period for pavement markings is not considered to be physical work. The WPCM shall thoroughly review the project and SWPPP documentation during these site visits to verify the Contractor's compliance with this specification and with the NPDES permit. In addition, the WPCM shall:

- Have the authority to supervise all work performed by the Contractor and subcontractors that involves stormwater requirements or affects stormwater compliance;
- Have the responsibility to order Contractor employees and subcontractors to take appropriate corrective action to comply with stormwater requirements, including requiring any such person to cease or correct a violation of stormwater requirements and to order or recommend such other actions or sanctions as necessary to meet stormwater requirements;
- Be familiar with the Project SWPPP;
- Be responsible for updating the Project SWPPP and site maps to accurately reflect the BMPs in use on the project;
- Be the point of contact for KDOT regarding stormwater compliance;
- Have completed KDOT's Environmental Inspector Training (EIT) and Environmental Manager Training (EMT) programs within the 12 months prior to beginning construction activities. Maintain these certifications for the duration of the project;
- Review and sign SWPPP inspection reports within 3 days after receiving such reports, acknowledging awareness of any deficiencies and ensuring the correction of all deficiencies.
- Maintain and monitor an active email account capable of receiving electronic communications including inspection reports, photos and other documents relevant to stormwater compliance.

The WPCM may, when approved by the Engineer, perform SWPPP Inspections according to **subsection 901.3e**.

Immediately notify the Engineer in writing if the designated WPCM is replaced. The replacement WPCM shall comply with the above requirements, except that they shall have completed the training requirements within the 12 months prior to assuming WPCM duties. The notification shall include training certificates and contact information for the replacement WPCM.

e. SWPPP Inspections. The Contractor's Environmental Inspector shall have completed KDOT's Environmental Inspector Training (EIT) and maintain a current certification while performing SWPPP Inspections.

KDOT's Inspector and the Contractor's Environmental Inspector shall perform a joint inspection of the temporary erosion and pollution control devices every 14 days during normal work hours and within 24 hours of a rainfall event of ½ inch or more. Continue inspections at this frequency until all physical work is complete and the Engineer issues the Notice of Acceptance or a partial Notice of Acceptance. The required 180 day observation period for pavement markings is not considered to be physical work.

Document the SWPPP inspections on KDOT Form 247, (SWPPP Inspection and Maintenance Report). KDOT and Contractor Inspectors shall each sign the report.

Correct any deficiencies noted during a SWPPP Inspection within 7 days of the inspection despite weather conditions that make it difficult (but not impossible) to perform corrections. No additional time shall be granted for making corrections on the basis of weather unless it is physically impossible due to flooding or frozen ground conditions for the Contractor to complete the corrections within the 7 days allowed. No additional time will be granted to complete corrective actions unless approved by the Stormwater Compliance Engineer.

Submit completed copies of KDOT Form 247 to the Area/Metro Engineer and the Contractor's WPCM within 24 hours after an inspection has been made.

The WPCM shall review and sign the report within 3 calendar days of receiving the completed inspection report. The WPCM's signature acknowledges awareness of all reported deficiencies and corrective actions required to be taken within 7 calendar days of the inspection.

The Contractor Inspector's signature acknowledges awareness of all reported deficiencies and corrective actions required to be taken within 7 calendar days of the inspection.

The obligation to conduct formal inspections and complete an associated report every 14 days and within 24 hours of a rainfall event of ½ inch or more does not limit or otherwise modify the Contractor's obligation to monitor and maintain temporary erosion and pollution control devices daily.

f. Stormwater Erosion Control Conferences. Each project shall have a stormwater erosion control pre-construction conference before the start of construction activities.

KDOT and the Contractor shall also hold stormwater erosion control conferences before the start of each major phase of construction and before the winter shutdown period begins.

These conferences shall be attended by the KDOT Area/Metro Engineer, the WPCM, and Environmental Inspector(s) for the Project, and any erosion control subcontractor(s). The attendance sheet and minutes of the conference will be kept in the SWPPP notebook.

g. Stormwater Compliance Disincentive Assessment. If deficiencies noted during SWPPP inspections performed according to **subsection 901.3e.** are not corrected within 7 calendar days of the inspection, the Contractor shall be liable for a disincentive assessment. The disincentive assessment charged and owing shall be fifty dollars ($50) per day for each deficiency not corrected.

Should an event causing flooding or frozen ground conditions make it impossible to perform corrections within the allowed time, notify the Area/Metro Engineer and the Stormwater Compliance Engineer within 48 hours of the event. Within 3 days of the notification, submit in writing an explanation and description of the reasons for the delay; the anticipated duration of the delay; all actions taken or to be taken to prevent or minimize the delay; and a schedule for implementation of any measures to be taken to prevent or mitigate the delay. Include with the submittal any relevant documentation supporting the claim that the delay is due to impossible conditions and that best efforts were made to complete the required corrections and to minimize any delay to the extent possible. No additional time will be granted to submit the required information unless approved in writing by the Stormwater Compliance Engineer.

The Engineer will deduct and withhold from contract funds the Stormwater Compliance Disincentive Assessment under **subsection 901.3g**. The assessments are to be computed in the same manner as damages under **SECTION 108** (Liquidated Damages and Disincentive Assessments) except calendar days include Sundays, Holidays and the Winter Holiday Period. If contract funds are insufficient, the Contractor shall pay KDOT the balance owed. If the Contractor fails to pay KDOT the amount owed within 10 days after demand from KDOT, the Contractor shall be considered in breach of contract under **SECTION 108**.

The disincentive assessments under **subsection 901.3g.** are in addition to federal and state statutory penalties and fines that are allowed against the Contractor under the Clean Water Act and other environmental laws for violations of those laws. See also **subsection 901.3h**.

h. Penalties and Fines. Nothing in **SECTION 901** prevents KDHE, EPA or both from assessing penalties and fines against the Contractor because of the Contractor's failure to comply with applicable laws, regulations, ordinances, NPDES permit, other permits, the SWPPP, governmental administrative compliance orders or corrective orders for the Project, or a combination thereof.

Nothing in this **SECTION 901** prevents KDHE, EPA, or both from assessing penalties and fines against the Contractor because of the Contractor's failure to comply with an administrative claims settlement or consent decree that governs KDOT projects and that is included in the Proposal Form or that is added "Extra Work", **SECTION 104**.

Understand that penalties/fines may be imposed against KDOT, the Contractor, or both because of "shared" responsibility/liability under applicable environmental law, regulations, ordinances; the NPDES permit, other permits, the SWPPP, administrative corrective action orders, administrative claims settlements, consent decrees, legal judgments or a combination thereof. The Contractor shall have no claim that such shared responsibility/liability voids the Contractor's liability for disincentive assessments under **subsection 901.3g.** or for penalties/fines under **subsection 901.3h**.

901.4 MEASUREMENT AND PAYMENT

The Engineer will measure each SWPPP inspection performed in compliance with this specification.

The Engineer will measure each Water Pollution Control Manager (WPCM). Each is defined as each calendar week (Sunday-Saturday) that the Contractor provides a WPCM according to **subsection 901.3.d**. Each week will be measured only once, regardless of the number of site visits or time spent performing WPCM duties for that week.

The Engineer will measure SWPPP design for payment as a lump sum upon the Area Engineer's approval. All revisions or updates to the SWPPP shall be subsidiary.

The Engineer will assess disincentives under the bid item "Stormwater Compliance Disincentive Assessment" by the Lump Sum.

SECTION 902

TEMPORARY EROSION AND SEDIMENT CONTROL

902.1 DESCRIPTION

Install, maintain and remove temporary erosion and pollution control devices as required during the construction of the project.

BID ITEMS	UNITS
Temporary Berm (Set Price)	Linear Foot
Temporary Slope Drain	Linear Foot
Silt Fence	Linear Foot
Biodegradable Log (***)	Linear Foot
Synthetic Sediment Barrier	Linear Foot
Filter Sock (***)	Linear Foot
Temporary Ditch Check (Rock)	Cubic Yard
Temporary Inlet Sediment Barrier	Each
Temporary Sediment Basin	Cubic Yard
Temporary Stream Crossing	Each
Sediment Removal (Set Price)	Cubic Yard
Temporary Fertilizer (**)	Pound
Temporary Seed (**)	Pound
Soil Erosion Mix	Pound
Temporary Seeding	Lump Sum
Erosion Control (*)(**)	Square Yard
Mulching (Temporary)	Ton
Water (Erosion Control) (Set Price)	M Gallon
Geotextile (Erosion Control)	Square Yard

* Class
** Type
*** Size

902.2 MATERIALS

Provide erosion control devices, sediment barriers, fertilizers, seeds, soil erosion mix, erosion control materials and mulch that comply with **DIVISION 2100**.

Provide aggregate that complies with aggregate ditch lining, D_{50} = 6 inches, **DIVISION 1100**. Existing aggregate from the project may be used under this specification, provided all applicable physical requirements are met.

Provide water for erosion control that complies with **DIVISION 2400**.

Provide geotextile (erosion control) that complies with **DIVISION 1700** for separation geotextile.

Provide metal pipe, plastic pipe or flexible rubber pipe for temporary slope drains. The Engineer will accept the material for temporary slope drain based on the condition of the pipe and visual inspection of the installed drain.

902.3 CONSTRUCTION REQUIREMENTS

a. General. If the contract does not include temporary erosion and sediment control bid items, and such work is required, items will be added as provided for in **SECTION 104**.

Use KDOT's Temporary Erosion Control Manual and standard plan sheets or approved alternate reference documents as a guide for the design, installation and maintenance of temporary erosion and sediment control best management practices (BMPs.).

Alternate BMP references include:

- EPA – Stormwater Menu of BMP: (http://water.epa.gov/polwaste/npdes/swbmp/Construction-Site-Stormwater-Run-Off-Control.cfm)
- Mn/DOT – Erosion and Sediment Control Pocketbook Guide:

(http://www.dot.state.mn.us/environment/erosion/pdf/2006mndotecfieldhandbook.pdf)

- NDOR – Construction Stormwater Pocket Guide: (http://www.transportation.nebraska.gov/environment/guides/Const-Strmwtr-Pocket%20Guide.pdf)
- Additional reference material available on KDOT's internet website: (http://www.ksdot.org/bureaus/burconsmain/Connections/swppp.asp).

b. Temporary Berms. Use temporary berms to divert storm runoff to stabilized slopes or temporary slope drains. Construct temporary berms as shown in the Contract Documents. Compact the berms until no further consolidation is observed, using a dozer track, grader wheel or other equipment.

c. Temporary Slope Drains. Use temporary slope drains to carry storm runoff down fill slopes and cut backslopes. Construct the temporary slope drains as shown in the Contract Documents.

d. Silt Fence. Install silt fence for slope barriers or ditch checks as shown in the SWPPP. When conditions warrant, supplement the temporary silt fence with a support fence. Reduce the post spacing and drive the posts further in the ground in low and soft, swampy areas. Remove and dispose of sediment deposits when the deposit approaches ⅓ the height of the silt fence.

Dispose of sediment on the project at locations approved by the Engineer. When necessary, stabilize the material as directed by the Engineer.

e. Biodegradable Logs. Install biodegradable logs for slope barriers or ditch checks as shown in the SWPPP. Remove and dispose of sediment deposits when the deposit approaches ½ the height of the biodegradable log.

Do not use straw logs for ditch checks or inlet sediment barriers.

Dispose of sediment on the project at locations approved by the Engineer. When necessary, stabilize the material as directed by the Engineer.

f. Synthetic Sediment Barriers. Install synthetic sediment barriers for slope barriers or ditch checks as shown in the SWPPP. Remove and dispose of sediment deposits when the deposit approaches ½ the height of the barrier.

Dispose of sediment on the project at locations approved by the Engineer. When necessary, stabilize the material as directed by the Engineer.

g. Filter Sock. Install filter socks with approved filler as shown in the SWPPP. Use coarse aggregate filler for protection of curb and gutter inlets.

h. Temporary Ditch Check (Rock). Use rock to construct temporary rock ditch checks as shown in the SWPPP or the Contract Documents. When deposits reach approximately ½ the height of the temporary rock ditch check, remove and dispose of the accumulated sediment.

Dispose of sediment on the project at locations approved by the Engineer. When necessary, stabilize the material as directed by the Engineer.

i. Temporary Inlet Sediment Barrier. Use any of the materials listed in the Contract Documents or the SWPPP to construct temporary inlet sediment barriers. Prefabricated protection devices or alternative systems may be used with the Engineer's approval. Provide the Engineer with a complete description, literature, test reports, etc. on the proposed system. Submit this information with the SWPPP documents for approval under **subsection 901.3.c**.

When temporary silt fence is used, reduce post spacing and drive the posts further into the ground in low and soft, swampy areas. Remove and dispose of the sediment when deposits reach approximately ⅓ the height of the silt fence.

When synthetic sediment barriers are used, remove and dispose of the sediment when deposits reach approximately ½ the height of the barrier.

Dispose of sediment on the project at locations approved by the Engineer. When necessary, stabilize the material as directed by the Engineer.

j. Temporary Sediment Basins. Before constructing a temporary sediment basin, clear the area of all vegetation. Construct the temporary sediment basin with a wide cross-section and a minimum grade, as shown in the Contract Documents. Dispose of excess excavated material.

Remove and dispose of the accumulated sediment when deposits reach approximately 20% of the basin capacity.

Dispose of sediment on the project at locations approved by the Engineer. When necessary, stabilize the material as directed by the Engineer.

k. Temporary Stream Crossing.

(1) General. When the Contractor's operations require a temporary stream crossing, and one is not shown in the Contract Documents, the Contractor may install the crossing at no cost to KDOT. Comply with all applicable rules and regulations, obtain all required permits and provide copies of all permits to the Field Engineer. An unanticipated stream crossing may require a permit from the Corps of Engineers if work is performed within Waters of the U.S. and/or a stream obstruction permit from the Kansas Department of Agriculture if the crossing is in a designated stream.

Before beginning work in the streambed, record existing stream channel elevations.

Construct temporary stream crossings as shown in the Contract Documents or the SWPPP.

Place 1 pipe buried 6 inches into the stream bottom, in the lowest point of the channel to allow the passage of aquatic organisms, with additional pipes placed along the remainder of the stream channel bottom such that ordinary high water (OHW) flows designated in the Contract Documents shall flow through the pipes without overtopping the crossing. If the OHW is not designated in the Contract Documents, the Engineer will determine the OHW. The OHW means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of the soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Submit to the Engineer for review and approval, the design flow calculations to determine the number and diameter of pipes required. A minimum 12 inch diameter pipe is required.

Place pipes parallel to flow.

Cover pipes with a minimum of 12 inches of clean aggregate fill.

Dispose of sediment on the project at locations approved by the Engineer. When necessary, stabilize the material as directed by the Engineer.

(2) Maintenance. At a minimum, perform weekly inspections to verify that drift and debris are not blocking the flow of water through the pipes. Perform additional inspections, as needed. Remove drift and debris when blockage occurs. Repair eroded areas, if necessary, to prevent washout and allow passage of flows.

(3) Removal. Remove the temporary crossing and all materials as soon as no longer needed. Restore the disturbed bed and bank area of the stream channel to its pre-existing elevations.

l. Temporary Fertilizer, Seed and Mulch. Repair any rills, gullies or other erosion damage prior to seeding. Prepare the seedbed, fertilize, seed and mulch according to **DIVISION 900**. Apply the temporary fertilizer, seed and mulch at the rates shown in the Contract Documents. Apply water to seeded and mulched areas when approved by the Stormwater Compliance Engineer or Local Public Authority to promote the establishment of vegetation in critical areas.

m. Soil Erosion Mix. Prepare the seedbed, fertilize and seed according to **DIVISION 900**. Lightly hand rake broadcasted seed before placement of the erosion control.

Only use the soil erosion mix under Erosion Control (Class 1) or Erosion Control (Class 2).

There are no seasonal placement limitations for the soil erosion mix.

n. Temporary Seeding. "Temporary Seeding" is to be used only if the project has less than 1 acre of erodible surface. If this item is used: fertilize, seed, and mulch all exposed erodible earth.

Prepare the seedbed, fertilize, seed and mulch according to **DIVISION 900**. Apply the temporary fertilizer, seed and mulch at the rates shown in the Contract Documents.

o. Erosion Control. After seeding according to **DIVISION 900**, install erosion control according to the manufacturer's requirements for edge and junction overlaps, staple size and staple pattern. Installation areas shall be free of erosion rills, rocks, clods or other debris that may cause "tenting" or otherwise inhibit uniform contact.

When shown in the plans, install erosion control materials within the time allowed for temporary stabilization under **subsection 901.3b**.

Use Erosion Control materials for the stabilization of all steep slopes (2 ½:1 or steeper) where construction activities have permanently or temporarily ceased and will not resume for a period exceeding 7 calendar days

(1) Areas with Erosion Control (Class 1). Place the Erosion Control (Class 1) on slopes according to the SWPPP. Do not mulch over the Erosion Control (Class 1).

(2) Areas with Erosion Control (Class 2). Place the Erosion Control (Class 2) in channels, ditches or areas of concentrated flow according to the SWPPP.

Do not cover erosion control materials with soil or mulch unless recommended by the manufacturer and approved by the Engineer.

Apply water to completed erosion control installations when approved by the Stormwater Compliance Engineer or Local Public Authority to promote the establishment of vegetation in critical areas.

p. Geotextile (Erosion Control). Install geotextile (erosion control) as a temporary measure to protect steep slopes and other areas where timely installation of the permanent (aggregate or concrete) slope protection is impractical. The installation area should be free of rills, rocks, clods or other debris. Secure geotextile to the ground with staples or other similarly effective methods to achieve uniform contact with minimal "tenting."

Remove geotextile prior to placement of the permanent slope protection.

Install geotextile (erosion control) as a temporary measure to protect temporary slopes, soil stockpiles and other areas where mulching or other means of stabilization is impractical. Preparation of the slopes and the method of securing the fabric shall be as approved by the Engineer.

q. Maintenance and Removal of Temporary Erosion and Pollution Control Devices. Maintain the effectiveness of the temporary erosion and pollution control devices as long as required to contain sediment runoff. Monitor temporary erosion and pollution control devices daily.

Remove the temporary devices according to the SWPPP or when directed by the Engineer. After removing the temporary erosion and pollution control devices, remove and dispose of the silt accumulation. Grade, fertilize, seed and mulch any bare areas.

When temporary erosion and pollution control devices are installed according to the Contract Documents, SWPPP, or as approved by the Engineer and such devices are no longer effective because of deterioration or functional incapacity, payment will be made for replacement of these devices, as directed by the Engineer. No payment will be made for replacing temporary erosion control devices that become ineffective because of improper installation, lack of maintenance or the Contractor's failure to pursue timely installation of permanent erosion control devices according to the Contract Documents.

902.4 MEASUREMENT AND PAYMENT

The Engineer will measure temporary berms, temporary slope drains, silt fence, biodegradable logs, synthetic sediment barriers, and filter sock by the linear foot. The Engineer will measure the top of the device from point to point or each bend/turn in the device, add them together from beginning to end to come up with the total liner feet per device. The length installed up side slopes beyond a point level from the top of the device in the ditch bottom will not be measured for payment.

The Engineer will measure temporary rock ditch checks by the cubic yard.

The Engineer will measure each temporary inlet sediment barrier.

The Engineer will measure each temporary stream crossing when shown as a bid item in the contract.

The Engineer will measure temporary sediment basins by the cubic yard excavated to construct the basin.

The Engineer will measure sediment removal by the cubic yard of sediment removed. If the quantity of sediment removal is approximately 50 cubic yards or greater in one location, the Engineer may pay for sediment removal by force account (**SECTION 109**) rather than paying the contract set price for the bid item ″Sediment Removal″. Whether paid as a set price or by force account, the Engineer will not pay for a quantity or cost that is incurred because of the Contractor's failure to install seed timely or failure to remove sediment timely as **SECTION 901** requires.

The Engineer will measure temporary fertilizer, temporary seed and soil erosion mix by the pound.

The Engineer will measure "Temporary Seeding" as a lump sum; no measurement of area is made.

The Engineer will measure erosion control by the square yard.

The Engineer will measure temporary mulching by the ton.

The Engineer will measure water used for establishment of vegetation by the M Gallon using calibrated tanks or meters.

The Engineer will measure geotextile (erosion control) by the square yard.

Payment for the various items of temporary erosion and pollution control is full compensation for the specified work. Contract unit prices will govern regardless of overruns or underruns of the estimated quantity unless specifically stated otherwise.

Payment for "Sediment Removal (Set Price)" at the contract set unit prices is full compensation for the specified work.

The Engineer will not measure for separate payment any erosion control devices or seeding installed in Contractor-Furnished borrows and waste locations or plant site locations outside the project limits.

SECTION 903

FERTILIZER, AGRICULTURAL LIMESTONE AND PEAT MOSS

903.1 DESCRIPTION

Provide and apply the designated materials as shown in the Contract Documents.

BID ITEMS	**UNITS**
Fertilizer (*-**-***)	Pound
Agricultural Limestone	Ton
Peat Moss	Ton

*Percent Nitrogen
**Percent Phosphorous
***Percent Potassium

903.2 MATERIALS

Provide fertilizer, agricultural limestone and peat moss that comply with **DIVISION 2100**.

903.3 CONSTRUCTION REQUIREMENTS

a. Fertilizer. Apply the fertilizer to the prepared seedbed (**subsection 904.3b.**) at the rates designated in the Contract Documents. Use an agricultural type broadcast spreader or a fertilizer attachment on the seed drill to apply the fertilizer. Spread the fertilizer uniformly by hand methods in areas where it is impracticable to use a seed drill.

When fertilizer is designated for use with sod, apply the fertilizer before placing the sod.

b. Agricultural Limestone. Before the areas are seeded, apply the agricultural limestone at the rates designated in the Contract Documents. Use a standard lime spreader to apply the agricultural limestone. Fertilizer may be blended with agricultural limestone. When blended, apply before the areas are seeded.

c. Peat Moss. Thoroughly blend the peat moss with soil from the planting pit, or blend the peat moss with the subsoil to the depth shown in the Contract Documents. Apply peat moss at the rates shown in the Contract Documents. Before backfilling, planting, seeding or sodding, blend the peat moss by tilling, cultivating or shovel mixing.

903.4 MEASUREMENT AND PAYMENT

The Engineer will measure the fertilizer by the pound. Bag weight or commercial scale tickets are acceptable.

The Engineer will measure the agricultural limestone by the ton. Commercial scale tickets are acceptable.

The Engineer will measure peat moss by ton.

Payment for "Fertilizer", "Agricultural Limestone" and "Peat Moss" at the contract unit prices is full compensation for the specified work.

SECTION 904

SEEDING

904.1 DESCRIPTION

Prepare the seedbed, provide the seed and plant at the rate and in the locations designated in the Contract Documents.

BID ITEMS	UNITS
Seed (*)	Pound
Seed (Hydro) (*)	Pound
Seeding	Lump Sum

* Type of Seed

904.2 MATERIALS

Provide seeds and nitrogen-fixing bacteria that comply with **DIVISION 2100**. Do not change seed or seed mixture without approval of the Environmental Scientist (Bureau of Right of Way, Environmental Services Section).

904.3 CONSTRUCTION REQUIREMENTS

a. Seeding Seasons. Determine the seeding season using **TABLE 904-1**.

TABLE 904-1: GRASS & WILDFLOWER SEEDING SEASONS	
Type	**Season**
Cool Season Grasses	February 15 thru April 20 August 15 thru September 30
Warm Season Grasses and Wildflowers	November 15 thru June 1

If cool season grasses are mixed with warm season grasses, seed the area during the seeding season for warm season grasses.

When the area to be seeded is less than 1 acre (bid item "Seeding" per lump sum), seed the area during the seeding seasons specified for either cool season grasses or warm season grasses. Plant temporary seeding any time of the year.

Seed the project during the proper seeding season to protect the finished grading. This may require seeding different parts of the project at different times or seasons. Complete permanent seeding during the first season after the grading work is finished. Complete the area once the seeding operations begin in an area.

The Environmental Scientist or Stormwater Compliance Engineer may extend the seeding season a few days in special situations depending on area and weather conditions.

b. Preparation of the Seedbed. Unless shown otherwise in the Contract Documents, prepare the seedbed and seed all disturbed or cultivated areas within the right-of-way and construction easements. Seed and mulch the area within 24 hours of seedbed preparation.

Repair eroded areas before the seedbed is prepared.

In urban areas, use a landscape box to level the seedbed. Grade seedbeds to the elevations of abutting sidewalks. Remove rocks and other debris detrimental to lawn maintenance equipment.

Before seeding, use tillage equipment that penetrates 2 to 3 inches to prepare a firm, friable and weed-free seedbed. If the use of disks and harrows is impracticable, prepare the seedbed using hand methods.

Prepare seedbeds in developed urban and residential areas using rotary tillers or similar equipment. Tractor mounted equipment is permitted if the area is large enough to facilitate the use of such equipment.

Do not injure trees while preparing the seedbed. If the Engineer designates areas of desirable perennial native grasses to remain, do not till such areas. If areas of annual grasses such as cheat, crabgrass or triple-awn are encountered, destroy such grasses by thorough disking.

Do not till areas if temporary or existing grasses provide stable slopes with no erosion. Seed the permanent grasses into the existing cover using a no-till drill.

c. Seeding. In rural areas, use seed drills that comply with **subsection 156.1**. If it is impracticable to operate a seed drill, broadcast the seed with a standard manufacture grass seeder. A hydro-seeder may be used in place of the broadcast seeder, when approved by the Engineer.

On lawn areas and small areas in developed urban areas, apply the seed with equipment suitable for the size of the area. Use manually operated drop-seeders, cyclone spreaders or other similar equipment when appropriate. After the seeding, but before mulching, hand rake the seeded lawn areas.

Similar size seeds may be mixed before drilling. The seed company may mix the seeds before delivery, or the Contractor may mix the seeds at the project site. If the seed company mixes the seeds, each bag of mixed seeds shall have a tag indicating the quantity (pounds) of each type seed and the total weight (pounds) of the bag. If the Contractor mixes the seeds, the Engineer must witness the mixing.

If required, inoculate the seeds according **DIVISION 2100**.

The drill used for seeding shall accommodate the seed sizes and weight of seed by the use of as many compartments as required. Seeds of compatible size and weight may be mixed and placed in the same compartment. Drill seed at the rate and in the locations shown in the Contract Documents. Drills shall comply with **subsection 156.1**.

Drill the seeds into the prepared seedbed. The maximum depth for drilling grass seeds is ½ inch. Unless shown otherwise in the Contract Documents, the maximum depth for drilling wildflower seeds is ⅛ inch. If grasses and wildflowers are seeded on the same area, drill the grasses first, then the wildflowers.

After an area is fertilized and seeded, use a seed drill with press wheels or separate cultipacker to firm the soil.

d. Hydro-seeding. On steep slopes or other areas inaccessible with a seed drill or broadcast seeder, a hydro seeder may be used when approved by the Engineer. Apply the seed-fertilizer-water slurry within 1 hour after the seed is added to the hydro-seeder tank. Apply seed evenly over the entire site. Use a fan-type nozzle with approximately 500 gallons of water per acre. Add 50 pounds of hydro-mulch per 500 gallons of water for a visual tracer. After the seeding, but before mulching, hand rake the seeded areas inaccessible by a cultipacker.

Immediately apply bonded fiber matrix mulching according to **subsection 905.3c**. Do not apply hydro-seed and bonded fiber matrix in one application.

e. Seeding/Lump Sum. This item is only used on projects with less than 1 acre of seeding.

Prepare the seedbed, fertilize, seed and mulch all disturbed or cultivated areas within the right-of-way and construction easements according to **DIVISION 900**.

904.4 MEASUREMENT AND PAYMENT

The Engineer will measure the total quantity for each type of pure live seed used by the pound.

The Engineer will not measure hydromulch used as a visual tracer for separate payment. This work is subsidiary to the hydro-seeding item.

Bonded fiber matrix mulching will be measured and paid for according to **SECTION 905**.

The Engineer will measure "Seeding" by the lump sum. No measurement will be made of the area seeded.

Payment for the various types of "Seed", "Seed (Hydro)" and "Seeding" at the contract unit prices is full compensation for the specified work.

SECTION 905

MULCHING

905.1 DESCRIPTION

Provide and uniformly place mulching materials as shown in the Contract Documents.

BID ITEMS	**UNITS**
Mulching (Permanent) (Set Price)	Tons
Mulching Tacking Slurry	Pound
Mulching (Hydro)	Square Yard
Mulching (Hydro BFM*)	Square Yard

*Bonded Fiber Matrix

905.2 MATERIALS

Provide materials that comply with the applicable requirements.

Mulch and Mulching Tacking Slurry .... **DIVISION 2100**
Water .... **DIVISION 2400**

905.3 CONSTRUCTION REQUIREMENTS

a. Mulching. Place and punch the mulch immediately after the fertilizing and seeding operations. Do not allow the mulching operations to lag behind the fertilizing and seeding operations more than 24 hours. If rain is forecast, make every effort to mulch areas the same day they are seeded.

A sufficient length of mulching material is needed for the mulch to interlap and bind together. Short stemmed mulching material is more vulnerable to wind action. When the mulching is applied with a straw blower, if required, remove the cutting knifes to prevent cutting the mulch too short.

After an area is fertilized and seeded, uniformly spread the mulch over the area. Apply the mulch at the rates shown in the Contract Documents. The rates shown in the Contract Documents are a guide. The Engineer will determine if the applied mulch is sufficient to protect the seeded area.

After the mulch is applied to an area, punch the mulching material (except wood chips and excelsior material) approximately 2 inches into the ground. Perform the punching operation longitudinally, using a mulch puncher. When needed, use weights on the mulch puncher to punch the mulching material into the soil.

When the slope is too steep to use a mulch puncher, "pat" the mulch with forks as it is placed on the slope. Apply mulching tacking slurry or cover with a light application of soil or sand to reduce wind loss.

On lawns and small areas in urban areas, apply the mulch material using hand methods, unless otherwise approved by the Engineer. As the mulch is placed, "pat" the mulch with a fork.

Apply mulching tacking slurry or cover with a light application of soil or sand to reduce wind loss.

b. Mulching (Hydro). Apply the hydromulch immediately after the seeding and cultipacking. Apply the hydromulch by means of a standard hydraulic slurry seeding machine. Demonstrate, to the Engineer's satisfaction, that the equipment and methods will result in a uniform application of the hydromulch.

Mix the hydromulch at the rate of 50 pounds per 100 gallons of water. Apply the hydromulch at the rate of (dry) 1,800 pounds per acre of seeded and cultipacked slope, immediately after the seeding and cultipacking to maximize adhesion and minimize slumping. Obtain complete coverage from a consistent angle of approach while applying hydromulch. Achieve no more than 65% coverage from the primary angle of application, and 35% coverage from the secondary angle of coverage. Maintain secondary angles of coverage of between 175º and 185º from the primary angle.

Mixing proportions, application methods and rates may be adjusted based on the manufacturer's recommendations.

c. Mulching Tacking Slurry. Place and punch the mulch immediately after the fertilizing and seeding operations.

A sufficient length of mulching material is needed for the mulch to interlap and bind together. Short stemmed mulching material is more vulnerable to wind action. When the mulching is applied with a straw blower, if required, remove the cutting knifes to prevent cutting the mulch too short.

After an area is fertilized and seeded, uniformly spread the mulch over the area. Apply the mulch at the rates shown in the Contract Documents. The rates shown in the Contract Documents are a guide, the Engineer will determine if the applied mulch is sufficient to protect the seeded area.

After the mulch is applied to an area, punch the mulching material (except wood chips and excelsior material) approximately 2 inches into the ground. Perform the punching operation longitudinally, using a mulch puncher. When needed, use weights on the mulch puncher to punch the mulching material into the soil.

When the slope is too steep to use a mulch puncher, "pat" the mulch with forks as it is placed on the slope. Apply mulching tacking slurry or cover with a light application of soil or sand to reduce wind loss. On lawns and small areas in urban areas, apply the mulch material using hand methods, unless otherwise approved by the Engineer. As the mulch is placed, "pat" the mulch with a fork. Apply mulching tacking slurry or cover with a light application of soil or sand to reduce wind loss.

Immediately after the designated areas are mulched and punched, use hydraulic slurry equipment to apply the mulching tacking slurry. Unless shown otherwise in the Contract Documents, apply the mulching tacking slurry at the rate of 900 pounds per acre. Distribute the mulching tacking slurry uniformly over the mulch, leaving no bare spots. Arrange work so the mulching tacking slurry can be placed within 24 hours after each area has been mulched.

d. Mulching (Hydro BFM). Apply the BFM over the specified areas by means of a standard hydraulic slurry seeding machine. Demonstrate, to the Engineer's satisfaction, that the equipment and methods will result in a uniform application of the bonded fiber matrix.

Mix the BFM at the rate of 50 pounds per 100 gallons of water. Apply the BFM at the rate of (dry) 3,500 pounds per acre of seeded and cultipacked slope, immediately after the seeding and cultipacking to maximize adhesion and minimize slumping. Obtain complete coverage from a consistent angle of approach while applying BFM. Achieve no more than 65% coverage from the primary angle of application, and 35% coverage from the secondary angle of coverage. Maintain secondary angles of coverage of between 175º and 185º from the primary angle.

Mixing proportions, application methods and rates may be adjusted based on the manufacturer's recommendations.

905.4 MEASUREMENT AND PAYMENT

a. Measured Quantities. All area measurements in this section will be based upon slope measurements.

The Engineer will measure the mulching (permanent)(set price) by the ton.

The Engineer will measure mulching tacking slurry by the pound. Payment will be made based on the dry package weight of the recycled paper fibers and tacking agent. Water will not be measured separately, but is subsidiary to the mulching tacking slurry.

The Engineer will measure mulching (hydro) and mulching (hydro BFM) by square yard.

b. Payment. Payment for "Mulching Tacking Slurry", "Mulching (Hydro)" and "Mulching (Hydro BFM)" at the contract unit prices is full compensation for the specified work.

When temporary seeding and permanent seeding are combined, the Engineer will pay for mulching under the bid item Mulching (Temporary), and the bid item Mulching (Permanent) (Set Price) will be underrun.

When the quantity of "Mulching Tacking Slurry" overruns or underruns the contract quantity by any amount, the contract unit price shall govern.

Payment for "Mulching (Permanent) (Set Price)" at the contract set unit price (subject to the adjustments in **TABLE 905-1**) is full compensation for the specified work.

TABLE 905-1: PERMANENT MULCHING PAYMENT

Mulching (Permanent) Quantity, M (acres)	Percent of Contract Set Unit Price Per Ton
$M \le 15$	100%
$15 < M \le 30$	90%
$30 < M$	80%

SECTION 906

TOPSOIL

906.1 DESCRIPTION

Provide and place topsoil at the locations shown in the Contract Documents.

BID ITEM	**UNITS**
Topsoil	Cubic Yard

906.2 MATERIALS

Provide topsoil that complies with **DIVISION 2100**.

The Contractor-furnished site (for excavation of the topsoil) is subject to the environmental clearance provisions noted in **SECTION 107**.

906.3 CONSTRUCTION REQUIREMENTS

Before excavating topsoil from the Contractor-furnished site, remove all grass, weeds, brush, stumps and other objectionable material from the site.

Spread the topsoil at the locations and to the depths shown in the Contract Documents. Do not harm existing plants or structures when placing and spreading the topsoil. Do not spill the topsoil on the roadway. Do not handle or spread topsoil when it is wet enough to form a 1 ½ inch soil ball without easily breaking.

Use only pulverized topsoil where 3 inches or less of topsoil is required.

After the topsoil is spread over the designated areas, remove any stones, roots, large clods (greater than 6 inches) and other objectionable material.

906.4 MEASUREMENT AND PAYMENT

a. Contract Quantities. The Engineer will use the contract quantities for payment, provided the project is constructed essentially to the lines and grades shown in the Contract Documents.

If the Contract Documents are altered, or if the Engineer or Contractor questions the accuracy of the contract quantities for topsoil, either party may request measurement of the quantities involved, when excavated, or after placed.

b. Measured Quantities. The Engineer will measure (by cross-sectioning) topsoil by the cubic yard. The Engineer will compute the quantities by the average end area method. Where it is impractical to measure material by the cross-section method, the Engineer may use three-dimensional measurements.

c. Payment. Payment for "Topsoil" at the contract unit price is full compensation for the specified work.

SECTION 907

SODDING

907.1 DESCRIPTION

Provide and place living sod at the locations shown in the Contract Documents.

BID ITEM	UNITS
Sod (*) (**)	Square Yard

*Variety
**Form of Sod: roots, plugs or strips

907.2 MATERIALS

Provide sod that complies with **DIVISION 2100**. Provide sod that is in vigorous growing condition.

907.3 CONSTRUCTION REQUIREMENTS

a. Sodding Seasons. Determine the sodding season using **TABLE 907-1**.

TABLE 907-1: SODDING SEASONS	
Type	**Season***
Cool Season Grasses	March 1 thru April 15 September 1 thru November 15
Warm Season Grasses	May 5 thru June 30

*If the soil is workable, the Engineer may allow placement of sod between November 15 and March 1. If sod is placed during this time, maintain the sod until 20 days after the beginning of the spring sodding season.

b. Construction Sequence. Sod the project during the proper sodding season to protect the finished grading. This may require sodding different parts of the project at different times or seasons. Complete the area once the sodding operations begin in an area.

c. Soil Preparation. Before preparing the soil, repair any eroded areas, and remove all weeds and surface stones greater than 1 inch in diameter. Undercut the soil below the adjacent areas so that the top of the new sod is flush with adjacent seedbeds or turfed areas, and 1 inch below sidewalks and tops of curbs.

Cultivate or pulverize the soil to a minimum depth of 1 inch. Smooth the soil, maintaining the grades established by the Grading Contractor. Before sodding, place the fertilizer as specified in the Contract Documents.

d. Placing the Sod. Place and fit sod strips as close together as possible. Stagger the joints between horizontal rows. Fill gaps between sod strips with sod pieces cut to the shape and size of the gaps.

Lay sod strips horizontally on slopes, starting at the bottom and working upwards, unless directed otherwise by the Engineer.

If the sod is placed on slopes of 2½:1 or steeper, or in ditch bottoms, secure the sod with 6 stakes per square yard or per roll of sod. If the sod is placed on slopes steeper than 20:1 and flatter than 2½:1, secure the sod with 2 to 4 stakes per square yard or per roll of sod. Use wooden lath (approximately 6 inches long) or similar wooden materials or ungalvanized wire staples (⅛ inch wire diameter approximately 6 inches long) to stake the sod. Drive the stakes and staples flush with the sod surface.

After the sod is placed and secured, firm the sod using a small roller, tamper or other method approved by the Engineer.

e. Watering the Sod. Immediately after placing the sod, thoroughly water to a depth of 3 inches. Continue watering the sod every other day for 20 days after the sod is placed. The sod shall be thoroughly watered and growing when it is accepted.

907.4 MEASUREMENT AND PAYMENT

The Engineer will measure sod by the square yard.

Payment for the various types of sod at the contract unit prices is full compensation for the specified work.

SECTION 908

TREES, SHRUBS AND OTHER PLANTS

908.1 DESCRIPTION

Provide and plant (or transplant) the designated plants as shown in the Contract Documents.

BID ITEMS	UNITS
Furnishing and Planting Plant Materials	Lump Sum
Transplanting Existing Plants	Lump Sum

908.2 MATERIALS

Provide topsoil, plants, fertilizers, peat moss, mulches, weed control fabrics and plant bed edging that complies with **DIVISION 2100**.

908.3 CONSTRUCTION REQUIREMENTS

a. Time of Planting. Follow **TABLE 908-1**.

TABLE 908-1: PLANT PLANTING SEASONS	
Plant Type	**Planting Date Range**
Deciduous Plants	November 15 thru April 15
Evergreen Plants	October 1 thru April 15

b. Packing and Shipping Plants. Pack all plants to protect against drying, freezing, breaking or other injury.

Do not dig bare-root plants until after they have been subject to a killing frost.

Pack bare-root plants in wet packing material. If it is necessary to transport bare-root plants more than 25 miles, treat the roots with anti-transpirant gel or acrylates before packing them for shipment.

Do not ship the plants to the project site unless the temperature at the project site is above freezing, and the soil is frost-free and in satisfactory workable condition.

Cover all plants with a tarpaulin while in transit.

Notify the Engineer at least 24 hours in advance of the delivery of the plants.

Do not plant or heel-in the plants until inspected by the Engineer.

c. Storage and Protection at the Project Site. After the Engineer has inspected and approved the plants delivered to the project, either plant immediately, or protect them by covering with canvas or heeling-in. Provide a temporary storage ground or a heel-in nursery located near the planting area.

Do not leave plants out of the ground overnight or otherwise unprotected during storage. The Engineer will reject plants damaged in any way by the lack of proper storage.

Do not cover bare-root plants with canvas for more than 10 hours. Heel-in bare-root plants that are not planted within 10 hours of delivery to the project. Treat the roots of bare-root plants with anti-transpirant gel or acrylates as soon as the plants reach the planting site or heel-in nursery.

d. Layout. Stake the locations of all plants, and verify the planting sites with the Engineer. Notify Kansas One Call and have sites investigated for underground utilities. If overhead or underground utility lines compromise the planting sites, the Engineer will relocate the sites.

e. Preparation of the Planting Sites. Remove all rocks and undesirable material encountered from the planting site.

Do not leave excavated plant pits open overnight.

(1) Trees. Clear a 10 foot radius area at each planting site. Remove all weeds, brush and other undesirable material.

Excavate the plant pit diameter 2 feet larger than the diameter of the root ball, and deep enough to allow the top 6 inches of the root ball to extend above the finished grade.

Mix the excavated soil with peat moss and pulverize the mixture before it is used for the backfill of the plant. Apply the peat moss at the rates in **TABLE 908-2**.

TABLE 908-2: PEAT MOSS APPLICATION FOR TREES		
Root Ball (inch)	**Container #**	**Pounds Peat/Plant Pit**
12	5	40
16	10	80
20	25	120

(2) Shrub Beds. Extend the perimeters of the shrub beds 30 inches from the center of the outside row of shrubs. Cultivate the existing soil in the shrub bed to a depth of 10 inches, and remove the loose vegetation. Remove all rocks and deleterious material greater than 6 inches in any dimension.

Excavate the individual plant pits deep enough to allow the top 6 inches of the root ball to extend above the finished grade.

Mix the excavated and cultivated soil with peat moss, and pulverize the mixture. Apply the peat moss at the rates in **TABLE 908-3**.

TABLE 908-3: PEAT MOSS APPLICATION FOR SHRUBS		
Root Ball (inch)	**Container #**	**Pounds Peat/Plant Pit**
8	1	20
10	3	30
12	5	40

(3) Groundcover and Perennial Plant Beds. Extend the perimeters of the plant beds 12 inches from the center of the outside row of plants. Cultivate the existing soil in the plant bed to a depth of 10 inches, and remove the loose vegetation. Remove all rocks, gravel and deleterious material greater than 6 inches in any dimension.

Mix the excavated and cultivated soil with peat moss, and pulverize the mixture before it is used for the backfill of the plant. Apply the peat moss at the rate of 4 pounds per square yard.

f. Planting and Mulching. Exercise care in handling all plants. Do not drop or roll plant balls. Do not lift or transport balled and burlapped (B&B) plants by the top or the trunk of the plant; lift the root ball. Replace plants damaged due to improper handling. The Engineer must approve the replacement plants.

Remove all pots and containers, regardless of the pot or container composition, from plants before planting. Do not remove wire cages before placing the plant in the planting pit. When the plant is set in the planting pit, cut and remove all twine, rope or binding material from around the stem or trunk of the plant, and from around the ball. After the plant is set in the planting pit, cut and remove the top loops and the top ring of wire cages.

Plant all plants plumb. Place trees and shrubs so that the top 6 inches of their root balls are above the finished grade. Place groundcover and perennial plants with the tops of their root balls even with or 1 inch below the finished grade.

Use the mixture of excavated material and peat moss to backfill the plants. Carefully firm the backfill material about the roots of the plant (lower ⅓ of the root ball on B&B plants). Place and firm the backfill in 3 to 4-inch layers. Firm the backfill by trampling, or by the use of a tamping tool.

After trees are planted, cultivate an area 8 feet in diameter and 10 inches deep around each tree. Construct a watering basin around each tree as shown in the Contract Documents.

Place weed control fabric over the cultivated area of all shrub beds. Cut slits in the fabric to allow it to fit around the stems of each plant.

Unless shown otherwise in the Contract Documents, place composted, shredded or chipped wood mulch on the cultivated areas around all plants:

- 6 inches thick around all trees;
- 4 inches thick around all shrub beds; and
- 2 inches thick around all groundcover and perennial plants.

Place the mulching within 24 hours of the planting. Water all plants immediately after planting. Water and rake the mulched areas to provide a uniform surface. Continue to water all plants as required during the establishment period.

Install plant bed edging, when shown in the Contract Documents.

g. Pruning. Do not prune plants except to remove dead or injured branches. Do not cut central leaders. Prune broken or damaged roots. Prune with clean, sharp tools. Remove cuttings from the planting site, or cut into small pieces and place with the mulch.

Remove and replace excessively pruned and misformed stock resulting from improper pruning.

h. Staking or Guying. Unless otherwise shown in the Contract Documents, stake or guy trees according to **TABLE 908-4**.

TABLE 908-4: GUIDELINES FOR STAKING AND GUYING TREES			
Type	**Size**	**Number**	**Minimum Depth of Stake in Ground (feet)**
Deciduous	Less than 1 ¼ inches in caliper	1 Stake	2
Deciduous	1 ¼ to 2 inches in caliper	3 Stakes	2
Deciduous	Greater than 2 inches in caliper	3 Guys	2
Evergreens	Greater than 6 feet tall	3 Guys	2

For staking trees, use wooden stakes 2 inches by 2 inches by 8 feet. For guying trees, use wooden stakes 2 inches by 2 inches by 3 feet. Place the stakes and guys at the same time the tree is planted. Do not damage the tree roots when placing the stakes.

Use pliable steel wire (No. 12 gauge, minimum) to tie trees to the stakes. Protect the tree trunk from the wire by encasing the wire in a section of flexible, rubber hose. Do not restrict the growth of the tree when attaching the wire ties to the trunk of the tree.

Commercial tree ties may be used if approved by the Engineer.

i. Wrapping Tree Trunks. Wrap the trunks of all maple, honeylocust, crabapple and ash trees. Begin wrapping at the base of the trunk, and extend the wrap upward to a point above the lowest tree tie.

Use a tree wrap consisting of double thickness waterproof paper with an asphalt center. Begin the wrap with 2 level loops, then wind upward with ⅓ to ½ width overlaps; end the wrap with 2 level loops. Secure the wrapping with loose-twist cotton twine (6-ply, maximum). Tie the twine around the wrap at the top; then wrap the twine spirally down the tree trunk in the opposite direction to the paper wrap, tying the twine again at the bottom. Place 2 additional ties between the top and bottom. Tie the twine loose enough to accommodate a season’s growth.

Stretchable or biodegradable tape or other materials may be used to secure the wrapping, when approved by the Engineer.

j. Clean-Up. After the planting operations are completed, remove all debris from the planting areas. Remove all labels from the plants. Remove all flags used for marking underground utilities.

Restore all disturbed areas to the finish grade.

k. Plant Establishment Period. The plant establishment period begins when the plants are planted (the current planting season), and ends on the following October 1.

During the plant establishment period, water, cultivate, weed, prune, spray, and repair and adjust the guys and stakes, as necessary. If dead plants are discovered before the end of the current planting season, remove and replace the dead plants before the current planting season expires.

Within 10 days of the end of the plant establishment period, the Engineer will inspect all plants (planted the previous planting season). The Engineer will designate any dead or unacceptable plants. Remove and replace the designated plants before the current planting season expires.

The plant establishment period for replacement plants begins when the plants are replanted (the current planting season) and ends 30 days following the end of the current planting season.

During the plant establishment period (for the replacement plants), water, cultivate, weed, prune, spray, and repair and adjust the guys and stakes, as necessary. If dead plants are discovered before the end of the current planting season, remove and replace the dead plants before the current planting season expires.

Within 10 days of the end of the plant establishment period for replacement plants, the Engineer will evaluate the replacement plants. If the Engineer determines any replacement plants are unacceptable, the Engineer will deduct such plants from the quantities measured for pay.

Remove unacceptable replacement plants and restore the planting pits to their original condition.

The Engineer will not assess working days for maintaining and replacing plants during the establishment periods.

l. Bare Root Tree Seedlings/Shrubs.

(1) Planting. When planting in excavated holes, carefully spread the roots in a natural position and work in the backfill material around the roots to eliminate air pockets. Use the excavated material to backfill the plants.

When planting in a slot made with a tree planting machine or a planting bar (a special planting spade manufactured for planting seedlings), construct the slot of adequate depth to allow the roots to be fully extended vertically when the seedling is placed in the slot at the proper depth. Take care when planting to prevent the end of the roots from being turned upward. Pruning of large massive root systems into balance with top growth will help in ease of planting and possibly prevent "J" roots from occurring. After placing the seedling in the slot at the proper depth, completely close the slot to eliminate all air pockets.

Install all plants in the plumb position.

Set the plants to a depth where the collar (where the root system turns to the trunk) is at the level of the surrounding soil or a maximum of ½ inch below the level of the surrounding soil.

(2) Mulch Cover. Within 24 hours after planting, place a mulch cover around all plants to control the growth of competing vegetation.

Use wood compost for mulch, applied 4 to 6 inches thick. Start application 1 inch from the tree/shrub trunk.

Install a weed free fabric such as a geo-membrane when specified in the Contract Documents.

Mulch an area extending a minimum of 2 feet from any plants spaced greater than 6 feet apart. Where plants are on less than 6 foot spacing, mulch the entire bed or area, plus a minimum of 3 feet beyond the peripherals of the plants.

Cover the mulch with hold down material when specified in Contract Documents.

(3) Watering. Water the plants when specified in the Contract Documents.

(4) Bracing. Bracing is not required for trees/shrubs seedlings under 4 feet tall measured from ground level.

(5) Rabbit Protective Tubes. Install rabbit protective tubes, when specified in the Contract Documents.

908.4 MEASUREMENT AND PAYMENT

The Engineer will measure furnishing and planting plant materials and transplanting existing plants by the lump sum.

The contract includes the required contract provision, Furnishing and Planting Plant Materials, which is a listing of the unit cost for the individual items, submitted by the Contractor with the proposal. The unit prices shown in the listing will be used to adjust the lump sum amount for overruns, underruns and deducting for unacceptable plants.

Payment for the "Furnishing and Planting Plant Materials" and for "Transplanting Existing Plants", at the contract unit prices is full compensation for the specified work.

SECTION 909

MOWING

909.1 DESCRIPTION

Mow the areas designated by the Engineer.

BID ITEM	**UNITS**
Mowing	Per Mile Per Side

909.2 MATERIALS - None specified.

909.3 CONSTRUCTION REQUIREMENTS

Use standard manufacture mowing equipment that is adequate for the work designated.

Mow only when the ground conditions prevent rutting.

If the mowing produces enough clippings and debris to retard the growth of grass, remove and dispose of the clippings and debris.

909.4 MEASUREMENT AND PAYMENT

The Engineer will measure areas mowed per mile per side for each side of the roadway mowed. The Engineer will use vehicle odometer readings (to the nearest 0.1 mile) for the measurement of quantities. The Engineer will measure the length of mowed areas along the shoulder of the side of the roadway that is mowed. Included in this measurement are all mowed areas from the shoulder to the right-of-way line. On multi-lane roadways with medians, mowing in the median is not measured for separate payment. Exceptions less than 0.1 miles, such as a bridge, are not deducted from the measurements.

Payment for "Mowing" at the contract unit price is full compensation for the specified work.

SECTION 910

SOIL COMPOST

910.1 DESCRIPTION

Incorporate compost into the soil as designated in the Contract Documents.

910.2 MATERIALS

Provide compost that complies with **DIVISION 2100**.

910.3 CONSTRUCTION REQUIREMENTS

Before incorporating the compost into areas that will be seeded, sodded or planted, thoroughly rototill the areas to a depth of 6 inches.

Spread a layer (1 ¼ ± ⅛ inch thick) of compost uniformly over the rototilled soil. Use a rototiller to mix the compost and soil to a depth of 6 inches. Fine grade the mixture by raking or dragging to eliminate high spots and low spots. Lightly roll or otherwise compact the soil surface.

Mix compost with the backfill material for all plants. Mix 1 part compost with 5 parts soil (by volume) from the planting hole.

910.4 MEASUREMENT AND PAYMENT

The Engineer will not measure the specified work for separate payment.

SECTION 911

STONE MASONRY TREE WELLS

911.1 DESCRIPTION

Construct stone masonry for tree wells at the locations designated in the Contract Documents.

BID ITEM	**UNITS**
Stone Masonry for Tree Wells	Cubic Yard

911.2 MATERIALS

Provide materials that comply with the applicable requirements.

Mortar and Concrete	**SECTIONS 401 & 402**
Aggregate for Mortar and Concrete Not Placed On Grade	**SECTION 1102**
Stone for Stone Masonry Tree Wells	**DIVISION 1100**
Burlap	**DIVISION 1400**

Provide granular material for tree root protection, such as sand, sand-gravel, gravel, and crushed stone. Provide material that is uniformly graded from coarse to fine, with all material passing a 3-inch sieve, with a gradation factor of not less than 3.00, and with a plasticity index no greater than 3. The Engineer will accept the granular material based on compliance with the specified requirements and visual inspection at the project site.

911.3 CONSTRUCTION REQUIREMENTS

Do not damage the trees while placing the embankment or constructing the tree wells.

Before placing the embankment around a tree, remove all vegetation; remove no more than 2 inches of soil. Do not damage the root system. Place a uniform layer of porous granular material (6 inches in depth unless shown otherwise in the Contract Documents) above the root spread of the tree (the same area as the branch spread). Place the embankment around the tree without disturbing the layer of porous material covering the root spread of the tree.

Construct the type of stone masonry tree well (either laid in mortar or dry-laid) as shown in the Contract Documents.

Shape the stones before placing in the tree well. Dressing or hammering on the stones is not allowed after they are placed in the tree well.

Select larger stones for the bottom or foundation course of the tree well. Construct the top of the stone masonry tree well to fit the embankment slope unless shown otherwise in the Contract Documents. Firmly place the capstone layer even (flush) with adjacent stones.

(1) Stone Masonry Laid in Mortar. Clean each stone and saturate it with water before setting the stone in mortar. Settle each stone into place in a full bed of mortar. Construct the retaining wall with full-mortared joints 1 to 1 ½ inches thick. Arrange the vertical joints to break a minimum of 6 inches with those in adjoining courses. Do not locate vertical joints above or below a header.

Construct the tree well with headers to tie the masonry together. Arrange the headers to occupy at least ¼ of the surface area on the face and back of the retaining wall. Distribute the headers evenly throughout the tree well.

Use a pointing tool to finish the exposed joints. If the exposed joints are not pointed before the mortar sets, rake the exposed joints to an approximate depth of 1 ½ inches. Thoroughly wet the raked area, pack the wetted area with fresh mortar and finish the joint with a pointing tool.

After the mortar is set, clean and remove all excess mortar from the joints and surface of the stones.

Cure the finished tree well with wet burlap for a minimum of 3 days.

During cold weather, the limitations and protection requirements of **SECTIONS 401 & 710** will apply to the concrete footing and concrete grout.

(2) Stone Masonry Laid Dry. Construct the dry-laid tree well with broken joints, placed to form a solid, self-supporting wall. After the stones are placed, key the stones together by filling the voids with spalls or small stones to obtain a uniform surface.

911.4 MEASUREMENT AND PAYMENT

The Engineer will measure stone masonry tree wells by the cubic yard. The measurement will be to the dimensions shown in the Contract Documents, or as revised by the Engineer.

Payment for "Stone Masonry for Tree Wells" at the contract unit price is full compensation for the specified work.

SECTION 912

PARK STRUCTURES

912.1 DESCRIPTION

Provide materials for and construct the specified park structures as shown in the Contract Documents.

BID ITEMS	UNITS
Bench	Each
Grill	Each
Table (*)	Each
Table Shade (**)	Each
Planter Unit	Each
Bicycle Rack	Each
Grate	Each
Waste Receptacle	Each
Comfort Station (***)	Each
Comfort Station (Modification)	Each

*Wood Without Base, Wood With Concrete Base or Concrete With Concrete Base.
**Masonry, Stone or Wood.
***Type shown in the Contract Documents.

912.2 MATERIALS

Provide materials that comply with the applicable requirements.

Mortar and Grade 3.5 Concrete	**SECTIONS 401 & 402**
Aggregate for Mortar and Concrete Not Placed On Grade	**SECTION 1102**
Concrete Masonry Units	**DIVISION 1300**
Concrete Curing Materials	**DIVISION 1400**
Cement	**DIVISION 2000**
Welded Steel Wire Fabric	**DIVISION 1600**
Steel for Grates	**DIVISION 1600**
Lumber	**DIVISION 2300**
Water	**DIVISION 2400**

Provide other materials as shown in the Contract Documents. The Engineer will accept other materials based on compliance with dimensions and details shown in the Contract Documents.

912.3 CONSTRUCTION REQUIREMENTS

a. Earthwork. Shape and finish the park areas as shown in the Contract Documents. Eliminate all depressions that will hold surface water. If necessary, provide additional earth material.

b. Mortar and Reinforced Concrete. Use reinforcing steel according to **DIVISION 700**.
Form, place, finish cure and protect the concrete according to **SECTION 710**.

c. Park Structures. Provide and construct the park structures as shown in the Contract Documents.

Apply a prime coat and 2 finish coats of paint, color and type as designated in the Contract Documents. Before painting any structure, submit color samples of the paint to the Engineer for approval. The Engineer will approve (or disapprove) the paint based on visual inspection.

912.4 MEASUREMENT AND PAYMENT

The Engineer will measure each park structure.

Payment for the various park structures at the contract unit prices is full compensation for the specified work.

SECTION 913

WATER SYSTEMS

913.1 DESCRIPTION

Provide materials for, and construct the water system as shown in the Contract Documents.

BID ITEM	**UNITS**
Water System	Lump Sum

913.2 MATERIALS

Provide materials that comply with the applicable requirements.

Grade 3.5 Concrete*	**SECTIONS 401 & 402**
Aggregates for Concrete Not Placed On Grade	**SECTION 1102**
Aggregates for Underdrains	**DIVISION 1100**
Concrete Curing Materials	**DIVISION 1400**
Cement	**DIVISION 2000**
Welded Steel Wire Fabric	**DIVISION 1600**
Drain Tile	**DIVISION 1900**
Water	**DIVISION 2400**

* Use Grade 3.5 Concrete unless specified otherwise in the Contract Documents.

913.3 CONSTRUCTION REQUIREMENTS

Construct the water system as shown in the Contract Documents. Make all service connections to the water supply unless specified otherwise in the Contract Documents.

913.4 MEASUREMENT AND PAYMENT

The Engineer will measure water systems by the lump sum.

Payment for "Water System" at the contract unit price is full compensation for the specified work.

SECTION 1101

GENERAL REQUIREMENTS FOR AGGREGATES

1101.1 DESCRIPTION

This specification covers the basis of approval, certification and acceptance of aggregates specified in **DIVISION 1100**.

1101.2 REQUIREMENTS

a. General. Provide aggregates that comply with all composition, quality, product control, and handling (stockpile) requirements of the applicable specifications.

b. Process Control.

(1) Perform or cause to be performed all inspections and tests necessary to provide and maintain an adequate process control system that will provide reasonable assurance that all aggregates or aggregate combinations submitted for acceptance will comply to Contract Document.

Before beginning aggregate production for quality control/quality assurance (QC/QA) projects, submit a proposed Process Control Plan in writing for review by the Engineer or the QC/QA Contractor. Include the sampling and testing frequencies, the sampling locations, the sampling and testing methods and other inspections expected to establish and maintain process control in the plan. If requested, KDOT will make a chart of recommended sampling and testing frequencies for process control available to the Producer.

A process control plan should include procedures for all aggregates produced to determine grading, plasticity index, deleterious substance content, and other properties that may be required by the specification, and to inspect stockpiles for separation, contamination and segregation. These guidelines are considered normal activities necessary to control the production of aggregates or aggregate combinations at an acceptable quality level. It is recognized that, depending on the type of process or materials, some of the activities listed may not be necessary, or other activities may be required. The frequency of these activities is not listed in these guidelines, as they will vary with the process and the materials.

(2) Sampling and Testing. Use the same sampling and testing methods and procedures in process control as those used by KDOT. These Kansas Test (KT) Methods are included in Part V, which is made available to the producer. Part V also includes a Sampling and Testing Frequency Chart for acceptance of materials that producers may wish to use as a guide to develop their process control plan. Producers supplying material for quality control/quality assurance projects have required minimum sampling and testing frequencies that can also be found in Part V.

(3) Test Reports. Maintain a file of all process control tests. Provide copies to the Engineer upon request.

(4) Acceptance Inspection. Acceptance of aggregate will be based on KDOT and/or Contractor tests at the point of usage unless designated otherwise by the Engineer. Aggregate production will also be inspected to determine if aggregates are being produced from deposits, ledges, and beds which meet the specific quality requirements. Aggregates produced from deposits, ledges, or beds that have not been previously approved for quality will be rejected. Remove rejected material from the project stockpile area immediately. Any work incorporating aggregates from sources not approved for quality for that work must be removed and replaced, or otherwise corrected, by and at the expense of the Contractor.

KDOT reserves the right to run any test at any time to determine specification compliance. When test results on aggregates or mineral filler supplements indicate non-compliance with specifications, the Engineer may cause those materials to be rejected and removed from the work site at the expense of the Contractor.

c. Certification of Aggregates. Provide the Engineer a certification for each classification of aggregate utilized in a project.

(1) Aggregates Delivered to the Site: Certify each classification of aggregate delivered to a project or product preparation site. Prepare these certifications under the signature of the aggregate producer or their designated representative.

(a) Certify aggregates that are tested at their destination to determine final disposition as to the locations of the deposits from which they were produced.

(b) Certify aggregates that are tested at their production site to determine final disposition. These certifications state that the aggregates were removed from a KDOT tested and approved stockpile at the production site, or that they were removed from a plant while it was producing aggregate that was in compliance with the applicable specifications.

(2) Aggregates Incorporated into the Project: At locations where aggregates and products that incorporate aggregates are produced for KDOT and non-KDOT use, provide certifications stating that only KDOT tested and approved aggregate were provided for KDOT projects.

(3) Frequency of Certification:

(a) Before the initial delivery of aggregates to a project or product preparation site, provide the Engineer a certification. This certification is to be under the signature of the aggregate producer or their designated representative and states that all aggregates to be provided for the project are in compliance with all the applicable KDOT specifications.

(b) Upon completion of the project, provide certifications as specified in **1101.2c.(1),(2)** to the Engineer. These certifications apply to all aggregates that were delivered to the project or product preparation site and ultimately used in the project.

These certifications are to indicate the approximate quantities in tons or cubic yards of each aggregate delivered to the project and the approximate quantities in tons or cubic yards of each aggregate delivered to the product preparation site and incorporated into a product that was utilized in the project.

(4) Certification Requirement for Chat: Sellers of chat must complete and submit the Chat User's Certificate within 30 days of the date of acquisition. The certification will contain the following information: location of origin of the chat, amount of chat acquired, and a certification that the chat will be used in accordance with the criteria of Chat Rule, 40 Code of Federal Regulations (CFR) Part 278. The certification should be submitted to both the Kansas Department of Health and Environment (KDHE) and to the Bureau of Construction and Materials. If the chat is sold or otherwise transferred to another party, the seller shall provide a copy of the certification to the new owner of the chat. The initial or any subsequent acquirer of chat will maintain copies of the following for a minimum of 3 years: a) a copy of the certification following transmittal to KDHE, and, as appropriate, b) any Synthetic Precipitation Leaching Procedure testing results, or c) any site specific risk assessments.

1101.3 TEST METHODS

Test all aggregates in accordance with the applicable methods cited in **SECTION 1115**.

1101.4 PREQUALIFICATION

With the exception of Lightweight (expanded shale) Aggregate, aggregates from each source require "Official Quality" testing on samples obtained by an authorized representative of KDOT before use on KDOT projects. These samples are taken from actual production, which may be "pit-run", "crusher-run" or may involve some processing. Approved sources remain approved only if there are no major changes in the production methods or deposit characteristics.

Lightweight (expanded shale) Aggregate must be prequalified. In-state producers wishing to get their product prequalified must submit a written request to the District Materials Engineer for the District in which the production facility is located. Out-of-state producers must submit their written request to the Engineer of Tests. In the request, the producer must specify whether they want the material to be used for Modified Lightweight Aggregate [**subsection 1102.2.e.(2)**] or for Cover Material (**subsection 1109**). Samples will be collected by KDOT and tested for compliance with applicable specifications. Lightweight aggregates that comply with all applicable requirements will be added to a list of prequalified lightweight aggregates maintained by the Bureau of Construction & Materials. Any change in material source, equipment, or process voids the prequalification and a new prequalification will be required.

1101.5 BASIS OF ACCEPTANCE

Aggregates from sources approved for the intended use are accepted based on the following:

a. Current official quality test results complying with the requirements of the applicable subsection are on file with KDOT or the aggregate source is named on an applicable Prequalified List (PQL).

b. Results of tests conducted on samples taken at a point or points designated by the Engineer. KDOT reserves the right to re-sample, test and reject any previously accepted aggregate if the Engineer has reason to believe it no longer complies with the Contract Documents.

c. Certifications as specified in **subsection 1101.2 c**.

SECTION 1102

AGGREGATES FOR CONCRETE NOT PLACED ON GRADE

1102.1 DESCRIPTION

This specification is for coarse aggregates, intermediate aggregates, fine aggregates, mixed aggregates (coarse, intermediate and fine material) and miscellaneous aggregates for use in construction of concrete not placed on grade.

For Intermediate Aggregates and Mixed Aggregates, consider any aggregate with 30% or more retained on the No. 8 sieve to be Coarse Aggregate.

1102.2 REQUIREMENTS

a. Quality of Individual Aggregates.

(1) Provide Aggregates for Concrete that comply with **TABLE 1102-1**. Fine Aggregates for Concrete have additional Quality Requirements stated in **subsection 1102.2e.(2).**

TABLE 1102-1: QUALITY REQUIREMENTS FOR CONCRETE AGGREGATES

Concrete Classification	Soundness (min.)	Wear (max.)	Absorption (max.)	Acid Insoluble[5] (min.)
Grade xx (AE)(SW)[1]	0.90	40	-	-
Grade xx (AE)(SA)[2]	0.90	40	2.0	-
Grade xx (AE)(AI)[3]	0.90	40	-	85
Grade xx (AE)(PB)[4]	0.90	40	3.0	-
Bridge Overlays	0.95	40	-	85
All Other Concrete	0.90	50	-	-

[1]Grade xx (AE)(SW) - Structural concrete with select coarse aggregate for wear.
[2]Grade xx (AE)(SA) - Structural concrete with select coarse aggregate for wear and absorption.
[3]Grade xx (AE)(AI) - Structural concrete with select coarse aggregate for wear and acid insolubility.
[4]Grade xx (AE)(PB) - Structural concrete with select aggregate for use in prestressed concrete beams.
[5]Acid Insoluble requirement does not apply to calcite cemented sandstone.

- Soundness (KTMR-21) requirements do not apply to aggregates having less than 10% material retained on the No. 4 sieve.
- Wear (AASHTO T 96) requirements do not apply to aggregates having less than 10% retained on the No. 8 sieve.
- Absorption KT-6 Procedure I for material retained on the No. 4 sieve. Apply the maximum absorption to the portion retained on the No. 4 sieve.

(2) All predominately siliceous aggregate must comply with the Wetting & Drying Test requirements, or be used with a Coarse Aggregate Sweetener, or will require Supplemental Cementitious Materials (SCM) to prevent Alkali Silica Reactions (ASR). When an SCM is utilized, provide the results of mortar expansion tests of ASTM C 1567 using the project's mix design concrete materials at their designated percentages. Provide a mix with a maximum expansion of 0.10% at 16 days after casting. Provide the results to the Engineer at least 15 days before placement of concrete on the project.

Wetting & Drying Test of Siliceous Aggregate for Concrete (KTMR-23)
Concrete Modulus of Rupture:

- At 60 days, minimum .... 550 psi
- At 365 days, minimum .... 550 psi

Expansion:

- At 180 days, maximum 0.050%
- At 365 days, maximum 0.070%

Aggregates produced from the following general areas are exempt from the Wetting and Drying Test:

- Blue River Drainage Area.
- The Arkansas River from Sterling, west to the Colorado state line.
- The Neosho River from Emporia to the Oklahoma state line.

(3) Coarse Aggregate Sweetener. Types and proportions of aggregate sweeteners to be used with Mixed Aggregates are listed in **TABLE 1102-2**.

TABLE 1102-2: COARSE AGGREGATE SWEETENER	
Type of Coarse Aggregate Sweetener	**Proportion Required by Percent Weight**
Crushed Sandstone*	40 (minimum)
Crushed Limestone or Dolomite*	40 (minimum)
Siliceous Aggregates meeting **subsection 1102.2a.(2)**	40 (minimum)
Siliceous Aggregates not meeting **subsection 1102.2a.(2)** **	30 (maximum)

*Waive the minimum portion of Coarse Aggregate Sweetener for all intermediate and fine aggregates that comply with the wetting and drying requirements for Siliceous Aggregates. In this case, combine the intermediate, fine and coarse aggregate sweetener in proportions required to comply with the requirements of **subsection 1102.2a.(3)**

**To be used only with intermediate and fine aggregates that comply with the wetting and drying requirements of Siliceous Aggregates unless a Supplemental Cementitious Material is utilized.

b. Mixed Aggregates.

(1) Composition. Provide coarse, intermediate, and fine aggregates in a combination necessary to meet **subsection 1102.2b.(2)**. Use a proven optimization method such as ACI 302.1 or other method approved by the Engineer. Aggregates may be from a single source or combination of sources.

(2) Product Control.

(a) Gradations such as those shown in **TABLE 1102-3** have proven satisfactory in reducing water demand while providing good workability. Adjust mixture proportions whenever individual aggregate grading varies during the course of the work. Use the gradations shown in **TABLE 1102-3**, or other gradation approved by the Engineer.

Optimization is not required for concrete for patching pavements more than 10 years old, or Commercial Grade Concrete. The Engineer may waive the optimization requirements if the concrete meets all the requirements of **DIVISION 400**.

Follow these guidelines:

1. Do not permit the percent retained on two adjacent sieve sizes to fall below 4%;
2. Do not allow the percent retained on three adjacent sieve sizes to fall below 8%; and
3. When the percent retained on each of two adjacent sieve sizes is less than 8%, the total percent retained on either of these sieves and the adjacent outside sieve should be at least 13%.

(for example, if both the No. 4 and No. 8 sieves have 6% retained on each, then:
1) the total retained on the 3/8 in. and No. 4 sieves should be at least 13%, and
2) the total retained on the No. 8 and No. 16 sieves should be at least 13%.)

TABLE 1102-3: ALLOWABLE GRADING FOR MIXED AGGREGATES FOR CONCRETE													
Type	Usage	Percent Retained - Square Mesh Sieves											
		1 ½"	1"	¾"	½"	⅜"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
MA-3	Optimized All Concrete		0	2-12	Note[1]	Note[1]	Note[1]	Note[1]	Note[2]	Note[2]	Note[2]	95-100	98-100
MA-4	Optimized All Concrete	0	2-12	Note[1]	Note[1]	Note[1]	Note[1]	Note[1]	Note[2]	Note[2]	Note[2]	95-100	98-100
MA-5	Optimized Drilled Shafts		0	2-12	8 min	22-34		55-65		75 min		95-100	98-100
MA-6	Optimized for Bridge Overlays		0	0	2-12	Note[1]	Note[1]	Note[1]	Note[2]	Note[2]	Note[2]	95-100	98-100
MA-7	Contractor Design KDOT Approved	Proposed Grading that does not correspond to other limits in this table but meet the requirements for concrete in **DIVISION 400**.											98-100

[1]Retain a maximum of 22% (24% for MA-6) and a minimum of 6% of the material on each individual sieve.
[2]Retain a maximum of 15% and a minimum of 6% of the material on each individual sieve.

(b) Optimization Requirements for all Gradations.

- Actual Workability must be within ± 5 of Target Workability.

Where: W_A = Actual Workability
W_T = Target Workability
CF = Coarseness Factor

1. Determine the Grading according to KT-2
2. Calculate the Coarseness Factor (CF) to the nearest whole number.

$$CF = \frac{+3/8\text{” Material \% Retained}}{+\#8\text{ Material \% Retained}} \text{x}100$$

3. Calculate the Actual Workability (W_A) to the nearest whole number as the percent material passing the #8 sieve.

$$W_A = 100 - \text{\% retained on \#8 sieve}$$

4. Calculate the Target Workability (W_T) to the nearest whole number where For 517 lbs cement per cubic yard of concrete

$$W_T = 46.14 - (CF/6)$$

For each additional 1 lb of cement per cubic yard, subtract 2.5/94 lbs from the Target Workability.

(c) Deleterious Substances. Maximum allowed deleterious substances by weight are:

- Clay lumps and friable particles (KT-7) 1.0%
- Coal (AASHTO T 113)...0.5%
- Shale or Shale-like material (KT-8)..0.5%
- Sticks (wet) (KT-35)..0.1%
- Sum of all deleterious 1.5%

(d) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) for each aggregate according to the procedure listed Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor) before delivery, or from the first 10 samples tested and accepted. Provide aggregate that is within ±0.20 of the average fineness modulus.

Provide a single point grading for the combined aggregates along with a plus/minus tolerance for each sieve. Use plus/minus tolerances to perform quality control checks and by the Engineer to perform aggregate grading verification testing. The tests may be performed on the combined materials or on individual aggregates, and then theoretically combined to determine compliance.

Maintain an Actual Workability within ± 5 of the Target Workability for the combined aggregate.

(3) Handling of All Aggregates.

(a) Segregation. Before acceptance testing, remix all aggregate segregated by transit or stockpiling.

(b) Stockpiling.

- Maintain separation between aggregates from different sources, with different gradings or with a significantly different specific gravity.
- Transport aggregate in a manner that promotes uniform grading.
- Do not use aggregates that have become mixed with earth or foreign material.
- Stockpile or bin all washed aggregate produced or handled by hydraulic methods for 12 hours (minimum) before batching. Rail shipment exceeding 12 hours is acceptable for binning provided the car bodies permit free drainage.
- Provide additional stockpiling or binning in cases of high or non-uniform moisture.

c. Coarse Aggregates for Concrete.

(1) Composition. Provide coarse aggregate that is crushed or uncrushed gravel or crushed stone meeting the quality requirements of **subsection 1102.2a.** Consider limestone, calcite cemented sandstone, rhyolite, quartzite, basalt and granite as crushed stone.

Mixtures utilizing siliceous aggregate not meeting **subsection 1102.2a.(2)** will require supplemental cementitious materials to prevent Alkali Silica Reactions. Provide the results of mortar expansion tests of ASTM C 1567 using the project's mix design concrete materials at their designated percentages. Provide a mix with a maximum expansion of 0.10% at 16 days after casting. Provide the results to the Engineer at least 15 days before placement of concrete on the project.

(2) Product Control. Use gradations such as those in **TABLE 1102-4** which have been shown to work in Optimized Mixed Aggregates, or some other gradation approved by the Engineer that will provide a combined aggregate gradation meeting **subsection 1102.2b.**

TABLE 1102-4: ALLOWABLE GRADING FOR COARSE AGGREGATES

Type	Composition	Percent Retained - Square Mesh Sieves							
		1½"	1"	¾"	½"	⅜"	No. 4	No. 8	No. 30
SCA-1	Siliceous Gravel or Crushed Stone	0	0-10	14-35	-	50-75	-	95-100	-
SCA-2	Siliceous Gravel or Crushed Stone			0	0-35	30-70	75-100	95-100	
SCA-4	Siliceous Gravel or Crushed Stone		0	0-20				95-100	

d. Intermediate Aggregate for Concrete.

(1) Composition. Provide intermediate aggregate for mixed aggregates (IMA) that is crushed stone, natural occurring sand, or manufactured sand meeting the quality requirements of **subsection 1102.2a.**

(2) Product Control. Provide IMA grading when necessary to provide a combined aggregate gradation meeting **subsection 1102.2b.**

e. Fine Aggregates for Concrete.

(1) Composition.

(a) Type FA-A. Provide either singly or in combination natural occurring sand resulting from the disintegration of siliceous or calcareous rock, or manufactured sand produced by crushing predominately siliceous materials meeting the quality requirements of **subsection 1102.2a.** and **1102.2e.(2)**.

(b) Type FA-C. Provide crushed siliceous aggregate, steel slag, or chat that is free of dirt, clay, and foreign or organic material.

(2) Additional Quality Requirements for FA-A.

(a) Mortar strength and Organic Impurities. If the DME determines it is necessary, because of unknown characteristics of new sources or changes in existing sources, provide fine aggregates that comply with the following:

- Mortar Strength (KTMR-26). Compressive strength when combined with Type III (high early strength) cement:
  - At age 24 hours, minimum 100%*
  - At age 72 hours, minimum 100%*

  *Compared to strengths of specimens of the same proportions, consistency, cement and standard 20-30 Ottawa sand.
- Organic Impurities (AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.

(b) Provide FA-C for Multi/Single-Layer Polymer Concrete Overlay complying with **TABLE 1102-5**.

TABLE 1102-5: QUALITY REQUIREMENTS FOR MULTI/SINGLE-LAYER POLYMER CONCRETE OVERLAY		
Property	**Requirement**	**Test Method**
Soundness, minimum	0.92	KTMR-21
Wear, maximum	30%	AASHTO T 96
Acid Insoluble Residue, minimum	55%	KTMR-28
Uncompacted Voids Fine Aggregate, minimum	45	KT-50
Moisture Content, maximum	0.2%	KT-11

(3) Product Control.

(a) Size Requirements. Provide FA-C for Multi/Single-Layer Polymer Concrete Overlay complying with **TABLE 1102-6**. Provide FA-A that comply with **TABLE 1102-6** or some other gradation approved by the Engineer that will provide a combined aggregate gradation meeting **subsection 1102.2.b.**

TABLE 1102-6: GRADING REQUIREMENTS FOR FINE AGGREGATES FOR CONCRETE								
Type	**Percent Retained-Square Mesh Sieves**							
	⅜"	**No. 4**	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 100**	**No. 200**
FA-A	0	0-10	0-27	15-55	40-77	70-93	90-100	98-100
FA-C	0	0	25-70	95-100	99-100	99-100	99-100	98-100

(b) Deleterious Substances.

- Type FA-A: Maximum allowed deleterious substances by weight are:
  - Coal (AASHTO T 113)... 0.5%
  - Sticks (wet) (KT-35).. 0.1%
  - Sum of all deleterious 0.5%

f. Miscellaneous Aggregates for Concrete.

(1) Aggregates for Mortar Sand, Type FA-M.

(a) Composition. Provide aggregates for mortar sand, Type FA-M that is natural occurring sand.

(b) Quality.

- Mortar strength and Organic Impurities. If the DME determines it is necessary, because of unknown characteristics of new sources or changes in existing sources, provide aggregates for mortar sand, Type FA-M that comply with the following:
  - Mortar Strength (KTMR-26). Compressive strength when combined with Type III (high early strength) cement:
    - At age 24 hours, minimum 100%*

- At age 72 hours, minimum 100%*

  * Compared to strengths of specimens of the same proportions, consistency, cement and standard 20-30 Ottawa sand.
- Organic Impurities (AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.

(c) Product Control.

- Size Requirements. Provide aggregates for mortar sand, Type FA-M that comply with **TABLE 1102-7**.

TABLE 1102-7: GRADING REQUIREMENTS FOR MORTAR SAND

Type	Percent Retained - Square Mesh Sieves							Gradation Factor
	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200	
FA-M	0	0-2	0-30	20-50	50-75	90-100	98-100	1.70-2.50

- Deleterious Substances. Maximum allowed deleterious substances by weight are:
  - Clay lumps and friable material (KT-7).................................... 1.0%
  - Coal (AASHTO T 113)... 0.5%
  - Sticks (wet) (KT-35)... 0.1%
  - Sum of all deleterious 1.5%

(2) Modified Lightweight Aggregates.

(a) Composition. Provide a modified lightweight aggregate produced from a uniform deposit of raw material combined with FA-A **subsection 1102.2c**.

(b) Quality.

- Soundness, minimum (KTMR-21) 0.90
- Loss on Ignition 5%

(c) Product Control.

- Size Requirements. Provide modified lightweight aggregates that comply with **TABLE 1102-8**.

TABLE 1102-8: GRADING REQUIREMENTS FOR MODIFIED LIGHTWEIGHT AGGREGATES

Type	Percent Retained - Square Mesh Sieves					
	¾"	½"	⅜"	No. 4	No. 8	No. 16
Grade 1	0	0-10	30-60	85-100	95-100	
Grade 2		0-2	0-30	20-50	50-75	90-100

- Deleterious Substances.
  - Organic Impurities (AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.
- Unit Weight (dry, loose weight) (max.) .... 1890 lbs/cu yd

(d) Concrete Making Properties. Drying shrinkage of concrete specimens prepared with modified lightweight aggregate and FA-A proportioned as shown in the Contract Documents can not exceed 0.07%.

(e) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) according to procedure listed in Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor) before delivery, or from the first 10 samples tested and accepted. Provide aggregate that is within ±0.20 of the average fineness modulus.

(f) Proportioning Materials. Submit mix designs for concrete using modified lightweight aggregate to Construction and Materials for approval prior to use.

(g) Stockpiling.

- Stockpile accepted aggregates in layers 3 to 5 feet thick. Berm each layer so that aggregates do not "cone" down into lower layers.
- Keep aggregates from different sources, with different gradings or with a significantly different specific gravity separated.
- Transport aggregate in a manner that promotes uniform gradation.
- Do not use aggregates that have become mixed with earth or foreign material.
- Stockpile or bin all washed aggregate produced or handled by hydraulic methods for 12 hours (minimum) before batching. Rail shipment exceeding 12 hours is acceptable for binning, provided the car bodies permit free drainage.
- Provide additional stockpiling or binning in cases of high or non-uniform moisture.

1102.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115**.

1102.4 PREQUALIFICATION

Aggregates for concrete must be prequalified according to **subsection 1101.4**.

1102.5 BASIS OF ACCEPTANCE

The Engineer will accept aggregates for concrete based on the prequalification required by this specification and **subsection 1101.5**.

SECTION 1103

AGGREGATES FOR HOT MIX ASPHALT (HMA)

1103.1 DESCRIPTION

This specification covers the quality, composition and gradation requirements of aggregates for hot mix asphalt (HMA) on QC/QA projects.

1103.2 REQUIREMENTS

a. Composition Individual Aggregates. Use aggregate from each source that complies with the gradation requirements listed in **TABLE 1103-1**.

(1) Crushed Aggregates. Limit crushed aggregates to the following materials.

(a) Produce Crushed Stone (CS-1) and Crushed Stone Screenings (CS-2) by crushing limestone, sandstone, porphyry, (rhyolite, basalt, granite, and Iron Mountain Trap Rock are examples of porphyry) or other types of stone.

(b) Produce Crushed Gravel (CG) by crushing siliceous gravel containing not more than 15% non-siliceous material. If 95% or more of crushed gravel is retained on the #8 (2.65 mm) sieve, then the material must have a minimum Uncompacted Void Content of Coarse Aggregate (UVA) value of 45 when tested in accordance with KT-80. Testing will be the same frequency as KT-50. Do not use material with a UVA value less than 45.

(c) Provide Chat (CH-1) obtained during the mining of lead and zinc ores in the tri-state mining district.

(d) Consider materials complying with Mineral Filler Supplements MFS-1, MFS-2, MFS-4, and MFS-7 as crushed aggregate.

(e) Produce Crushed Steel Slag (CSSL) by crushing electric furnace steel slag. Some sources of steel slag are angular when produced and may be treated the same as crushed gravel and manufactured sand. Use steel slag with an Uncompacted Void Content of the Fine Aggregate “U” Value, determined by test method KT-50, of more than 42.00 and the Coarse Aggregate Angularity greater than the minimum specified value. The maximum allowable quantity of crushed steel slag is 50% of the total aggregate weight.

(f) Manufactured sand shall have an Uncompacted Void Content of the Fine Aggregate “U” Value, determined by test method KT-50, greater than or equal to 42.00. Produce manufactured sand by crushing siliceous sand and gravel (designate as crushed gravel (CG-2, CG-3, etc) in the mix design), or by washing or screening crushed stone (designate as crushed stone (CS-2, CS-3, etc) in the mix design), or by washing or screening chat (designate as chat (CH-2, CH-3, etc) in the mix design).

(2) Uncrushed Aggregates. Limit uncrushed aggregates to the following materials.

(a) Produce Sand-Gravel (SSG) by mixing natural sand and gravel formed by the disintegration of siliceous and/or calcareous materials.

(b) Provide Natural Sand consisting of particles formed by the natural disintegration of siliceous and/or calcareous materials. Use natural sand with an Uncompacted Void Content “U” value of less than 42.

(c) Provide Grizzly (Grizzly Waste) consisting of the matrix or bedding material occurring in conjunction with calcitic or dolomitic cemented sandstone "Quartzite", generally separated from the sandstone prior to crushing.

(d) Provide Wet Bottom Boiler Slag (WBBS) consisting of a hard angular by-product of the combustion of coal in wet-bottom boilers. Quality requirements do not exist for this material. Obtain written approval by the Chief of Construction and Materials for use in HMA. The use of WBBS does not modify the requirements for minimum contents of either crushed stone or natural sand.

(3) Mineral Filler Supplement. Provide a mineral filler supplement that is easily pulverized and free of cemented lumps, mudballs, and organic materials that complies with the following and the general requirements in **subsection 1103.2c**. Do not blend 2 or more materials to produce mineral filler supplement. Provide only 1 mineral filler supplement in each HMA design.

(a) Mineral Filler Supplement designation MFS-1 is Portland cement, blended hydraulic cements, or crushed stone.
(b) Mineral Filler Supplement designation MFS-2 is crushed limestone.
(c) Mineral Filler Supplement designation MFS-3 is water or wind deposited silty soil material.
(d) Mineral Filler Supplement designation MFS-4 is Hydrated lime. The minimum allowable quantity of MFS-4 or Hydrated Lime is 1% of the total aggregate weight when required as a supplement on the Contract Documents.
(e) Mineral Filler Supplement designation MFS-5 is volcanic ash containing a minimum of 70% glass shard. The maximum allowable quantity of MFS-5 is 5% of the total aggregate weight when specified as acceptable mineral filler supplement.
(f) Mineral Filler Supplement designation MFS-6 is fly ash. Fly ash is the finely divided residue resulting from the combustion of ground or powdered coal and is transported from the boiler by flue gasses. The maximum allowable quantity of MFS-6 is 3% of the total aggregate weight when specified as acceptable mineral filler supplement.
(g) Mineral Filler Supplement designation MFS-7 is processed chat sludge that has been dewatered at the source of supply, and does not exceed 15% moisture content by weight at the time of shipping.

(4) Reclaimed Asphaltic Pavement (RAP). Use RAP in HMA only when such an option is permitted by Contract Special Provision. Subject the RAP to the limitations (i.e. source, max. percent allowed in mix, etc.) shown on the Contract Documents and contained in the appropriate Contract Special Provisions. Screen the RAP through a 2 ¼ inch screen or grizzly before it enters the HMA plant.

Fractionated Reclaimed Asphaltic Pavement (FRAP) is defined as having two or more RAP stockpiles, where the RAP is divided into a minimum of two fractions consisting of coarse and fine fractions. Subject the FRAP to the same limitations shown on the Contract Documents and contained in the appropriate Contract Special Provisions for RAP. Comprise the maximum percentage of FRAP of coarse or fine FRAP or a combination of coarse and fine FRAP, unless otherwise stated in the Contract Documents. Utilize a separate cold feed bin for each stockpile of FRAP used. Add FRAP to the mix through the RAP collar. Include the processing requirements for each FRAP stockpile within the Quality Control Plan.

(5) Recycled Asphalt Shingles**.** Recycled Asphalt Shingles (RAS) are allowed in any mixture specified to use RAP. The Contractor may use the %RAP as shown in the Contract Special Provision **or** a maximum of 5% RAS and 10% RAP.

Follow the guidelines in AASHTO PP 53 except as modified in this Special Provision. Drop the grade of the virgin binder one grade from both the top and the bottom grade specified for 0% RAP. For example, if a PG 64-22 is specified for 0% RAP, then the virgin grade of the binder for up to 5% RAS and 10% RAP is PG 58-28.

Comply with the Kansas Department of Health and Environment’s Bureau of waste Management Policy 2011-P3 or current version and other regulations pertaining to the recycling of shingles.

Grind the shingles to a minus 3/8-inch size. Remove deleterious materials from waste, manufacturer, or new shingles. Use post-consumer RAS that contains less than 0.5% wood by weight or less than 1.0% total deleterious by weight. Determine the gradation of the aggregate by extraction of the binder or by using TABLE 2 as a standard gradation:

TABLE 1103-1: SHINGLE AGGREGATE GRADATION	
Sieve Size	**Percent Retained**
3/8 in.	0
No. 4	5
No. 8	15
No. 16	30
No. 30	50
No. 50	55
No. 100	65
No. 200	75

b. Quality of Individual Aggregates.

- Soundness, minimum (KTMR-21) 0.90

Soundness requirements do not apply to aggregates having less than 10% material retained on the No. 4 mesh sieve.

- Wear, maximum (AASHTO T 96)..40%
  Wear requirements do not apply to aggregates having less than 10% retained on the No. 8 sieve.
- Absorption, maximum (KT-6) 4.0%
  Test aggregates for absorption as follows:
  - Crushed Stone (CS-1) ....Test Method KT-6, Procedure I
  - Screenings (CS-2)..Test Method KT-6, Procedure II
  - Sand Gravel (SSG)/Crushed Gravel (CG) ....Test Method KT-6, Procedures I & II

  Apply the specified maximum absorption to both the fraction retained on the No. 4 sieve and the fraction passing the No. 4. Screenings produced concurrently with CS-1 will be accepted without tests for absorption.

  Crushed aggregates with less than 10% materials retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.
- Plasticity Index, the maximum P.I. for MFS-1, MFS-2, MFS-3, MFS-5, and MFS-7 is 6.

c. Product Control of Individual Aggregates

(1) Size Requirements. Produce each individual aggregate that complies with **TABLE 1103-2 and 1103-3**

(2) Deleterious Substances. Provide combined aggregates free from alkali, acids, organic matter, or injurious quantities of other foreign substances that does not exceed the following maximum percentages by weight.

- Shale or Shale-like (KT-8) 1.0%
- Clay lumps and friable particles (KT-7) 1.0%
- Sticks (wet) (KT-35) 0.1%
- Coal (AASHTO T-113) 0.5%

TABLE 1103-2: REQUIREMENTS FOR INDIVIDUAL AGGREGATES								
Designation	**Material**	**Percent Retained – Square Mesh Sieves**						
		1”	**½”**	**3/8”**	**No. 4**	**No. 8**	**No. 30**	**No. 200**
CS-1	Crushed Stone	0						95.5-100.0
CS-2	Crushed Stone Screenings		0	0 - 5				60-100
CG	Crushed Gravel	Blend gradation with other aggregates in the mix.						
CH-1	Chat	Blend gradation with other aggregates in the mix						
SSG	Sand & Sand Gravel	0						80-100
WBBS	Wet Bottom Boiler Slag		0	Blend gradation with other aggregates in the mix.				
CSSL	Crushed Steel Slag	Blend gradation with other aggregate in the mix.						

TABLE 1103-3: REQUIREMENTS FOR MINERAL FILLER SUPPLEMENTS								
Designation	**Material**	**Percent Retained – Square Mesh Sieves**						
		1”	**½”**	**3/8”**	**No. 4**	**No. 8**	**No. 30**	**No. 200**
MFS-1	Cement or Crushed Stone			0		0-5	0-8	0-40
MFS-2	Crushed Limestone			0		1-10		60-80
MFS-3	Silt			0	0-5			0-40
MFS-4	Hydrated Lime	Blend gradation with other aggregate in the mix						
MFS-5	Volcanic Ash			0		0-5	0-8	0-40
MFS-6	Fly Ash	Blend gradation with other aggregate in the mix						
MFS-7	Processed Chat Sludge			0		0-5	0-8	0-40

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

e. Special Requirements for aggregates used in ultrathin bonded asphalt surface (UBAS).

TABLE 1103-4: INDIVIDUAL COARSE AGGREGATE PROPERTIES		
Property	**Test Method**	**Limits**
Coarse Aggregate Angularity (% min.)	KT-31	95/90 [a]
Los Angeles Abrasion (% max.) [b]	AASHTO T 96	35 [c]
Micro-Deval,(% max.) [b]	AASHTO T 327	18[d]
Soundness (% min.)	KTMR-21	0.90 [d]
Absorption (% max.)	KT-6	4.0 [d]
Methylene Blue (% max.)	AASHTO T 330	10 [e]
An individual aggregate will be considered a coarse aggregate source if it contributes more than 5% of the total plus No. 4 sieve material of the combined aggregate (individual aggregate contribution No. 4 / total JMF retained No. 4 > 5%). a – 95% of the coarse aggregate has one fractured face & 90% has two or more fractured faces. b – Sample from stockpiled material with top size aggregate not larger than the maximum aggregate size for the mix designation type from **TABLE 613-1**. c - For calcitic or dolometic cemented sandstone “quartzite”, the maximum percent is 40. d - May use KDOT’s Official Quality results e – Perform this test on all individual aggregates that contribute more than 1.0% to the JMF for the material passing the No. 200 sieve.		

TABLE 1103-5: INDIVIDUAL FINE AGGREGATE PROPERTIES		
Property	**Test Method**	**Limits**
Methylene Blue (% max.)	AASHTO T 330	10
Soundness (% min.)	KTMR-21	0.90 [a]
Los Angeles Abrasion (% max.)	AASHTO T 96	40 [a]
Absorption (% max.)	KT-6	4.0 [a]
a –May use KDOT's Official Quality results. • The above requirements for wear do not apply for aggregates having less than 10% material retained on the No. 8 sieve. • The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.		

1103.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTIONS 1115 and 2501**.

1103.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1103.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedure described in **subsection 1101.5.**

SECTION 1104

AGGREGATES FOR AGGREGATE BASE CONSTRUCTION

1104.1 DESCRIPTION

This specification covers aggregates for use in aggregate base construction.

1104.2 REQUIREMENTS

a. Composition.

(1) Type AB-1 or AB-2 may be singularly or any combination of crushed stone, crushed or uncrushed gravel, sand, sand-gravel, or limestone gravel mixed with soil or other qualified binder material.

(2) Type AB-3 is at least 85% limestone or dolomite produced by mechanical crushing.

b. Quality[1].

- Soundness[2], minimum (KTMR-21) 0.85
- Wear[3], maximum (AASHTO T 96) 50%

[1]Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

[2]The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

[3]The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

c. Product Control.

(1) Gradation and Plasticity. Provide a uniformly mixed final product that complies with **TABLE 1104-1**.

(2) Deleterious Substances. Provide aggregates that are free from weeds, sticks, grass, roots and other undesirable foreign matter.

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1104.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115**.

TABLE 1104-1: GRADATION AND PLASTICITY OF AGGREGATES FOR AGGREGATE BASE CONSTRUCTION

Type	Percent Retained-Square Mesh Sieves									P.I.	Liquid Limit (Max.)
	2”	1 ½”	1”	¾”	3/8”	No. 4	No. 8	No. 40	No. 200		
AB-1	0	0-10		5-40		35-75	54-85	78-95	90-98	0-6	25
AB-2*			0		1-35		25-50	60-75	78-90	1-6	25
AB-3**	0	0-5		5-30		35-60	45-70	60-84	80-92	1-8	30

*The fraction passing the No. 200 sieve shall not exceed 2/3 of the fraction passing the No. 40 sieve.

**The fraction passing the No. 200 sieve shall not exceed 3/4 of the fraction passing the No. 40 sieve.

1104.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1104.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5.**

SECTION 1105

AGGREGATES FOR CEMENT TREATED BASES

1105.1 DESCRIPTION

This specification covers aggregate for the construction of fly ash and portland cement treated base.

1105.2 REQUIREMENTS

a. Composition. Provide singly or in combination, crushed limestone, crushed dolomite, crushed portland cement concrete pavement (PCCP) reclaimed from the project site and sand or sand-gravel produced from a naturally occurring alluvial deposit.

b. Quality [1]. Provide individual aggregates that comply with the following:
Crushed Limestone and Dolomite.

- Soundness [2], minimum (KTMR-21) 0.85
- Wear [3], maximum (AASHTO T 96) 50%

Reclaimed crushed PCCP.

- Soundness [2], minimum (KTMR-21) 0.85
- Wear [3], maximum (AASHTO T 96) 60%

Sand or Sand Gravel.

- Soundness [2], minimum (KTMR-21) 0.85
- Wear [3], maximum (AASHTO T 96)... 50%

[1] Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

[2] The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

[3] The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

c. Product Control.

(1) Size Requirements. Develop a single point aggregate gradation and establish a plus and minus tolerance for each sieve specified in **TABLE 1105-1**. The established tolerances will be applied to the designated single point gradation for the purposes of establishing a gradation band for field acceptance testing. Perform sieve analyses of the aggregates and chart the results. Suspend production of materials when any test result on any sieve falls outside the gradation band.

TABLE 1105-1: GRADATION OF AGGREGATES FOR CEMENT TREATED BASES (PERCENT RETAINED)

Sieve size	1 ½”	¾”	No. 4	No. 8	No. 40	No. 200
Single point	*	*	*	*	*	*
Tolerance	*	+/-*	+/-*	+/-*	+/-*	+/-*

* These values to be established by the Contractor

(2) Deleterious Substances. Provide aggregates that are free from grass, weeds, roots, sticks, and other undesirable foreign matter.

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1105.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115.**

1105.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1105.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5.**

SECTION 1106

AGGREGATES FOR GRANULAR BASE

1106.1 DESCRIPTION

This specification covers aggregate for granular base for concrete pavements.

1106.2 REQUIREMENTS

a. Composition. Mix sand, gravel, crushed stone, and/or a suitable binder soil, singly or in combination, to produce uniformity of grading and plasticity, and comply with the following.

b. Quality [1].

- Soundness [2], minimum (KTMR-21) 0.85
- Wear [3], maximum (AASHTO T 96) 50%

[1]Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

[2]The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

[3]The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

Apply the specified maximum absorption to both the fraction retained on the No. 4 sieve and the fraction passing the No. 4 sieve. Screenings produced concurrently with products approved under KT-6, Procedure I, will be accepted without tests for absorption.

c. Product Control.

(1) Size and Plasticity Requirements:

TABLE 1106-1: GRADATION OF AGGREGATES FOR GRANULAR BASE					
Percent Retained – Square Mesh Sieves					
1 ½”	**¾”**	**No. 4**	**No. 8**	**No. 40**	**No. 200**
0	0-15	10-65	25-70	50-90	85-95

Plasticity Index.

- Mixes containing more than 50% Crushed Limestone 1-8
- Other Aggregate Combinations 3-8
- Liquid Limit, maximum 25

(2) Pulverization.

(a) Binder Soil. Pulverize binder soil that occurs in natural deposits and not naturally combined with coarse material that complies with **TABLE 1106-2**:

TABLE 1106-2: GRADATION OF BINDER SOIL		
Percent Retained – Square Mesh Sieves		
¾”	**No. 4**	**No. 8**
0	0-25	0-50

Determine pulverization of binder soil in moist or natural conditions at the latest possible point before incorporation into the total combined material.

(b) Natural Mixtures. When binder and coarse material occur naturally combined, pulverize the combination so that at least 25% of the total passing the No 40 sieve by washing passes the No. 40 sieve by dry screening.

(3) Deleterious Substances. Provide aggregates that are free from grass, weeds, roots, sticks, and other undesirable foreign matter.

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1106.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115**.

1106.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1106.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5.**

SECTION 1107

AGGREGATES FOR BACKFILL

1107.1 DESCRIPTION

This specification covers aggregate for backfill. Use this when structures, pipe, mechanically stabilized earth (MSE) walls (panel or modular), underdrain, permeable or crushed stone backfill requirements are specified in the Contract Documents.

1107.2 REQUIREMENTS

a. Structures or Pipe.

(1) Composition. Provide singly or in combination sand, gravel, or crushed stone. Consider limestone, calcite-cemented sandstone, rhyolite, basalt, and granite as crushed stone.

(2) Quality[1].

- Soundness[2], minimum (KTMR-21) 0.85
- Wear[3], maximum (AASHTO T 96) 45%

For Structures Backfill Only:

- Coarse Aggregate Angularity[4], minimum (KT-31) 75%
- Fine Aggregate Angularity[4], minimum (KT-50) 40%

[1]Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

[2]The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

[3]The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

[4]Required testing for sand and gravel.

(3) Product Control.

(a) Gradation and Plasticity.

TABLE 1107-1: AGGREGATES FOR STRUCTURES OR PIPE BACKFILL

Type	Percent Retained-Square Mesh Sieves									Plasticity Index (Max.)
	2”	1 ½”	1”	¾”	3/8”	No. 4	No. 8	No. 40	No. 200	
SB-1	0	0-10		15-40	50-75		95-100			
SB-2			0	0-20	40-70	75-100	95-100			
SB-3	0	0-5		5-30		35-60	45-70	60-84	80-92	8
PB-1[1]	0	0-10		15-40	50-75		95-100			
PB-2[1]			0	0-20	40-70	75-100	95-100			
PB-3[1]			0	0-30		35-60	50-75	70-90	90-100	8

[1]Use of PB is required for PE and PVC pipe backfill.

(b) Deleterious Substances.

- Shale or shalelike material, maximum (KT-8) 3.0%
- Clay Lumps and friable particles, maximum (KT-7) 3.0%
- Sticks (wet), maximum (KT-35) 1.0%

(4) Foundation Stabilization. Use SB aggregates at those locations where the use of SB aggregates for foundation stabilization is specified elsewhere in the Contract Documents. When the preceding sentence applies, use SB-3 when the expected depth of foundation stabilization is less than 6 inches.

Except at the locations described above, the use of alternate granular materials (except chat) may be permitted, but only with the approval of the District Materials Engineer.

b. MSE Walls: Precast Panel and Modular Block with Steel Soil Reinforcing Mesh or Steel Reinforcing Strips and Tie Strips.

(1) Composition. Use granular backfill material in the structure volume of sand, sand-gravel, or crushed stone, reasonably free from organics or other deleterious materials, and complies with the following:

(2) Quality. Submit representative material samples for the following tests to the Materials and Research Center, 2300 Van Buren, Topeka, KS 66611 (ATTENTION: Geotechnical Engineer) for acceptance prior to utilizing this material on the project.

(a) The Plasticity Index (P.I.) is 6 maximum, determined by KT-10.

(b) An angle of internal friction of 34 degrees or greater, as determined by the standard direct shear test – AASHTO T 236, utilizing a sample of the material compacted to 95 percent of AASHTO T 99 Methods C or D (with oversize correction, as outlined in Note 9 in AASHTO T 99) at optimum moisture content.

(c) Soundness. Use material substantially free of shale or other soft, poor durability particles as determined in accordance with **SECTION 1115**. "Freeze and Thaw", minimum 0.90 as determined in **DIVISION 1100**.

(d) Wear. Los Angeles Wear Abrasion, maximum 40%.

(e) Provide material that complies with **TABLE 1107-2**.

TABLE 1107-2: ELECTROCHEMICAL REQUIREMENTS (PANEL)	
Requirements	**Test Method**
Resistivity > 5000 ohm-cm	AASHTO T 288
pH: 5.0 to 10.0	AASHTO T 289
Organic Content < 1%	AASHTO T 267

If the resistivity is less than 5000 ohm-cm, but greater than 3000 ohm-cm, the backfill material can be accepted if it complies with **TABLE 1107-3**.

TABLE 1107-3: ADDITIONAL ELECTROCHEMICAL REQUIREMENTS		
Property	**Requirements**	**Test Method**
Chlorides	< 100 parts per million	ASTM D 4327
Sulfates	< 200 parts per million	ASTM D 4327

(3) Product Control.

(a) Gradation.

TABLE 1107-4: AGGREGATES FOR PANEL MSE WALLS BACKFILL		
Percent Retained – Square Mesh Sieves		
4"	No. 40	No. 200
0	**40 - 100**	**95 - 100**

(b) Coefficient of Uniformity. Provide material with a minimum coefficient of uniformity of 4.0 as defined by ASTM D 2487 for systems that utilize steel reinforcing strips and tie strips (Reinforced Earth). Material with a coefficient of uniformity less than 4.0 may be accepted based on the results of pullout tests conducted by the University of Kansas, Civil Engineering Department, Geotechnical Section. (Contact: Dr. Jie Han @ 785-864-3714 or Dr. Bob Parsons @ 785-864-2946.)

(4) Use only crushed stone in District 1.

For select granular backfill material composed of crushed stone, submit a proposed project gradation with single-point gradations and tolerances for approval. For sand and sand-gravel combinations, a project gradation will be issued that will specify gradation tolerances after the proposed material is approved. Any quality assurance samples which fall outside the tolerances will necessitate re-approval to be in compliance with **subsection 1108.2 b.(2).**

c. MSE Walls: Modular Block with Soil Reinforcing Geogrid.

(1) Composition. Use granular backfill material in the structure volume of sand, sand-gravel, or crushed stone, reasonably free from organics or otherwise deleterious materials, and complies with the following:

(2) Quality. Submit representative material samples for the following tests to the Materials and Research Center, 2300 Van Buren, Topeka, KS 66611 (ATTENTION: Geotechnical Engineer) for acceptance prior to utilizing this material on the project.

(a) The Plasticity Index (P.I.) is 6 maximum, determined by KT-10.

(b) An angle of internal friction of 34 degrees or greater, as determined by the standard direct shear test – AASHTO T 236, utilizing a sample of the material compacted to 95% of AASHTO T 99 Methods C or D (with oversize correction, as outlined in Note 9 in AASHTO T 99) at optimum moisture content.

(c) Soundness. "Freeze and Thaw", minimum 0.90 as determined in **DIVISION 1100**.

(d) Wear. Los Angeles Wear Abrasion, maximum 40%.

(e) Provide material that complies with **TABLE 1107-5**.

TABLE 1107-5: ELECTROCHEMICAL REQUIREMENTS (Block)		
	Requirements	**Test Method**
(Mesa)	pH > 3.0	AASHTO T 289
(Anchor Landmark)	pH: 3.0 to 9.0	AASHTO T 289
	Organic Content < 1%	AASHTO T 267

(3) Product Control.

(a) Gradation.

TABLE 1107-6: AGGREGATES FOR MODULAR BLOCK MSE WALLS BACKFILL			
Type of Material	**% Retained – Square Mesh Sieves**		
	1"	**No. 40**	**No. 200**
Sand	0	40-100	95-100
Crushed Stone	0	40-100	95-100

Limit the maximum particle size to ¾ inch for geosynthetic reinforced structures and for epoxy or PVC coated reinforcements. Use only crushed stone in District 1.

For select granular backfill material composed of crushed stone, submit a proposed project gradation with single-point gradations and tolerances for approval. For sand and sand-gravel combinations, a project gradation will be issued that will specify gradation tolerances after the proposed material is approved. Any quality assurance samples which fall outside the tolerances will necessitate re-approval to be in compliance with **subsection 1108.2 c.(2)**.

d. Underdrain, Permeable or Granular Backfill.

(1) Composition. Provide washed aggregate Type BD-1 and Type UD-1 composed of crushed or uncrushed gravel, or crushed stone.

(2) Quality.

- Soundness, minimum (KTMR-21) 0.90
- Wear, maximum (KTMR-24) 40%

(3) Product Control. Provide aggregate that complies with **TABLE 1107-7**

TABLE-1107-7: AGGREGATES FOR UNDERDRAIN AND OTHER PERMEABLE BACKFILL										
Type	**Percent Retained-Square Mesh Sieves**									
	1 ½"	**1"**	**¾"**	**3/8"**	**No. 4**	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 100**
BD-1*	0	0-10	10-40		80-100		90-100		93-100	98-100
UD-1			0	0-15		40-60		70-95		98-100

*BD-1 is intended for use with a filter fabric.

(4) Deleterious substances.
- Shale or shalelike material, maximum (KT-8) 3.0%
- Clay Lumps and friable particles, maximum (KT-7) 3.0%
- Sticks (wet), maximum (KT-35) 1.0%

e. Crushed Stone.
(1) Composition. Provide material produced by the crushing of any type of stone complying with the following.
(2) Quality.
- Soundness, minimum (KTMR-21) 0.70
- Wear, maximum (AASHTO T 96) 50%

(3) Product Control.
(a) Size Requirements. Provide uniformly graded crushed stone, from coarse to fine, for backfill that complies with **TABLE 1107-8**:

TABLE 1107-8: CRUSHED STONE BACKFILL		
Percent Retained-Square Mesh Sieves		
2”	3/8”	No. 16
0	20 - 50	50 - 100

(b) Deleterious Substances.
- Clay lumps and friable particles, maximum (KT-7) 5.0%

1107.3 TEST METHODS
Test aggregates according to the applicable provisions of **SECTION 1115**.

1107.4 PREQUALIFICATION
Prequalify aggregate sources according to **subsection 1101.4**.

1107.5 BASIS OF ACCEPTANCE
Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

SECTION 1108

AGGREGATES FOR COVER MATERIAL

1108.1 DESCRIPTION

This specification covers aggregates for cover material to be used for asphalt sealing of the type shown in the Contract Documents for each project.

1108.2 REQUIREMENTS

a. Composition. Provide sand-gravel, lightweight aggregate, crushed limestone, crushed sandstone, crushed or uncrushed gravel for cover material. Use expanded shale as lightweight aggregate.

b. Quality Requirements.

- Soundness, minimum (KTMR-21) 0.90
- Wear, Maximum (AASHTO T 96)
  - Sand-gravel, Gravel or Limestone 40%
  - Sandstone 45%
  - Lightweight aggregate 30%
- Absorption, maximum (KT-6, Procedure I) 4.0%

(All types except CM-L)

c. Product Control.

(1) Size Requirements. Use various size cover material that comply with **TABLE 1108-1**. Determine the gradation factor according to Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor).

(2) Deleterious Substances. Do not exceed the following deleterious substances by weight:

- Shale or Shale like material (KT-8) 1.5%
- Clay lumps and friable particles (KT-7) 1.5%
- Coal (AASHTO T-113) 0.5%
- Sticks (wet) (KT-35) 0.1%
- Sum of all deleterious... 2.0%

TABLE 1108-1: GRADATION REQUIREMENTS FOR AGGREGATES FOR COVER MATERIAL

Type	Composition	Percent Retained-Square Mesh Sieves*							Minimum Gradation Factor
		¾"	½"	3/8"	No. 4	No. 8	No. 50	No. 200	
CM-A	Sand-Gravel		0	0-20	30-100	85-100		98-100	
CM-B	Sand-Gravel		0	0-25		35-100	90-100	98-100	4.00
CM-C	Crushed Stone	0	0-12	40-100	95-100			98-100	
CM-D	Crushed Sandstone	0	0-5	15-35	70-100	95-100		98-100	
CM-G	Sand-Gravel, or Crushed Sandstone		0	0-15	45-100	95-100		99-100	
CM-H**	Crushed Stone	0	0-5		40-100	90-100		98-100	
CM-J**	Sand-Gravel	0	1-20			30-100	90-100	96-100	
CM-K	Crushed Limestone	0	0-5	15-35	70-100	95-100		98-100	
CM-L-1	Lightweight Aggregate	0	0	0-10	10-40	85-100		98-100	
CM-L-2	Lightweight Aggregate	0	0-5	0-15	70-100	90-100		98-100	
CM-L-3	Lightweight Aggregate	0-15	0-60	65-100	95-100			98-100	

*After removal of all deleterious substances.
**Do not specify Types CM-H and CM-J for Federal Aid projects.

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1108.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115**.

1108.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1108.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5.**

SECTION 1109

AGGREGATE FOR MICROSURFACING

1109.1 DESCRIPTION

This specification covers aggregates for use in microsurfacing operations.

1109.2 REQUIREMENTS

a. Composition. Provide aggregate for microsurfacing that is crushed gravel, crushed calcite cemented sandstone, or chat which is a material obtained from the mining of lead and zinc ores.

Produce crushed gravel by mechanical crushing of siliceous gravel and not containing more than 15% non-siliceous material.

b. Quality.

- Soundness, minimum (KTMR-21) 0.90
- Wear, maximum (AASHTO T 96) 40%

c. Product Control.

Provide material that complies with **TABLE 1109-1**:

TABLE 1109-1: GRADING REQUIREMENTS							
Percent Retained - Square Mesh Sieves							
½"	**3/8"**	**No. 4**	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 200**
0	0-1	6-14	35-55	54-75	65-85	75-90	85-95

Additional Requirements for Crushed Gravel.

- Percent Crushed Particles (KT-31) (minimum) 98%*
- Uncompacted Void Content of Fine Aggregates (KT-50) (minimum) 46%
- Sand Equivalent (KT-55) (minimum) 65%

*Provide 98% of the crushed gravel with 2 or more fractured faces.

Deleterious Substances. Provide materials that are free from weeds, sticks, grass, roots and other undesirable foreign matter.

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1109.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115**.

1109.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1109.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5.**

SECTION 1110

AGGREGATES FOR SUBGRADE MODIFICATION OR RECONSTRUCTION

1110.1 DESCRIPTION

This specification covers the required types of aggregates for use in subgrade modification or reconstruction operations as shown in the Contract Documents.

1110.2 REQUIREMENTS

a. Composition. Provide one of the types of aggregate for subgrade modification or reconstruction as shown in **TABLE 1110-1.**

b. Quality[1].

- Soundness[2], minimum (KTMR-21) 0.85
- Wear[3], maximum (AASHTO T 96) 50%

[1]Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.
[2]The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.
[3]The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

c. Product Control.

(1) Size and Plasticity. Provide aggregate that complies with **TABLE 1110-1**. Determine the grading factor in accordance with the procedures listed in Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor).

TABLE 1110-1: GRADING AND PLASTICITY REQUIREMENTS

Type	Material	Percent Retained-Square Mesh Sieves[1]								Plasticity Index[2]
		1 ½”	1”	¾”	3/8”	No. 4	No. 16	No. 50	No. 200	
SR-1	Crushed Stone	0	0-15			35-100		85-100	85-100	0-6
SR-3	Crushed Stone Screenings[3]	0			0-5				85-100	0-5
SR-4	Sand-Gravel[4]		0	0-5	0-20				85-100	0-6
SR-7	Sand-Gravel	0					5-50	85-100	85-100	0-6

[1]After removal of all deleterious substances.
[2]This requirement does not apply if there is more than 70% retained on the No. 30 sieve.
[3]Do not exceed 7% of moisture contained in the aggregate when delivered to the road.
[4]Grading Factor is between 4.00-5.00.

(2) Deleterious Substances. Do not exceed the following percentages of deleterious substances by weight:
For crushed stone and sand-gravel:

- Shale or shalelike material (KT-8) 3.0
- Clay lumps & friable material (KT-7) 3.0
- Sticks (wet) (KT-35) 1.0

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1110.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115**.

1110.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1110.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

SECTION 1111

AGGREGATES FOR SURFACING OR RESURFACING

1111.1 DESCRIPTION

This specification covers the type of aggregate used for surfacing or resurfacing operations as shown in the Contract Documents.

1111.2 REQUIREMENTS

a. Composition. Provide one of the following types of aggregates for surfacing or resurfacing as shown in **TABLE 1111-1**.

b. Quality[1].

- Soundness[2], minimum (KTMR-21) 0.85
- Wear[3], maximum (AASHTO T 96) 45%

[1]Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

[2]The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

[3]The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

c. Product Control.

(1) Size Requirements. Provide aggregate that complies with **TABLE 1111-1**. Determine the fineness modulus in accordance with the procedures listed in Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor).

TABLE 1111-1: GRADING REQUIREMENTS FOR AGGREGATES FOR SURFACING OR RESURFACING

Type	Material	Percent retained-square mesh sieve (Gradings after removal of deleterious substances)							Fineness Modulus
		1 ½”	1”	¾”	3/8”	No. 8	No. 30	No. 200	
SA-1	Sand-gravel		0	0-5	0-20			97-100	4.00 min.*
SA-2	Sand-gravel	0	1-15					97-100	5.00 min.
SA-6	Crushed Stone	0	0-5	5-25	45-100		95-100	97-100	
SA-7	Crushed Stone	0		25-50		85-100		97-100	
SA-X	Crushed Stone		0	0-5	35-65		95-100	97-100	

*For fineness modulus less than 4.00 but greater than 3.75, provide additional materials as a penalty at a rate of 1.5% for each 0.05 less than 4.00 fineness modulus. Use a maximum lot size of 500 cubic yards or tons to determine penalty. Average all tests within the lot to determine penalty.

(2) Deleterious Substances. Do not exceed the following percentages of deleterious substances by weight:

- Clay lumps and friable particles (KT-7) 2.0
- Sticks (wet) (KT-38) 2.0

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1111.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1111**.

1111.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1111.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

1112 - AGGREGATES FOR SURFACING OR SUBGRADE MODIFICATION FOR COUNTY SECONDARY ROADS

SECTION 1112

AGGREGATES FOR SURFACING OR SUBGRADE MODIFICATION FOR COUNTY SECONDARY ROADS

1112.1 DESCRIPTION

This specification covers types of aggregates used for surfacing or subgrade modification for county secondary roads as shown in the Contract Documents.

1112.2 REQUIREMENTS

a. Composition. Provide one of the types of aggregate for surfacing or subgrade modification for secondary roads as shown in **TABLE 1112-1 and 1112-2**.

b. Quality[1].

- Soundness[2], minimum (KTMR-21) 0.85
- Wear[3], maximum (AASHTO T 96) 55%

[1]Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.

[2]The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.

[3]The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.

c. Product Control.

(1) Size Requirements. Provide aggregate that complies with **TABLE 1112-1**. Determine the gradation factor in accordance with the procedures listed in Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor).

TABLE 1112-1: GRADATION REQUIREMENTS

Type	Material	Percent retained On standard square mesh sieves*									Gradation Factor
		2”	1 ½”	1”	¾”	3/8”	No. 4	No. 8	No. 30	No. 200	
SS-3	Crushed Stone		0	0-15		45-85			90-100	92-100	
SS-5	Crushed Stone	0	0-5	0-30		45-90			90-100	92-100	
SS-7	Sand-gravel			0	0-5	0-20				97-100	4.00 - 5.00**
SS-8	Sand-gravel			0	0-5	0-30				92-100	3.75+
SS-9	Sand-gravel			0		0-20				90-100	3.50+
SS-10	Sand-gravel	0	0-5			0-30				90-100	3.25+
SS-14	Limestone gravel		0							93-100	

*After removal of all deleterious substances

**For grading factors less than 4.00 but greater than 3.75, provide additional materials as a penalty at a rate of 1.5% for each 0.05 less than 4.00 grading factors. Use a maximum lot size of 500 cubic yards or tons to determine penalty. Average all tests within the lot to determine penalty.

(2) Deleterious Substances. Do not exceed the values for each respective type as shown in **TABLE 1112-2**.

TABLE 1112-2: DELETERIOUS SUBSTANCES				
Type	**Material**	**Sticks (wet)**	**Clay Lumps & Friable Particles**	**Combination[1]**
SS-3	Crushed Stone	2.0	5.0	5.0
SS-5	Crushed Stone	2.0	5.0	5.0
SS-7	Sand-gravel	2.0	5.0	5.0
SS-8	Sand-gravel	2.0	4.0	
SS-9	Sand-gravel	2.0	3.0	
SS-10	Sand-gravel	2.0	3.0	
SS-14	Limestone gravel			

[1]Of any deleterious substances.

d. Stockpiling.

Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1112.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115.**

1112.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1112.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

SECTION 1113

AGGREGATES FOR SHOULDER CONSTRUCTION

1113.1 DESCRIPTION

This specification covers types of aggregates for shoulder construction.

1113.2 REQUIREMENTS

a. Composition.

(1) Type AS-1 is a mixture of aggregate and binder with at least 85% the material produced by the mechanical crushing of limestone, dolomite or sandstone.

b. Quality[1].

- Soundness[2], minimum (KTMR-21) 0.85
- Wear[3], maximum (AASHTO T 96) 50%
- Specific Gravity[4] (dry), minimum (KT-6 Procedure I) 2.20

[1]Crushed aggregates with less than 10% material retained on the No. 4 sieve (excluding mineral filler supplements) must be produced from a source complying with the official quality requirements of this Section prior to crushing.
[2]The above requirements for soundness do not apply for aggregates having less than 10% material retained on the No. 4 sieve.
[3]The above requirements for wear do not apply to aggregates having less than 10% material retained on the No. 8 sieve.
[4]Apply the specific gravity requirement to individual materials and to any combination of materials required to meet the grading and plasticity requirements.

c. Product Control.

(1) Gradation and Plasticity. Provide aggregate that complies with **TABLE 1113-1**.

TABLE 1113-1: GRADING AND PLASTICITY REQUIREMENTS FOR AGGREGATES FOR SHOULDER CONSTRUCTION

Type	Percent Retained - Square Mesh Sieves								P.I.	L.L.[3] (Max)	Ratio[4] (Max)
	2"	1½"	¾"	3/8"	No. 4	No. 8	No. 40	No. 200			
AS-1	0	0-5	5-30		35-60	45-70	60-84	80-92	1-8[1] 4-8[2]	30	3/4

[1]Crushed Limestone or Dolomite
[2]Crushed Sandstone
[3]Liquid Limit
[4]Ratio of percent passing the No. 200 sieve to the percent passing the No. 40 sieve.

(2) Deleterious Substances. Provide aggregates for shoulder construction that are free from grass, weeds, roots, sticks, and other undesirable foreign matter.

d. Stockpiling. Stockpile and handle aggregates in such a manner to prevent detrimental degradation and segregation, the incorporation of appreciable amounts of foreign material, and the intermingling of stockpiled materials.

1113.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115**.

1113.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1113.5 BASIS OF ACCEPTANCE

Aggregates covered by this subsection are accepted based on the procedures described in **subsection 1101.5**.

SECTION 1114

STONE FOR RIPRAP, DITCH LINING AND OTHER MISCELLANEOUS USES

1114.1 DESCRIPTION

This specification covers stone for the following uses:

- Riprap
- Aggregate Ditch Lining (D_{50})
- Filter Course
- Flumes, Flume Drains and Slope Drains
- Tree Wells or Cribs
- Shot Rock
- Granular Drainage Blanket
- Sediment Basin Risers

Where referred to, quarried stone is defined as limestone, dolomite, calcite cemented sandstone, rhyolite, quartzite, basalt and granite, removed from naturally occurring formation by standard extraction and sizing methods.

Recycled PCCP may be used for Riprap, Ditch Lining, and Shot Rock, provided the respective Soundness and Wear requirements are met.

1114.2 REQUIREMENTS

a. Stone for Riprap.

(1) Composition. Provide quarried stone for riprap that meets the installation class specified in the Contract Documents.

(2) Quality.

- Soundness, minimum (KTMR-21).. 0.85
- Wear, maximum (AASHTO T 96) 45%
- Inspection of the quarry ledge, stock piles, and available sites where comparable stone from the same bed(s) is in service to verify the Product Control requirements have been met.

(3) Product Control.

- Provide stone for riprap that is free of soil, shale or shale-like material and cracks, seams or other defects that will decrease the durability of the material after placement.
- Provide riprap from sources that have been inspected and approved by the KDOT Geologist.
- A riprap source may be rejected if more than 15% of the product from the source deteriorates within 5 years of exposure, either in service or in a natural weathering test plot (such as a boulder pile at the quarry). Deterioration is defined as any one piece losing more than 25% of its original volume either due to damage during handling and placement or due to cracking or splitting as a result of weak seams in the rock. Determination is made by visual inspection.
- Size. The class requirements are given in **TABLE 1114-1**.

TABLE 1114-1: STONE FOR RIPRAP*											
Class	**Percent Heavier Than**										
	8 ton	**4 ton**	**2 ton**	**1 ton**	**½ ton**	**¼ ton**	**250 lbs**	**200 lbs**	**100 lbs**	**75 lbs**	**5 lbs**
Heavy Series											
8 Ton	50+	95+									
4 Ton	0	50+	95+								
2 Ton		0	50+	95+							
1 Ton			0	50+	95+						
½ Ton				0	50+	95+					
¼ Ton					0	50+				90+	
Light Series											
Facing								0		50+	90+
Light 24”				0				50+			90+
Light 18”					0				50+		90+

*Percent of total sample weight composed of pieces heavier than the indicated weight

b. Stone for Aggregate Ditch Lining (D_{50}).

(1) Composition. Provide crushed or uncrushed gravel or quarried stone meeting the size of ditch lining aggregate specified in the Contract Documents.

(2) Quality

- Soundness, minimum (KTMR-21).. 0.85
- Wear, maximum (AASHTO T 96).. 45%
- Inspection of the quarry ledge, stock piles, and available sites where comparable stone from the same beds is in service to verify the Product Control requirements have been met.

(3) Production Control.

- Provide stone for ditch lining that is free of soil, chert, shale or shale-like material and cracks, seams, or other defects that will decrease the durability of the material after placement. No more than 10% of individual rocks shall have their least dimension less than 1/3 of their greatest dimension.
- Provide ditch lining from sources that have been inspected and approved by the KDOT Geologist.
- A ditch lining source may be rejected if more than 15% of the product from the source deteriorates within 5 years of exposure, either in service or in a natural weathering test plot (such as a boulder pile at the quarry). Deterioration is defined as any one piece losing more than 25% of its original volume either due to damage during handling and placement or due to cracking or splitting as a result of weak seams in the rock. Determination is made by visual inspection.
- Size. Provide stone for ditch lining that complies with **TABLE 1114-2.**

TABLE 1114-2: STONE FOR AGGREGATE DITCH LINING (D_{50})												
Size D_{50}	**Max. Size**	**Percent Retained on Sieve Size (Minimum)**										
Inch	**Inch**	**8”**	**6 ½”**	**6”**	**5”**	**4”**	**3”**	**2 ½”**	**2”**	**1 ½”**	**1”**	**½”**
1	2										50	85
2	4							15*	50		85	
3	6					15*	50			85		
4	8				15*	50			85			
5	10		15*		50			85				
6	12	15*		50			85					

*Suggested

c. Stone for Filter Course.

(1) Composition. Provide crushed or uncrushed gravel or quarried stone for filter course that meets the installation type specified in the Contract Documents.

(2) Quality.
- Soundness, minimum (KTMR-21) 0.85
- Wear, maximum (AASHTO T 96) 45%

(3) Product Control.
- Size. Provide stone for filter course material that complies with **TABLE 1114-3**.

TABLE 1114-3: STONE FOR FILTER COURSE									
Material	**Percent Retained on Sieve Size**								
	6”	**5”**	**4”**	**3”**	**2”**	**1”**	**½”**	**3/8”**	**No. 4**
Type I		0	0-5		10-40	25-60		55-85	70-95
Type II			0	0-5			50-90		
Type III	0	5-25			40-60			75-95	

d. Stone for Flumes, Flume Drains and Slope Drains.
(1) Composition. Provide aggregate that is crushed or uncrushed gravel or quarried stone.

(2) Quality.
- Soundness, minimum (KTMR-21) 0.85
- Wear, maximum (AASHTO T 96) 45%

(3) Product Control.
- Deleterious Substances. Provide stone that is free from soapstone, shale, shalelike or other easily disintegrated material.
- Size. Provide stone for flumes, flume drains and slope drains as shown in the Contract Documents or as required by the Engineer.

e. Stone for Tree Wells or Cribs. Stone may be set aside during excavation on the project or obtained from nearby deposits. If stone is not available, use salvaged, durable concrete blocks from old structures or other materials approved by the Engineer.

f. Stone for Shot Rock.
(1) Composition. Provide stone resulting from drilling and blasting or other various methods of excavation. Shot rock may be subsequently sized using heavy equipment or other suitable methods.

(2) Quality.
- Soundness, minimum (KTMR-21) 0.85
- Wear, maximum (AASHTO T 96) 45%

(3) Product Control.
- Deleterious Substances. Provide stone for shot rock that is free from injurious quantities of clay and soapstone.
- Size. Shot rock shall be quarry run with no more than 10 percent larger than10 feet in circumference measured in any direction and not more than 10 percent passing the 1 inch sieve as determined by visual inspection. The maximum size of the shot rock will be limited by the thickness of the rock to be placed, as shown on the Contract Documents.

g. Granular Drainage Blanket
(1) Composition. Provide aggregate that is crushed or uncrushed gravel or quarried stone.

(2) Quality
- Soundness, minimum (KTMR-21)... 0.85
- Wear, maximum (AASHTO T 96).. 45%

(3) Product Control.

- Deleterious Substances. Stone for these types of construction shall be free from soapstone, shale, shale-like or other easily disintegrated material.
- Size Requirements. Provide aggregate for granular drainage blankets that complies with **TABLE 1114-4**.

TABLE 1114-4: AGGREGATE FOR GRANULAR DRAINAGE BLANKETS	
Percent Retained – Square Mesh Sieves	
4 in	**No. 8**
0	95-100

h. Sediment Basin Risers

(1) Composition. Provide aggregate that is crushed or uncrushed gravel or quarried stone.

(2) Quality

- Soundness, minimum (KTMR-21).. 0.85
- Wear, maximum (AASHTO T 96).. 45%

(3) Product Control.

- Deleterious Substances. Stone for these types of construction shall be free from soapstone, shale, shale-like or other easily disintegrated material.
- Size Requirements. Provide stone for sediment basin risers that complies with **TABLE 1114-5**:

TABLE 1114-5: SEDIMENT BASIN RISERS	
Percent Retained	
5 in	**2 in**
0	90

1114.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115**.

1114.4 PREQUALIFICATION

Prequalify aggregate sources according to **subsection 1101.4**.

1114.5 BASIS OF ACCEPTANCE

a. Aggregates covered by this subsection, except stone for tree wells and cribs, are accepted based on the procedures described in **subsection 1101.5**.

b. Stone for tree wells or cribs are acceptable based on visual inspection by the Engineer.

SECTION 1115

TEST METHODS FOR DIVISION 1100, AGGREGATES

1115.1 GENERAL TEST METHODS

KT tests are general procedures performed in the field and the central laboratory. They are included in Part V. Copies can be obtained by contacting the Plans and Proposals Section in the Bureau of Construction and Materials, the local DME, or the Quality Assurance Section at the Materials and Research Center. Check the special provision regarding test methods to ascertain the date of the latest revision.

TITLE	TEST METHOD
Sampling Aggregates	KT-1
Sieve Analysis of Aggregates	KT-2
Material Passing No. 200 Sieve by the Wash Method	KT-3
Percent Retained on the No. 200 Sieve by Dry Screening	KT-4
Unit Weight of Aggregate	KT-5
Specific Gravity and Absorption of Aggregate	KT-6
Clay Lumps and Friable Particles in Aggregate	KT-7
Shale or “Shalelike” Materials in Aggregate	KT-8
Plasticity Test	KT-10
Moisture Test	KT-11
Determination of Free Moisture or Absorption of Aggregate For Use in Concrete	KT-24
Determination of Percentage of Crushed Particles in Crushed Gravel	KT-31
Sieve Analysis of Extracted Aggregate	KT-34
Sticks in Aggregate	KT-35
Making, Curing and Testing Cement Treated and Unbound Bases In the Laboratory	KT-37
Moisture Contents of Asphalt Mixtures of Mineral Aggregates -Microwave Oven Method	KT-43
Uncompacted Void Content of Fine Aggregate	KT-50
Plastic Fines in Combined Aggregates by Use of the Sand Equivalent Test	KT-55
Flat and Elongated Particles in Coarse Material Test	KT-59

1115.2 MATERIALS AND RESEARCH CENTER TEST METHODS

KTMR tests are procedures found at the Materials and Research Center and are not expected to be performed in the field. Copies can be obtained by contacting the Quality Assurance Section in the Materials and Research Center.

TITLE	MR TEST METHOD
Permeability for Base Course Material	KTMR-5
Soundness and Modified Soundness of Aggregates by Freezing and Thawing	KTMR-21
Durable Aggregate Test	KTMR-22
Wetting and Drying Test of Sand-Gravel Aggregate for Concrete	KTMR-23
Procedures for Testing Lightweight Aggregates	KTMR-24
Test Method for Compressive Strength of Hydraulic Cement Mortars Using 2 inch Cube Specimens	KTMR-26
Modified Specific Gravity and Absorption of Aggregate	KTMR-27
Determination of Total Acid Insoluble Residue	KTMR-28

1115.3 AASHTO TEST METHODS

In addition to the test methods referenced above, the following American Association of State Highway and Transportation Officials (AASHTO) test methods are used as written in the current edition of the AASHTO Materials Manual, Part II. Copies can be obtained from AASHTO, or can be viewed at the offices of the local DME, Construction and Materials Headquarters, or the Quality Assurance Section in the Materials and Research Center.

TITLE	AASHTO TEST METHOD
Organic Impurities in Fine Aggregates for Concrete	AASHTO T 21
Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine	AASHTO T 96
Lightweight Pieces in Aggregate	AASHTO T 113

SECTION 1116

AGGREGATES FOR ON GRADE CONCRETE

1116.1 DESCRIPTION

This specification is for coarse aggregates, intermediate aggregates, fine aggregates, mixed aggregates (coarse, intermediate and fine material) and miscellaneous aggregates for use in construction of concrete placed on grade.

For Intermediate Aggregates and Mixed Aggregates, consider any aggregate with 30% or more retained on the No. 8 sieve to be Coarse Aggregate.

1116.2 REQUIREMENTS

a. Quality of Individual Aggregates.

(1) Provide aggregate for concrete that complies with the following requirements. Crushed aggregates with less than 20% material retained on the 3/8" sieve from a source complying with these requirements prior to crushing. Fine Aggregates for Concrete have additional Quality Requirements stated in s**ubsection 1116.2e.(2).**

Soundness by Freeze/Thaw (min.) (KTMR-21)*.. 0.90
Wear Grading B (max.)(AASHTO T 96)**.. 50%
Additional Requirements:***
Modified Soundness by Freeze/Thaw (min.) (KTMR-21)... 0.90
Relative Dynamic Modulus of Elasticity, minimum (KTMR-22 @ 660 F/T cycles) ... 95
Expansion, maximum (KTMR-22 @ 660 F/T cycles).. 0.025%
* Soundness (KTMR-21) requirements do not apply to aggregates having less than 10% material retained on the No. 4 sieve.
** Wear (AASHTO T 96) requirements do not apply to aggregates having less than 10% retained on the No. 8 sieve.
***The additional requirements do not apply for uncrushed sand-gravel aggregates having less than 5% material retained on the ½" sieve.

(2) All predominately siliceous aggregate must comply with the Wetting & Drying Test requirements, or be used with a Coarse Aggregate Sweetener, or will require Supplemental Cementitious Materials (SCM) to prevent Alkali Silica Reactions (ASR). When an SCM is utilized, provide the results of mortar expansion tests of ASTM C 1567 using the project's mix design concrete materials at their designated percentages. Provide a mix with a maximum expansion of 0.10% at 16 days after casting. Provide the results to the Engineer at least 15 days before placement of concrete on the project.

Wetting & Drying Test of Siliceous Aggregate for Concrete (KTMR-23)
Concrete Modulus of Rupture:

- At 60 days, minimum...550 psi
- At 365 days, minimum...550 psi

Expansion:

- At 180 days, maximum 0.050%
- At 365 days, maximum 0.070%

Aggregates produced from the following general areas are exempt from the Wetting and Drying Test:

- Blue River Drainage Area.
- The Arkansas River from Sterling, west to the Colorado state line.
- The Neosho River from Emporia to the Oklahoma state line.

(3) Coarse Aggregate Sweetener. Types and proportions of aggregate sweeteners to be used with Mixed Aggregates are listed in **TABLE 1116-1**.

TABLE 1116-1: COARSE AGGREGATE SWEETENER	
Type of Coarse Aggregate Sweetener	**Proportion Required by Percent Weight**
Crushed Sandstone*	40 (minimum)
Crushed Limestone or Dolomite*	40 (minimum)
Siliceous Aggregates meeting **subsection 1116.2a.(2)**	40 (minimum)
Siliceous Aggregates not meeting **subsection 1116.2a.(2)** **	30 (maximum)

*Waive the minimum portion of Coarse Aggregate Sweetener for all intermediate and fine aggregates that comply with the wetting and drying requirements for Siliceous Aggregates. In this case, combine the intermediate, fine and coarse aggregate sweetener in proportions required to comply with **subsection 1116.2a.(2)**

**To be used only with intermediate and fine aggregates that comply with the wetting and drying requirements of Siliceous Aggregates unless a Supplemental Cementitious Material is utilized.

b. Mixed Aggregates

(1) Composition. Provide coarse, intermediate, and fine aggregates in a combination necessary to meet **subsection 1116.2b.(2).** Use a proven optimization method such as ACI 302.1 or other method approved by the Engineer. Aggregates may be from a single source or combination of sources.

(2) Product Control.

(c) Gradations such as those shown in **TABLE 1116-2** have proven satisfactory in reducing water demand while providing good workability. Adjust mixture proportions whenever individual aggregate grading varies during the course of the work. Use the gradations shown in **TABLE 1116-2**, or other gradation approved by the Engineer.

Optimization is not required for concrete for patching pavements more than 10 years old, or Commercial Grade Concrete. The Engineer may waive the optimization requirements if the concrete meets all the requirements of **DIVISION 400** and/or **DIVISION 500**.

Follow these guidelines:

1. Do not permit the percent retained on two adjacent sieve sizes to fall below 4%;

2. Do not allow the percent retained on three adjacent sieve sizes to fall below 8%; and

3. When the percent retained on each of two adjacent sieve sizes is less than 8%, the total percent retained on either of these sieves and the adjacent outside sieve should be at least 13%.

(for example, if both the No. 4 and No. 8 sieves have 6% retained on each, then:
1) the total retained on the 3/8 in. and No. 4 sieves should be at least 13%, and
2) the total retained on the No. 8 and No. 16 sieves should be at least 13%.)

TABLE 1116-2: ALLOWABLE GRADING FOR MIXED AGGREGATES FOR CONCRETE													
Type	**Usage**	**Percent Retained - Square Mesh Sieves**											
		1 ½"	**1"**	**¾"**	**½"**	**⅜"**	**No. 4**	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 100**	**No. 200**
MA-3	Optimized All Concrete		0	2-12	Note[1]	Note[1]	Note[1]	Note[1]	Note[2]	Note[2]	Note[2]	95-100	98-100
MA-4	Optimized All Concrete[3]	0	2-12	Note[1]	Note[1]	Note[1]	Note[1]	Note[1]	Note[2]	Note[2]	Note[2]	95-100	98-100
MA-5	Optimized All Concrete		0	2-12	8 min	22-34		55-65		75 min		95-100	98-100
MA-7	Contractor Design KDOT Approved	Proposed Grading that does not correspond to other limits in this table but meet the requirements for concrete in **DIVISION 400 and/or DIVISION 500**.											98-100

[1] Retain a maximum of 22% and a minimum of 6% of the material on each individual sieve.
[2] Retain a maximum of 15% and a minimum of 6% of the material on each individual sieve.
[3] Maximum top size of Limestone is ¾".

(d) Optimization Requirements for all Gradations.

- Actual Workability must be within ± 5 of Target Workability.

Where: W_A = Actual Workability

W_T = Target Workability
CF = Coarseness Factor

1. Determine the Grading according to KT-2
2. Calculate the Coarseness Factor (CF) to the nearest whole number.

$$CF = \frac{+3/8\text{” Material \% Retained}}{+\#8 \text{ Material \% Retained}} \text{x}100$$

3. Calculate the Actual Workability (W_A) to the nearest whole number as the percent material passing the #8 sieve.

$$W_A = 100 – \% \text{ retained on \#8 sieve}$$

4. Calculate the Target Workability (W_T) to the nearest whole number where
   For 517 lbs cement per cubic yard of concrete

$$W_T = 46.14 – (CF/6)$$

   For each additional 1 lb of cement per cubic yard, subtract 2.5/94 lbs from the Target Workability.

(c) Deleterious Substances. Maximum allowed deleterious substances by weight are:

- Clay lumps and friable particles (KT-7) 1.0%
- Coal (AASHTO T 113)... 0.5%
- Shale or Shale-like material (KT-8).. 0.5%
- Sticks (wet) (KT-35) 0.1%
- Sum of all deleterious 1.5%

(d) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) for each aggregate according to the procedure listed in Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor) of Part V before delivery, or from the first 10 samples tested and accepted. Provide aggregate that is within ±0.20 of the average fineness modulus.

Provide a single point grading for the combined aggregates along with a plus/minus tolerance for each sieve. Use plus/minus tolerances to perform quality control checks and by the Engineer to perform aggregate grading verification testing. The tests may be performed on the combined materials or on individual aggregates, and then theoretically combined to determine compliance.

Maintain an Actual Workability within ± 5 of the Target Workability for combined aggregates.

(3) Handling of All Aggregates.

(a) Segregation. Before acceptance testing, remix all aggregate segregated by transit or stockpiling.

(b) Stockpiling.

- Maintain separation between aggregates from different sources, with different gradings or with a significantly different specific gravity.
- Transport aggregate in a manner that promotes uniform grading.
- Do not use aggregates that have become mixed with earth or foreign material.
- Stockpile or bin all washed aggregate produced or handled by hydraulic methods for 12 hours (minimum) before batching. Rail shipment exceeding 12 hours is acceptable for binning provided the car bodies permit free drainage.
- Provide additional stockpiling or binning in cases of high or non-uniform moisture.

c. Coarse Aggregates for Concrete.

(1) Composition. Provide coarse aggregate that is crushed gravel or crushed stone meeting the quality requirements of **subsection 1116.2a**. Consider limestone, calcite cemented sandstone, rhyolite, quartzite, basalt and granite as crushed stone.

Mixtures utilizing siliceous aggregate not meeting **subsection 1116.2a.(2)** will require supplemental cementitious materials to prevent Alkali Silica Reactions. Provide the results of mortar expansion tests of ASTM C 1567 using the project's mix design concrete materials at their designated percentages. Provide a mix with a maximum expansion of 0.10% at 16 days after casting. Provide the results to the Engineer at least 15 days before placement of concrete on the project.

(2) Product Control. Use gradations such as those in **TABLE 1116-3** which have been shown to work in Optimized Mixed Aggregates, or some other gradation approved by the Engineer that will provide a combined aggregate gradation meeting **subsection 1116.2b.**

TABLE 1116-3: GRADING REQUIREMENTS FOR COARSE AGGREGATES

Type	Composition	Percent Retained - Square Mesh Sieves							
		1 ½″	1″	¾″	½″	3/8″	No. 4	No. 8	No. 30
CPA-1	Crushed Gravel or Crushed Stone	0	0-10	14-35	-	50-75	-	95-100	-
CPA-3	Crushed Gravel or Crushed Stone	-	-	0	0-35	30-70	75-100	95-100	-
CPA-4	Crushed Gravel or Crushed Stone	-	0	0-20	-	-	-	95-100	-

d**. Intermediate Aggregate for Concrete.**

(1) Composition. Provide intermediate aggregate for mixed aggregates (IMA) that is crushed stone, natural occurring sand, or manufactured sand meeting the quality requirements of **subsection 1116.2a.**

(2) Product Control. Provide IMA grading when necessary to provide a combined aggregate gradation meeting **subsection 1116.2b.**

e. Fine Aggregates for Concrete.

(1) Composition.

(a) Type FA-A. Provide either singly or in combination natural occurring sand resulting from the disintegration of siliceous or calcareous rock, or manufactured sand produced by crushing predominately siliceous materials meeting the quality requirements of **subsection 1116.2a.** and **subsection 1116.2e.(2)**.

(2) Additional Quality Requirements.

(a) Mortar strength and Organic Impurities. If the DME determines it is necessary, because of unknown characteristics of new sources or changes in existing sources, provide fine aggregates that comply with the following:

- Mortar Strength (KTMR-26). Compressive strength when combined with Type III (high early strength) cement:
  - At age 24 hours, minimum 100%*
  - At age 72 hours, minimum 100%*

  *Compared to strengths of specimens of the same proportions, consistency, cement and standard 20-30 Ottawa sand.
- Organic Impurities (AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.

(3) Product Control.

(a) Size Requirements. Provide FA-A that comply with **TABLE 1116-5** or some other gradation approved by the Engineer that will provide a combined aggregate gradation meeting **subsection 1116.2b**.

TABLE 1116-4: GRADING REQUIREMENTS FOR FINE AGGREGATES FOR CONCRETE								
Type	**Percent Retained-Square Mesh Sieves**							
	⅜"	**No. 4**	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 100**	**No. 200**
FA-A	0	0-10	0-27	15-55	40-77	70-93	90-100	98-100

(b) Deleterious Substances.

- Type FA-A: Maximum allowed deleterious substances by weight are:
  - Coal (AASHTO T113)..0.5%
  - Sticks (wet) (KT-35)...0.1%
  - Sum of all deleterious 0.5%

f. Miscellaneous Aggregates for Concrete.

(1) Aggregates for Mortar Sand, Type FA-M.

(a) Composition. Provide aggregates for mortar sand, Type FA-M that is natural occurring sand.

(b) Quality.

- Mortar strength and Organic Impurities. If the DME determines it is necessary, because of unknown characteristics of new sources or changes in existing sources, provide aggregates for mortar sand, Type FA-M that comply with the following:
  - Mortar Strength (KTMR-26). Compressive strength when combined with Type III (high early strength) cement:
    - At age 24 hours, minimum 100%*
    - At age 72 hours, minimum 100%*

    * Compared to strengths of specimens of the same proportions, consistency, cement and standard 20-30 Ottawa sand.
  - Organic Impurities (AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.

(c) Product Control.

- Size Requirements. Provide aggregates for mortar sand, Type FA-M that comply with **TABLE 1116-5**.

TABLE 1116-5: GRADING REQUIREMENTS FOR MORTAR SAND								
Type	**Percent Retained - Square Mesh Sieves**							
	No. 4	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 100**	**No. 200**	**Gradation Factor**
FA-M	0	0-2	0-30	20-50	50-75	90-100	98-100	1.70-2.50

- Deleterious Substances. Maximum allowed deleterious substances by weight are:
  - Clay lumps and friable material (KT-7)...................................1.0%
  - Coal (AASHTO T 113)..0.5%
  - Sticks (wet) (KT-35)..0.1%
  - Sum of all deleterious 1.5%

(2) Modified Lightweight Aggregates.

(a) Composition. Provide a modified lightweight aggregate produced from a uniform deposit of raw material combined with FA-A that meets **subsection 1102.2c**.

(b) Quality.
- Soundness, minimum (KTMR-21) 0.90
- Loss on Ignition 5%

(c) Product Control.
- Size Requirements. Provide modified lightweight aggregates that comply with **TABLE 1116-6**.

TABLE 1116-6: GRADING REQUIREMENTS FOR MODIFIED LIGHTWEIGHT AGGREGATES						
Type	**Percent Retained - Square Mesh Sieves**					
	¾"	**½"**	**⅜"**	**No. 4**	**No. 8**	**No. 16**
Grade 1	0	0-10	30-60	85-100	95-100	
Grade 2		0-2	0-30	20-50	50-75	90-100

- Deleterious Substances.
  - Organic Impurities (AASHTO T 21). The color of the supernatant liquid is equal to or lighter than the reference standard solution.
- Unit Weight (dry, loose weight) (max.) .... 1890 lbs/cu yd

(d) Concrete Making Properties. Drying shrinkage of concrete specimens prepared with modified lightweight aggregate and FA-A proportioned as shown in the Contract Documents can not exceed 0.07%.
(e) Uniformity of Supply. Designate or determine the fineness modulus (grading factor) according to procedure listed in Part V, Section 5.10.5-Fineness Modulus of Aggregates (Gradation Factor) before delivery, or from the first 10 samples tested and accepted. Provide aggregate that is within ±0.20 of the average fineness modulus.
(f) Proportioning Materials. Submit mix designs for concrete using modified lightweight aggregate to Construction and Materials for approval prior to use.
(g) Stockpiling
- Stockpile accepted aggregates in layers 3 to 5 feet thick. Berm each layer so that aggregates do not "cone" down into lower layers.
- Keep aggregates from different sources, with different gradings or with a significantly different specific gravity separated.
- Transport aggregate in a manner that promotes uniform gradation.
- Do not use aggregates that have become mixed with earth or foreign material.
- Stockpile or bin all washed aggregate produced or handled by hydraulic methods for 12 hours (minimum) before batching. Rail shipment exceeding 12 hours is acceptable for binning, provided the car bodies permit free drainage.
- Provide additional stockpiling or binning in cases of high or non-uniform moisture.

1116.3 TEST METHODS

Test aggregates according to the applicable provisions of **SECTION 1115**.

1116.4 PREQUALIFICATION

Aggregates for concrete must be prequalified according to **subsection 1101.4**.

1116.5 BASIS OF ACCEPTANCE

The Engineer will accept aggregates for concrete based on the prequalification required by this specification and **subsection 1101.5**.

SECTION 1201

GENERAL REQUIREMENTS FOR DIVISION 1200 – ASPHALT MATERIALS

1201.1 DESCRIPTION

This specification covers general requirements for asphalt materials specified in **DIVISION 1200**.

1201.2 REQUIREMENTS

a. Storage and Heating. Provide storage tanks, pipelines and loading facilities for asphalt materials that are equipped with adequate heating equipment that will not damage the material.

b. Shipping Facilities. Provide shipping containers that are equipped with appropriate hoses and pumps, are insulated and are equipped for heating the contents when requested by the KDOT. Do not heat asphalt materials in transit by open flame heaters on tank trucks.

Before loading, examine the shipping container and remove all remnants of previous cargoes that might contaminate the material to be loaded.

For each shipment to KDOT projects, maintain a loading log showing the following items: contract or project number, date, time, ticket number, shipping container number, contractor, grade and quantity. Mail a copy of the log to the Engineer of Tests monthly during the shipping season.

c. Weighing Equipment. For quantities measured by weight, provide a scale having a platform of adequate length to weigh the longest truck or truck-trailer combination in one operation. Calibrate the scales through the range of use by an approved scale company as often as necessary to verify their accuracy, with intervals not greater than six months. For manufacturers not operating through the winter, calibrate the scales before the production season and thereafter at intervals not greater than 6 months for the duration of the production season. Provide a copy of the calibration report to the Engineer of Tests.

d. Sampling and Inspection.

(1) General. The Engineer will perform the sampling of asphalt materials. Permit inspection of all tanks, tank cars, tank trucks, blending units, loading lines and other items relating to the production and loading of asphalt materials being shipped to KDOT work.

(2) Tests by Producer. Provide a testing laboratory with laboratory and sampling equipment complying with the appropriate AASHTO or ASTM specifications to be available to all production and terminal facilities servicing KDOT projects. The laboratory must be staffed with competent personnel who can conduct tests to verify all asphalt material intended for shipment to KDOT projects complies with the specifications before it is shipped. Perform testing necessary to maintain continuous quality control.

The minimum quality control testing and reporting requirements for each product that is shipped to KDOT projects is described in the following sections.

e. Performance Graded Asphalt Binder (PGAB).

(1) Definition of testing levels.

Complete AASHTO Specification Compliance (SC) test for PGAB:

- Original Binder:
  - Flash Point (COC)
  - Brookfield Viscosity, 275°F
  - Dynamic Shear
  - Separation Test, 325°F, 48 hours (Polymer modified only)
- Rolling Thin Film Oven Residue:
  - Mass Loss
  - Dynamic Shear
  - Elastic Recovery, 77°F (Polymer modified only)
- Pressure Aging Vessel Residue:
  - Dynamic Shear
  - Creep Stiffness, S, 60s

Slope, m
Quality Control (QC) Tests for PGAB:
DSR on Original Binder
DSR after RTFO
Any other short-term test(s) the producer has found to provide useful information for quality control of the product.

(2) When shipping from Refineries and Blending Facilities, use the following guidelines:

(a) For a tank which is filled before beginning shipping, and then emptied before more material is added, perform 1 complete AASHTO SC test per tank when filled, and weekly QC tests.

(b) For a tank being continually filled while continuous shipping is made from the tank, perform 1 complete AASHTO SC test per week, and daily QC tests

(c) When blending directly into a tanker, sample every third truck for QC tests, and perform 1 complete AASHTO SC test per week.

(d) Under any of the operations described above, if the results of any of the QC tests indicate the product may be out of specification, stop shipment from that source immediately. Perform a complete AASHTO SC test to ascertain the product status and re-certify the source.

(3) When shipping from Terminals, use the following guidelines:

(a) For operations where a tank is filled before beginning shipping, and then emptied before more material is added, perform a complete AASHTO SC test at the refinery on the material being shipped. When the shipment arrives at the terminal, run the QC tests to verify the material as it is being unloaded. After that, perform the QC tests weekly until the tank is emptied.

(b) For operations where a tank is being continually filled while continuous shipping is being made from the tank, perform a complete AASHTO SC test at the refinery on the material being shipped. When the shipment arrives at the terminal, run the QC tests to verify the material as it is being unloaded. Perform the QC tests on the contents in the tank weekly. Perform a complete AASHTO SC test on the contents in the tank once per month.

(c) Under any of the operations described above, if the results of any of the QC tests indicate the product may be out of specification, stop shipment from that source immediately. Perform a complete AASHTO SC test to ascertain the product status and re-certify the source.

f. Emulsions and Asphalt Rejuvenating Agents.

(1) Perform 1 complete AASHTO test each time a batch of material is produced. A tank must be tested each time new material is added to it.

(2) A complete AASHTO test for Emulsions is defined as follows:
Saybolt Furol Viscosity, 77°F or 122°F
Residue by Distillation
Oil Distillate-**WHEN REQUIRED**
Storage Stability, 1 day-**WHEN REQUIRED**
Sieve Test
Demulsibility-**WHEN REQUIRED**
Tests on Distillation Residue:
Penetration, 77°F
Solubility-**WHEN REQUIRED**
Ductility, 39°F or 77°F-**WHEN REQUIRED**
Elastic Recovery - **EMULSIONS with a "P" DESIGNATION**

(3) A complete AASHTO test for asphalt rejuvenating agents is defined as follows:
Viscosity, Saybolt-Furol, 77°F
Residue by Distillation
Oil Distillate
Sieve Test
Storage Stability
Tests on Residue:
Penetration @39°F, 50g, 5 sec.
Asphaltenes
Elastic Recovery

g. Cutbacks.

(1) For a tank being filled and emptied before more material is added, perform 1 complete AASHTO test per tank, and weekly tests for 140°F viscosity.

(2) For a tank being continually filled while continuous shipping is made from the tank, perform 1 complete AASHTO test per week, and daily tests for 140°F viscosity.

(3) When blending directly into a tanker, sample every third truck for 140°F viscosity, and perform 1 complete AASHTO test per week.

(4) A complete AASHTO test for cutback asphalt is defined as follows:

Kinematic Viscosity, 140°F
Flash Point, TOC
Distillation Test:
Distillates
Residue
Tests on Distillation Residue:
Vacuum Viscosity, 140°F and/or Penetration, 77°F
Ductility, 77°F or 60°F

h. Reports. For all types of products discussed above, prepare quarterly summary reports for all quality control and specification compliance testing performed during that period, including any statistical analysis associated with process control. Retain the reports for a minimum of 1 year. Submit them to KDOT if requested.

i. Asphalt Cement (AC).

(1) Definition of testing levels.

Complete AASHTO Specification Compliance (SC) test for AC:
Viscosity, 140°F
Penetration, 77°F
Flash Point, COC
Solubility
Tests on Residue from TFOT
Loss on heating
Viscosity, 140°F
Ductility, 77°F
Quality Control (QC) Tests for AC:
Viscosity @ 140°F
Penetration @ 77°F

(2) When shipping from Refineries and Blending Facilities, use the following guidelines:

(a) For a tank which is filled before beginning shipping, and then emptied before more material is added, perform 1 complete AASHTO SC test per tank when filled, and weekly QC tests.

(b) For a tank being continually filled while continuous shipping is made from the tank, perform 1 complete AASHTO SC test per week, and daily QC tests

(c) When blending directly into a tanker, sample every third truck for QC tests, and perform 1 complete AASHTO SC test per week.

(d) Under any of the operations described above, if the results of any of the QC tests indicate the product may be out of specification, stop shipment from that source immediately. Perform a complete AASHTO SC test to ascertain the product status and re-certify the source.

(3) When shipping from Terminals, use the following guidelines:

(a) For operations where a tank is filled before beginning shipping, and then emptied before more material is added, perform a complete AASHTO SC test at the refinery on the material being shipped. When the shipment arrives at the terminal, run the QC tests to verify the material as it is being unloaded. After that, perform the QC tests weekly until the tank is emptied.

(b) For operations where a tank is being continually filled while continuous shipping is being made from the tank, perform a complete AASHTO SC test at the refinery on the material being shipped. When the shipment arrives at the terminal, run the QC tests to verify the material as it is being unloaded. Perform the QC tests on the contents in the tank weekly. Perform a complete AASHTO SC test on the contents in the tank once per month.

(c) Under any of the operations described above, if the results of any of the QC tests indicate the product may be out of specification, stop shipment from that source immediately. Perform a complete AASHTO SC test to ascertain the product status and re-certify the source.

(4) Asphalt cement containing particulate modifiers may be susceptible to separation of the modifier. Provide appropriate circulation or agitation in storage if separation of the modifier is expected, suspected or if the modified asphalt will be stored at elevated temperature for more than one day before use.

1201.3 TEST METHODS

As described in the specification for each type of asphalt material.

1201.4 PREQUALIFICATION

a. Producers are required to submit qualification samples of any type or grade of material provided under this specification that has not previously been produced by them, or which has not been used on KDOT projects within the last 12 months. PGAB producers will also be required to submit material that complies with **SECTION 1202.** For each material being qualified or re-qualified, submit samples taken from a production batch, along with a copy of the producer's complete AASHTO test results on the same material to the Engineer of Tests. The Engineer will test the sample and compare the results. The producer will be notified of the results in writing.

b. Any change in formulation will require requalification. Changes in base stock or major components may require requalification. Contact the Engineer of Tests' Chief Chemist to determine if requalification is necessary.

c. All producers supplying material to KDOT projects must have a written quality control plan addressing the requirements of this specification. Producers of performance graded asphalt binder must also address any requirements in the latest edition of AASHTO R 26 that are not specifically covered here.

Submit a copy of the written quality control plan to the Bureau of Construction and Materials for review and approval. Quality control plans and the testing information contained therein will be maintained as confidential by KDOT. An approved plan is a required prerequisite to prequalification of any product.

In addition to the requirements specified in AASHTO R 26, include provisions in the QC plan for maintaining the mixing and compaction temperature ranges using the following guidelines:

(1) Unmodified PGAB Suppliers: Record the initial mixing and compaction temperature ranges on the certificate. Once 3 sets of tests for temperature ranges have been accumulated, then maintain a 3-point moving average. Maintain the mixing and compaction temperature ranges constant unless there is a change to any component (example: upper compaction temperature) of the 3-point moving averages by more than 40ºF. If this occurs, then replace all of the old temperature ranges with the 3-point moving average temperature ranges.

Provide a monthly copy of all individual and 3-point moving average temperature ranges to the Chief Chemist at the Materials and Research Center. Provide the Contractor with the most current mixing and compaction temperature ranges as outlined above.

(2) Modified PGAB Suppliers: In additional to the requirements stated in (1) above, include a detailed description of the method used by your laboratory to determine the modified PGAB mixing and compaction temperature ranges in the QC Plan.

d. The Bureau of Construction and Materials will maintain a list of producers that are qualified to supply specific types and grades of materials. Qualified producers will be permitted to supply qualified materials on a certification basis. Monthly loading logs and results of the producer's quality control testing are required to be forwarded to the Engineer of Tests to maintain status on the prequalified list. In addition, suppliers of CRS-1HP and EBL are to submit up to two samples per year to the Engineer of Tests at the Materials and Research Center at the request of the Chief Chemist to maintain status on the prequalified list.

e. An annual split-sample testing program will be conducted for each producer on the Prequalified List. Producers must participate in this program for each type of material they have prequalified. When notified by KDOT, producers will be required to split a sample, test the material according to specifications, and send KDOT a portion to test along with their test results. The 2 sets of test results will be compared using the precision and bias guidelines outlined by AASHTO. If there are any discrepancies in the test results that cannot be resolved, a laboratory inspection may be necessary. Producer laboratories that are AMRL certified will be exempt from this program.

f. Results of the split sample testing program, producer quality control testing required by **subsection 1201.2d.(2)** and verification testing conducted by the KDOT will be used to determine the reliability of the producer's certifications. If any of these data indicate that the certifications are not reliable, permission granted to the producer to supply asphalt materials on the basis of certification will be withdrawn. The producer may still supply asphalt materials, but the contents of each shipping container must be sampled and tested by KDOT before acceptance for use. This procedure will be followed until the producer has provided to the Bureau Chief of Construction and Materials, adequate indication that future certifications will be reliable.

1201.5 BASIS OF ACCEPTANCE

a. For producers prequalified as required by **subsection 1201.4** above, asphalt materials covered by this specification will be accepted upon receipt and approval by the Field Engineer of a certification prepared by the producer to cover the quality and quantity of material in each shipping container. Certifications must be based on the results of the producer's quality control testing as required in **subsection 1201.2d.(2)**.

b. For producers who are not prequalified, asphalt materials covered by this specification will be accepted based on the results of tests by the Materials and Research Center on samples from each shipping container. Testing must be completed before incorporation of the product into the project.

SECTION 1202

PERFORMANCE GRADED ASPHALT BINDER

1202.1 DESCRIPTION

This specification covers performance graded asphalt binder (PGAB).

1202.2 REQUIREMENTS

a. Provide material* that complies with the applicable requirements of **SECTION 1201** and AASHTO M 320. Polymer modified binders must meet the additional requirements shown in **TABLE 1202-1**.

*Perform all tests after adding 0.5% high molecular weight amine antistripping agent (by weight) to the PGAB. Contact the Chief Chemist, Bureau of Construction and Materials, for a list of acceptable high molecular weight amines.

TABLE 1202-1: ADDITIONAL REQUIREMENTS

Temperature Spread [1], °C	**86**	**92**	**98**	**104**	**110**
Separation, ASTM D 5976, ºC max. Run on Original Binder	2	2	2[2]	2	2
Elastic Recovery, ASTM D 6084, Procedure A, % min. Run on RTFO Residue	50	60	65	75	80

[1] Temperature Spread is determined by subtracting low temperature from high temperature; for example PG 64-28: 64-(-28) = 92
[2] For PG 70-28 RCI, separation test requirement no greater than 6.

b. Provide the grade of material designated in the Contract Documents. KDOT will not make changes in the grade of asphalt. The Contractor may substitute PGAB that complies with or exceeds the upper and lower grade designations for the grade specified. For example, if a maintenance overlay specifies a PG 58-22, a PG 64-22 or a PG 58-28 will also be accepted. Such substitutions require advance approval by the Engineer and a no-cost change order.

1202.3 TEST METHODS

Test according to the applicable provisions of ASTM D 5976, D 6084 and AASHTO T 48, T 240, T 313, T 315, T 316, and R 28.

1202.4 PREQUALIFICATION

Prequalify material according to **SECTION 1201**.

1202.5 BASIS OF ACCEPTANCE

See applicable requirements under **SECTION 1201**.

SECTION 1203

EMULSIFIED ASPHALT

1203.1 DESCRIPTION

This specification covers emulsified asphalt used for asphalt mixes, surface sealing, microsurfacing and tack coats.

1203.2 REQUIREMENTS

a. General. Provide emulsified asphalt that is an intimate, homogenous mixture of base asphalt and emulsifying agent held suspended in water. Certain emulsified asphalt grades may contain petroleum distillates.

The grade of material is designated in the Contract Documents. The KDOT reserves the right to change the grade and class as necessary due to aggregate type, road surface or weather conditions. Make the required change after being notified in writing by the KDOT.

Provide emulsified asphalt that remains homogenous and stable during transportation, storage and distribution. Material that performs unsatisfactorily in any of the above situations will be rejected even if the material passes all laboratory tests.

b. Chemical and Physical Requirements. Provide emulsified asphalt that complies with **TABLES 1203-1, 1203-2 and 1203-3**.

TABLE 1203-1: SPECIFICATIONS FOR ANIONIC EMULSIFIED ASPHALT

	RS-1H/ RS-1HP		SS-1H		MS-1		SS-1HP	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity, Saybolt Furol								
At 77°F, sec.	-----	-----	10	100	-----	-----	10	75
At 122°F, sec.	75	300	-----	-----	100	400	-----	-----
Residue by Distillation, (% by Mass)………………	65	-----	57	-----	65	-----	57	-----
Oil Distillate, (% by Volume). .	-----	-----	-----	-----	-----	8	-----	-----
Storage Stability, %[1]	-----	1	-----	1	-----	1	-----	-----
Demulsibility:								
35 ml of 0.02 N $CaCl_2$, %. .	60	-----	-----	-----	-----	-----	-----	-----
50 ml of 0.1 N $CaCl_2$, %. . .	-----	-----	-----	-----	75	-----	-----	-----
Sieve Test, % Retained.	-----	0.50	-----	0.50	-----	0.50	-----	0.1
Tests on Distillation Residue:								
Penetration, 77°F, 100g, 5 sec.	75	150	75	125	300	-----	75	150
Solubility, %.	97.5	-----	97.5	-----	97.5	-----	-----	-----
Ductility, 77°F, mm.	800	-----	800	-----	-----	-----	-----	-----
Ductility, 39°F, mm	-----	-----	-----	-----	-----	-----	100	350
Elastic Recovery @ 50°F, 20 cm elongation, %	60[2]	-----	-----	-----	-----	-----	25	-----

[1] If the Contractor's storage tanks are equipped with a mechanical propeller type agitation device, and the entire contents of the tank are thoroughly mixed before each day's use, the requirement for satisfactory compliance with the storage stability test will be waived.

[2] RS-1HP only

TABLE 1203-2: SPECIFICATIONS FOR CATIONIC EMULSIFIED ASPHALT

	CRS-1H/ CRS-1HP		CSS-1H/ CSS-1HM		CMS-1		CSS-Special	
	Min.	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
Viscosity, Saybolt-Furol:								
At 77°F, sec.	-----	-----	10	60	-----	-----	----	----
At 122°F, sec.	75	300	-----	-----	100	400	----	----
Residue by Distillation, (% by Mass)…………………	65	-----	57	-----	65	-----	64.0[1]	66.0[1]
Oil Distillate, (% by Volume).	-----	3	-----	-----	-----	8	----	0.5
Storage Stability, %.	-----	1	-----	1	-----	1	----	----
Sieve Test, % Retained.	-----	0.50	-----	0.50	-----	0.50	----	0.1
Tests on Distillation Residue:								
Penetration, 77ºF, 100g, 5 sec	75	150	50	100	300	-----	-25%[2]	+25%[2]
Solubility, %.	97.5	-----	97.5	-----	97.5	-----	----	----
Ductility, 77°F, mm. . . .	800	-----	800	-----	-----	-----	----	----
Viscosity, Saybolt-Furol, 180°F, sec..	-----	-----	-----	-----	300	700	----	----
Elastic Recovery @50°F, 20 cm elongation, %	60[3]	----	----	----	----	----	----	----

[1] Use modified AASHTO T 59 procedure – distillation temperature of 350°F with a 20 minute hold.
[2] Penetration will be determined by the producer and submitted to the Chief Chemist at the time of prequalification.
[3] CRS-1HP only

TABLE 1203-3: SPECIFICATIONS FOR EMULSION BONDING LIQUID

	EBL	
Tests on Emulsion:	**Min.**	**Max.**
Viscosity, Saybolt-Furol @ 122ºF, sec	25	125
Storage Stability Test[1], 24 h, %		1
Sieve Test[2], % Retained		0.3
Residue by Distillation, %	63	
Oil Distillate by Distillation, %		2
Demulsibility, % (35 ml, 0.02 N $CaCl_2$) (Anionic Version) Demulsibility, % (35 ml, 0.8% Dioctyl Sulfosuccinate) (Cationic Version)	60	
Tests on Distillation Residue:	Min.	Max.
Penetration, 77ºF, 100g, 5 sec	90	150
Elastic Recovery[3], %	60	

[1] After sitting undisturbed for 24 hours, the sample shall show no more than 5 ml of the white latex residue.
[2] The sieve test is waived if successful application of the material has been achieved in the field.
[3] Elastic recovery, AASHTO T 301, 50ºF, 20 cm elongation, 5 minute hold, % min., run on Distillation Residue.

c. Mixing Grade Emulsions. Formulate mixing emulsions (MS-1 and CMS-1) for use with regional aggregate types. In general, these will be crushed limestone and/or dolomite with sand for the eastern section of the state and sand-gravel with mineral filler for the central and western sections. Formulate emulsions for use by both windrow and plant mixing methods and for either damp or dry aggregates. Provide an emulsion formulated for the intended end use if these conditions cannot be met by a single formulation. Provide an emulsion that enables material in a stockpile to easily be removed at temperatures as low as 39ºF for an extended period of time after mixing.

d. Modified Emulsions, RS-1HP, CRS-1HP and CSS-1HM and CSS-Special

(1) Provide anionic emulsified asphalt (RS-1HP) that complies with **TABLE 1203-1** or cationic emulsified asphalt (CRS-1HP or CSS-1HM) that complies with **TABLE 1203-2**.

(2) Provide a modified emulsion that contains a minimum of 3.0 percent polymer solids by weight of asphalt.

(3) Provide a modified emulsion that shows no more than 5 ml of the white latex residue after sitting undisturbed for 24 hours.

(4) For use in Microsurfacing. Formulate the modified emulsified asphalt so that if the paving mixture is applied at a thickness of 1 inch, and the relative humidity is not more than 50 percent with the ambient air temperature at least 75ºF, it will cure sufficiently so rolling traffic can be allowed on the pavement in 1 hour with no damage to the surface. It must show no separation after mixing.

1203.3 TEST METHODS

a. Test in accordance with the applicable provisions of AASHTO T 44, T 49, T 51, and T 59.

b. When testing modified emulsions, test the Elastic Recovery using AASHTO T 301. In addition, modify the distillation procedure of AASHTO T 59 as follows:

"Slowly bring the temperature of the lower thermometer to 350 ± 9ºF and maintain for 20 minutes. Complete the distillation in 60 ± 15 minutes from the first application of heat."

1203.4 PREQUALIFICATION

Prequalify material under this specification according to **SECTION 1201**.

1203.5 BASIS OF ACCEPTANCE

See applicable requirements under **SECTION 1201**.

SECTION 1204

CUTBACK ASPHALT

1204.1 DESCRIPTION

This specification covers cutback asphalt used for bituminous mixes and surface sealing.

1204.2 REQUIREMENTS

a. General. Provide material that complies with the applicable requirements of **SECTION 1201**. Provide the grade of material designated in the Contract Documents. The KDOT reserves the right to change any grade of asphalt due to the characteristics of the roadbed, seasons of the year or weather conditions. This change will be to obtain a material having the characteristics of the next higher or lower grade of cutback asphalt of the same type (RC or MC). Make the required change after being notified in writing by the KDOT.

b. Rapid Curing Cutback Asphalt. Provide Rapid Curing Cutback Asphalt consisting of an asphaltic base fluxed with suitable petroleum distillates. Provide a material that shows no separation before use and complies with all requirements for the designated grade shown in AASHTO M 81, Table 1.

c. Medium Curing Cutback Asphalt. Provide Medium Curing Cutback Asphalt consisting of an asphaltic base fluxed with suitable petroleum distillates. Provide a material that shows no separation before use and complies with all requirements for the designated grade shown in AASHTO M 82, Table 1.

1204.3 TEST METHODS

Test according to the applicable provisions of AASHTO M 81 and M 82.

1204.4 PREQUALIFICATION

Prequalify material under this specification according to **SECTION 1201**.

1204.5 BASIS OF ACCEPTANCE

See applicable requirements under **SECTION 1201**.

SECTION 1205

ASPHALT REJUVENATING AGENT

1205.1 DESCRIPTION

This specification covers materials to be used as an emulsified polymer-modified asphalt rejuvenating agents for the use in hot in-place recycling of asphalt pavements.

1205.2 REQUIREMENTS

Provide material that has a record of satisfactory performance based on the capability of the material to increase the ductility and lower the viscosity of the asphalt binder in the pavement surface. Provide an asphalt rejuvenating agent composed of a polymer-modified asphalt emulsion. Modify the asphalt base stock with a minimum of 3.0% styrene-butadiene solution polymer. Blend the polymer modified base stock with process oils or other additives before emulsification to achieve the desired finished product properties. The material must comply with the following physical and chemical requirements in **TABLE 1205-1**:

TABLE 1205-1: ASPHALT REJUVENATING AGENT

Property	Requirement
Viscosity, Saybolt-Furol at 25ºC, sec	15 – 100
Residue, % min.[1]	60
Sieve Test, % max.	0.10
Oil Distillate, % max.	2
Storage Stability, 24 hrs., % max.	1
Tests on Residue from Distillation:	
Asphaltenes, % max.	25
Penetration @ 4°C, 100g, 5 sec.	50 – 150
Elastic Recovery, AASHTO T 301, 4°C, 20 cm elongation, % min. Run on Distillation Residue	60

[1] Use modified AASHTO T 59 procedure – distillation temperature of 350°F with a 20 minute hold.

1205.3 TEST METHODS

Test in accordance with the applicable provisions of AASHTO T 59, ASTM D 4402 and KT-MR20, "Chemical Analysis of Asphalt Rejuvenating Agents".

1205.4 PREQUALIFICATION

Prequalify material under this specification according to **SECTION 1201**.

1205.5 BASIS OF ACCEPTANCE

See applicable requirements under **SECTION 1201**.

SECTION 1206

POLYMER MODIFIED ASPHALT CEMENT FOR CHIP SEALS

1206.1 DESCRIPTION

This specification covers polymer modified (tire rubber and/or SBS) asphalt cement for use in chip seals.

1206.2 REQUIREMENTS

Provide material that complies with the requirements shown in **TABLE 1206-1**.

TABLE 1206-1: ASPHALT CEMENT FOR CHIP SEALS

	AC-20-5TR		AC-10-2TR	
	Min.	**Max.**	**Min.**	**Max.**
Polymer	TR & SBS(1)		TR & SBS(2)	
Polymer Content, %	5	-----	3	-----
Dynamic shear, G*/sin δ, 64°C, 10 rad/s, kPa	1.0	-----	-----	-----
Dynamic shear, G*/sin δ, 58°C, 10 rad/s, kPa	-----	-----	1.0	-----
Viscosity, 140°F, Poise	2,000	-----	1,000	-----
Penetration, 77°F, 100g, 5sec	75	115	95	130
Elastic Recovery, ASTM D6084 50°F, % Recovery, 1 hour	55	-----	30	-----
Softening Point, °F	120	-----	110	-----
Test of Residues from RTFO Aging and PAV Bending Beam Rheometer at - 18°C, MPa				
Creep Stiffness	-----	300	-----	300
m-value	0.300	-----	0.300	-----

(1) Produce the AC-20-5TR with a minimum of 5% scrap, group, whole tire rubber.
(2) Produce the AC-10-2TR will a minimum of 3% polymers to include a combination of tire rubber and SBS.

1206.3 TEST METHODS

Test according to the applicable provisions of ASTM D 36 and D 6084 Procedure B, and AASHTO T 49, T 202, T 313, and T 315.

1206.4 PREQUALIFICATION

Prequalify material according to **SECTION 1201**.

1206.5 BASIS OF ACCEPTANCE

See applicable requirements under **SECTION 1201**.

SECTION 1207

WARM MIX ASPHALT ADDITIVES

1207.1 DESCRIPTION

This specification covers Warm Mix Asphalt (WMA) additives and processes.

1207.2 REQUIREMENTS

Provide prequalified WMA additives or processes.

1207.3 TEST METHODS

WMA additives and processes will be tested and evaluated by the Texas Department of Transportation following the procedures outlined in **subsection 1207.4**.

1207.4 PREQUALIFICATION

Obtain prequalification procedures by writing to the Texas Department of Transportation, Director of Construction and Maintenance, 125 East 11th Street, Austin, TX 78701-2483. A list of prequalified additives and processes based on the prequalification process for the Texas Department of Transportation and field performance within Kansas will be maintained by the Bureau of Construction and Materials. The KDOT prequalified list establishes the acceptable additives and processes to be incorporated into KDOT projects. Products will remain on the KDOT list provided field performance is satisfactory. Products may be removed from the KDOT list if the manufacturer requests the removal of their own product.

1207.5 BASIS OF ACCEPTANCE

a. WMA Foaming Processes.

(1) Prequalification as specified in **subsection 1207.4**.
(2) Field observation of WMA production.

b. WMA additives.

(1) Prequalification as specified in **subsection 1207.4**.
(2) Receipt and approval of a Type C certification as specified in **DIVISION 2600**.
(3) Field observation of WMA production.

SECTION 1301

MASONRY BRICK

1301.1 DESCRIPTION

This specification covers requirements for masonry brick for various types of construction. Supply masonry brick made from clay, shale, or a mixture of aggregates, water and portland cement.

1301.2 REQUIREMENTS

a. Building Brick. ASTM C 62 defines the requirements for this type of brick, except "Maximum Water Absorption by Five-hour Boiling" and "Maximum Saturation Coefficient" does not apply.

Provide grade MW masonry brick unless specified otherwise in the Contract Documents.

b. Sewer and Manhole Brick. ASTM C 32 defines the requirements for this type of brick. Provide either Grade MM or MS bricks.

c. Concrete Building Brick. ASTM C 55 defines the requirements for this type of brick, except "Water Absorption" and "Moisture Content" does not apply.

Provide Grade S-II concrete building brick unless specified otherwise in the Contract Documents.

d. ADA Compliant Paving Brick. ASTM C 902 defines the requirements for this type of brick. Provide a brick that complies with Class SX, Type I, and Application PS requirements.

1301.3 METHODS OF TEST

Test masonry bricks by the procedures in the ASTM standards cited with each brick type. Note the exceptions taken by the Department.

1301.4 PREQUALIFICATION

None required.

1301.5 BASIS OF ACCEPTANCE

Acceptance of Sewer and Manhole Brick, and Concrete Building Brick will be based on satisfactory results of tests conducted on samples submitted to the Engineer of Tests.

Acceptance of ADA Compliant Paving Brick will be based on receiving a Type A certification and satisfactory results of tests conducted on samples submitted to the Engineer of Tests.

SECTION 1302

CONCRETE MASONRY UNITS

1302.1 DESCRIPTION

This specification covers solid, concrete masonry units for manholes, catch basins and similar items.

1302.2 REQUIREMENTS

Provide masonry units that comply with ASTM C 139.

1302.3 TEST METHODS

Test masonry units in accordance with the methods in ASTM C 139.

1302.4 PREQUALIFICATION

None Required.

1302.5 BASIS OF ACCEPTANCE

Acceptance of concrete masonry units will be based on satisfactory results of tests conducted on samples submitted to the Engineer of Tests.

SECTION 1303

HOLLOW LOAD-BEARING CONCRETE MASONRY UNITS

1303.1 DESCRIPTION

This specification covers hollow load-bearing concrete masonry units made from portland cement, water, and suitable mineral aggregates with or without the inclusion of other materials.

1303.2 REQUIREMENTS

Provide normal weight, masonry units that comply with ASTM C 90 unless otherwise designated in the Contract Documents.

1303.3 METHODS OF TEST

Use the methods specified in ASTM C 90.

1303.4 PREQUALIFICATION

None Required.

1303.5 BASIS OF ACCEPTANCE

Acceptance of hollow load-bearing concrete masonry units will be based on satisfactory results of tests conducted on samples submitted to the Engineer of Tests.

SECTION 1304

SOLID INTERLOCKING PAVING UNITS

1304.1 DESCRIPTION

This specification solid interlocking paving units (paving bricks) made from portland cement, water, and suitable mineral aggregates with or without the inclusion of other materials.

1304.2 REQUIREMENTS

Provide materials that comply with the applicable requirements.

Fine Aggregate FA-A...**DIVISION 1100**

Concrete and Mortar...**DIVISION 400**

Provide paving brick that complies with ASTM C 936 in the styles, dimensions and colors shown in the Contract Documents.

If specified, provide commercially available edging for edge restraints of the type and dimensions shown in the Contract Documents.

1304.3 METHODS OF TEST

Use the methods specified in ASTM C 936.

1304.4 PREQUALIFICATION

None Required.

1304.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

SECTION 1401

AIR-ENTRAINING ADMIXTURES FOR CONCRETE

1401.1 DESCRIPTION

This specification covers admixtures for use as air-entraining agents to be added to concrete mixtures. An air-entraining agent is defined as an admixture that is used as an ingredient of concrete, added to the batch immediately before or during mixing, for the purpose of entraining air.

1401.2 REQUIREMENTS

Provide material that complies with AASHT0 M 154 for compressive and flexural strength, and resistance to freezing and thawing.

1401.3 TEST METHODS

As specified in AASHTO M 154. Tests for bleeding, time of set, and length change are not required.

1401.4 PREQUALIFICATION

a. Each air-entraining admixture must be prequalified. Submit a written request to be evaluated for prequalification to the Bureau Chief of Construction and Materials. Provide the following for each brand and type of material to be evaluated:

(1) Name and address of the manufacturer.

(2) Brand name of the material.

(3) Two copies of a certified test report prepared by a laboratory regularly inspected by the Cement and Concrete Reference Laboratory (CCRL) of the National Institute of Standards and Technology, showing test results complying with the applicable requirements of AASHTO M 154. Also, include evidence that the laboratory is regularly inspected by CCRL. Test results are to be no more than 36 months out of date.

(4) An infra-red spectrum of the admixture which was used in the laboratory tests.

(5) Results of tests from the AASHTO National Transportation Product Evaluation Program (NTPEP). Include the most recent NTPEP test report along with evidence that the product being offered is identical to the one reported in the NTPEP report.

b. A one-liter sample from production of each type of admixture being offered will be accepted in lieu of the NTPEP test report until June 1, 2016. Submit the sample in addition to the documentation requested above for prequalification to the Engineer of Tests. The manufacturer will be advised of the results.

c. The Bureau of Construction and Materials will maintain a list of prequalified air-entraining admixtures. Products that have been prequalified by the above procedures will remain prequalified, as long as the formulation and manufacturing processes remain unchanged, and field experience indicates that the admixture functions appropriately. Any prequalified product that does not have a NTPEP test report on file as of January 1, 2017 will be removed from the list of prequalified air-entraining admixtures for concrete. Changes in the formulation, manufacturing process, or failure of the admixture to function appropriately will require a new prequalification.

1401.5 BASIS OF ACCEPTANCE

a. Prequalification as set forth under **subsection 1401.4**.

b. Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

SECTION 1402

CHEMICAL ADMIXTURES FOR CONCRETE

1402.1 DESCRIPTION

This specification covers chemical admixtures to be added to concrete mixtures during mixing operations for the purposes listed below:

a. Type A – Water Reducing Admixture. An admixture that reduces the quantity of mixing water required to produce concrete of a given consistency.

b. Type B – Set Retarding Admixture. An admixture that retards the setting of concrete.

c. Type C - Accelerating Admixture. An admixture that accelerates the setting of concrete.

d. Type D – Water Reducing-Set Retarding Admixture. An admixture that reduces the quantity of mixing water required to produce concrete of a given consistency, and retards the setting of concrete.

e. Type E - Water Reducing and Accelerating Admixture. An admixture that reduces the quantity of mixing water required to produce concrete of a given consistency, and accelerates the setting of concrete.

f. Type F – Water-Reducing, High Range Admixture. An admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater.

g. Type G – Water Reducing, High Range, and Retarding Admixture. An admixture that reduces the quantity of mixing water required to produce concrete of a given consistency by 12% or greater, and retards the setting of concrete.

h. Type S – Specific Performance Admixture. An admixture that provides a desired performance characteristic(s) other than reducing water content, or changing the time of setting of concrete, or both, without any adverse effects on the fresh, hardened, or durability properties of concrete.

i. Type I – Plasticizing Admixture. An admixture that produces flowing concrete without further addition of water.

j. Type II – Plasticizing and Set Retarding Admixture. An admixture that produces flowing concrete without further addition of water, and retards the setting of concrete**.**

NOTE: Flowing concrete is defined as having a slump equal to or greater than 7 ½ inches.

1402.2 REQUIREMENTS

a. Provide Type A, B, C, D, E, F, G, and S admixtures that comply with ASTM C 494.

b. Provide Type I and II plasticizing admixtures that comply with ASTM C 1017.

1402.3 TEST METHODS

a. Test Type A, B, C, D, E, F, G, and S admixtures as specified in ASTM C 494, with the following exception:

(1) Provisional qualification, as stated in Table 1, Note C, will not be considered until at least 6 months of data has been established.

b. Test Type I and II plasticizing admixtures as specified in ASTM C 1017.

1402.4 PREQUALIFICATION

a. Each brand and type of admixture covered by this specification must be prequalified. Submit a written request to be evaluated for prequalification to the Bureau Chief of Construction and Materials. Provide the following for each brand and type of material to be evaluated:

(1) Name and address of the manufacturer.

(2) Brand name of the material.

(3) Type of material as defined in **subsection 1402.1**.

(4) The chloride content of the admixture and whether or not chloride was added during its manufacture.

(5) Recommended manner and time of adding the admixture to the concrete batch.

(6) Two copies of a certified test report prepared by a laboratory regularly inspected by the Cement and Concrete Reference Laboratory (CCRL) of the National Institute of Standards and Technology, showing test results complying with the applicable requirements of ASTM C 494 or ASTM C 1017. Also, include evidence that the laboratory is regularly inspected by CCRL. Test results are to be no more than 36 months out of date.

(7) An infra-red spectrum of the admixture which was used in the laboratory tests.

(8) Results of tests from the AASHTO National Transportation Product Evaluation Program (NTPEP). Include the most recent NTPEP test report along with evidence that the product being offered is identical to the one reported in the NTPEP report.

b. A one-liter sample from production of each type of admixture being offered will be accepted in lieu of the NTPEP test report until June 1, 2016. Submit the sample in addition to the documentation requested above for prequalification to the Engineer of Tests. The manufacturer will be advised of the results.

c. The Bureau of Construction and Materials will maintain a list of prequalified chemical admixtures for concrete. Products that have been prequalified by the above procedures will remain prequalified, as long as the formulation and manufacturing processes remain unchanged, and field experience indicates that the admixture functions appropriately. Any prequalified product that does not have a NTPEP test report on file as of January 1, 2017 will be removed from the list of prequalified chemical admixtures for concrete. Changes in the formulation, manufacturing process, or failure of the admixture to function appropriately will require a new prequalification.

1402.5 BASIS OF ACCEPTANCE

a. Prequalification as set forth under **subsection 1402.4**.

b. Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

SECTION 1403

PRECURE/FINISHING AID

1403.1 DESCRIPTION

This specification covers evaporation retarding material for use in finishing concrete flatwork, and serves as a finishing aid. This material is not a substitute for regular curing compound, which must be applied after the concrete is finished.

1403.2 REQUIREMENTS

a. Provide a pigmented water based material, as described in ACI 345R, capable of producing a monomolecular film over freshly placed concrete, which serves to retard evaporation from the surface.

b. The material may have no deleterious effects on concrete.

c. Prepare and use the material in accordance with the manufacturer's instructions. Provide a copy of those instructions to the Field Engineer prior to commencing operations.

1403.3 TEST METHODS

None specified.

1403.4 PREQUALIFICATION

Pre-cure/ finishing aid materials must be prequalified. For approval of proposed products, submit complete technical data and material safety data sheets to the Bureau of Construction and Materials. The manufacturer will be notified of the acceptance or denial of the product. The Bureau of Construction and Materials will maintain a list of prequalified pre-cure/finishing aid material for concrete. Products prequalified by the above procedures will remain prequalified, as long as the formulation and manufacturing processes remain unchanged, and field experience indicates that the admixture functions appropriately.

1403.5 BASIS OF ACCEPTANCE

a. Prequalification as required by **subsection 1403.4** of this specification.

b. Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

SECTION 1404

LIQUID MEMBRANE FORMING COMPOUNDS

1404.1 DESCRIPTION

This specification covers liquid membrane forming compounds (also referred to as concrete curing compounds) suitable for spraying on horizontal and vertical concrete surfaces to retard the loss of water during the early hardening period and subsequent curing period.

1404.2 REQUIREMENTS

a. Provide liquid membrane forming compound that complies with ASTM C 309 for Type 1-D, clear or translucent with fugitive dye, or Type 2, white pigmented compound.

b. Type 2 white pigmented compound will be further classified into Type 2 (Wax Based) and Type 2 (Other). This is to allow specifying of wax based compound for certain applications where a bond breaker is desired. Either formulation base may be supplied except when wax based is specified.

c. Do not allow water-emulsion based material to freeze. Material that has been subjected to freezing temperatures will be rejected.

1404.3 TEST METHODS

Test materials in accordance with ASTM C 309. Fingerprinting and screening of verification samples by infrared spectroscopy is done according to ASTM E 1252.

Water emulsion based material is not subject to the long term settling test by the freeze thaw cycling method.

Wax-based material for Cement Treated Base (CTB) with the following exceptions:

Moisture Loss, kg/sq m (max.) 0.60
Daylight Reflectance (min.).. 50%

1404.4 PREQUALIFICATION

Submit two 1-quart samples of material and a copy of the manufacturer's test results on samples of the same lot of material to the Engineer of Tests. Include a copy of the Material Safety Data Sheet (MSDS). For Type 2 white pigmented compounds, include a statement regarding whether the formulation is wax based or other, unless it is specifically addressed in the MSDS.

Samples will be tested for compliance with this specification. The manufacturer will be notified of the test results on the samples submitted.

Results of tests from the AASHTO National Transportation Product Evaluation Program (NTPEP) will be accepted in lieu of the sample requested above. Include the most recent NTPEP test report along with the other documentation requested. Include evidence that the product being offered is identical to the one reported in the NTPEP report.

Manufacturers whose products comply with this specification will be placed on a prequalified list. Manufacturers will remain on the list as long as the results of verification samples and performance in the field are satisfactory. Any changes in formulation will require re-submittal for prequalification testing.

1404.5 BASIS OF ACCEPTANCE

a. Prequalification as required by **subsection 1404.4** above.

b. Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

SECTION 1405

BURLAP

1405.1 DESCRIPTION

This specification covers new and used burlap for use in curing concrete.

1405.2 REQUIREMENTS

a. General. Provide material which complies with AASHTO M 182, Class 3 (10 oz/yd) with the following additions:

(1) Manila hemp may also be used to make burlap.

(2) Burlap fabricated from bags may not be used.

(3) Burlap may not contain any water soluble ingredient which will retard the setting time of portland cement concrete.

b. Used Burlap. Used burlap must comply with the requirements stated above, and can only have been used previously for curing concrete. "Like new" cleanliness is not expected, but contamination with any substance foreign to the concrete curing process (e.g. grease or oil) will be cause for rejection.

1405.3 TEST METHODS

As specified in AASHTO M 182.

1405.4 PREQUALIFICATION

None Required

1405.5 BASIS OF ACCEPTANCE

a. New burlap will be accepted on the basis receipt and approval of a Type D certification as specified in **DIVISION 2600** and a visual inspection for compliance with AASHTO M 182.

b. Used burlap will be accepted on the basis of a Contractor certification regarding the source and previous use of the material, and a visual inspection for compliance with AASHTO M 182.

SECTION 1406

SHEET MATERIALS FOR CURING CONCRETE

1406.1 DESCRIPTION

This specification covers materials in sheet form used for covering the surfaces of hydraulic cement concrete to inhibit moisture loss during the curing period. In the case of white reflective materials, it also reduces temperature rise in concrete exposed to radiation from the sun. Materials included are clear and white opaque polyethylene film, and white-burlap polyethylene sheet.

1406.2 REQUIREMENTS

a. General. Provide material that complies with AASHTO M 171.

b. Used Sheet Material. Used sheet material must comply with the requirements stated above, and can only have been used previously for curing concrete. "Like new" cleanliness is not expected, but contamination with any substance foreign to the concrete curing process (e.g. grease or oil) will be cause for rejection.

1406.3 TEST METHODS

As specified in AASHTO M 171.

1406.4 PREQUALIFICATION

None Required.

1406.5 BASIS OF ACCEPTANCE

a. New sheet materials will be accepted on the basis receipt and approval of a Type D certification as specified in **DIVISION 2600**, and a visual inspection for compliance with AASHTO M 171.

b. Used sheet materials will be accepted on the basis of a Contractor certification regarding the source and previous use of the material, and a visual inspection for compliance with AASHTO M 171.

SECTION 1501

HOT JOINT SEALING COMPOUND

1501.1 DESCRIPTION

This specification covers hot joint sealing compound for use in sealing joints and cracks in asphalt and portland cement concrete pavements.

1501.2 REQUIREMENTS

a. General. Provide a joint sealing compound that is a homogeneous blend of elastomers and other plasticizers and agents blended to result in a product that seals cracks in pavements from water intrusion. The sealant must retain adhesion and flexibility during extremes of expansion and contraction of the crack through a temperature range of 0ºF to 140ºF. Heat and apply the material according to manufacturer's recommendations.

b. Bond. When tested at -20ºF to 200% extension of 1/2 inch to 1-1/2 inch for 3 cycles, the material exhibits no cracking, separation, or other opening that at any point is greater than ¼ inch deep in the sealer or between the sealer and the mortar block. A minimum of 2 test specimens in a set of 3 representing a given sample must comply with this requirement.

c. Flow. 5 mm maximum.

d. Resilience. 50 – 80% recovery**.**

e. Cone Penetration. 0ºF, 150 grams, 5 seconds: 18 - 80

f. Provide material capable of a minimum 12-hour pot life at application temperature and of being re-heatable at least once (in a normal field application) without experiencing changes in application characteristics, polymer and oil separation, balling or other signs of gelling.

g. Package the material in pails or boxes clearly marked with recommended pouring temperature, maximum heating temperature, shelf life if appropriate, and batch number. The size of a batch, which is any well-defined quantity produced by essentially the same process during a designated amount or time (such as an 8-hour shift), must be a minimum of 10,000 lbs.

h. Lots from the same manufacturer may be commingled during application. <u>Do not</u> commingle materials from different manufacturers.

1501.3 TEST METHODS

a. Sample Preparation. ASTM D5167, sample size of 5 lbs. Maintain the material at the manufacturer's recommended pouring temperature for 6 hours for both initial and reheat, before preparing the specimens.

b. Bond. ASTM D5329, Section 9. In forming the bond test specimens, space the blocks 0.50 ± 0.01 inch apart by means of suitable spacer strips to enclose a space of 2.0 ± 0.05 inch by 2.0 ± 0.05 inch.

c. Flow. ASTM D5329, Section 8.

d. Resilience. ASTM D5329, Section 12.

e. Cone Penetration. ASTM D5329, Section 6 with the following variations:

(1) Pour the sample into a 6 oz. tin flush with the top and allow to cool overnight.

(2) Place the specimen in a freezer at 0ºF for 4 hours. Place the cone in the freezer for the last hour before the test.

(3) At the end of the 4-hour period, remove the cone from the freezer, place the specimen on the stand, and penetrate immediately.

(4) Return the specimen to the freezer, clean the cone, and return the cone to the freezer for 30 minutes before making each successive penetration.

f. Reheat. Allow the remainder of the sample to cool to room temperature until the next working day. Repeat **subsections 1501.3a.** through **1501.3e.** Results of tests must meet requirements, and be consistent with those from the first set of specimens.

1501.4 PREQUALIFICATION

a. Manufacturers interested in prequalifying material under this specification must provide a thirty pound sample to the Engineer of Tests for laboratory testing. Include a copy of the quality control test report for the batch of material the sample represents, material safety data sheets, and a complete set of heating and installation recommendations and instructions. Include any conditions and limits to the number of re-heating cycles for the material.

b. Results of testing from the AASHTO National Transportation Product Evaluation Program (NTPEP) will be accepted in lieu of the sample requested above. Include the most recent NTPEP test report along with the other documentation requested. Include evidence that the product being offered is identical to the one reported in the NTPEP report.

c. The material will be evaluated for compliance with this specification, and the manufacturer will be notified of the results. The Bureau of Construction and Materials will maintain a list of qualified materials. Products will remain on the prequalified list as long as the results of batch testing and field performance are satisfactory. Report any changes in formulation to the Engineer of Tests for review and evaluation to determine if requalification is necessary.

1501.5 BASIS OF ACCEPTANCE

a. Prequalification as required in **subsection 1501.4**.

b. Receipt and approval of manufacturer's certification for minimum pot life and reheatability requirements. The manufacturer must certify that the material is capable of a minimum 12-hour pot life at application temperature and is re-heatable at least once (in a normal field application) without experiencing changes in application characteristics, polymer and oil separation, balling or any other signs of jelling. The manufacturer must designate any conditions and limits to the number of re-heating cycles for the material.

c. Satisfactory results of tests conducted at the Materials and Research Center on each batch of material. Samples will be obtained by a representative of KDOT and must be available for testing at the Materials and Research Center a minimum of 10 working days before the date the material is required for installation.

d. Visual observation of performance in the field.

SECTION 1502

COLD APPLIED CHEMICALLY CURED JOINT SEALANT

1502.1 DESCRIPTION

This specification covers cold applied chemically cured joint sealant and backer rod to be used for filling joints in portland cement concrete pavement.

1502.2 REQUIREMENTS

a. Joint Sealant. Prequalify joint sealant before use on KDOT projects. Use either Type NS (Non Self-Leveling) or Type SL (Self-Leveling). Provide joint sealants that consist of a cold applied formulation that is self-priming and compatible with portland cement concrete. The sealants must comply with the applicable test requirements in ASTM D 5893. Acetic acid cure sealants will not be accepted.

b. Backer Rod. Furnish material that is resilient closed or open cell polyethylene foam rod as recommended by the manufacturer of the sealant. Provide a backer rod compatible with the sealant, with no bond or reaction occurring between the rod and the sealant.

1502.3 TEST METHODS

Test materials covered by this section in accordance with the applicable test methods in ASTM D 5893.

1502.4 PREQUALIFICATION

a. Laboratory Prequalification. Manufacturers interested in qualifying sealant under this specification must supply actual test data from an approved testing laboratory showing compliance with the specification. Submit test results to the Engineer of Tests.

b. NTPEP Prequalification. Results of testing from the AASHTO National Transportation Product Evaluation Program (NTPEP) will also be accepted. Submit a copy of the most recent NTPEP test report to the Engineer of Tests. Include evidence that the product being offered is identical to the one reported in the NTPEP report.

c. Prequalified List. The Bureau of Construction and Materials will include products complying with **subsection 1502.2** on a prequalified list. Failure of any field installation in less than the anticipated life will be cause for removal of the product from prequalified status. Products removed from prequalified status will be considered for re-qualification if the manufacturer can provide evidence that the cause of failure has been positively identified, and necessary formulation changes and quality control measures have been implemented to eliminate that cause. Complete prequalification under **subsection 1502.4**. is required for products removed from the prequalified list.

1502.5 BASIS OF ACCEPTANCE

a. Prequalified status as required in **subsection 1502.4**.

b. Receipt and approval of a Type A certification as specified in **DIVISION 2600**. Report all test requirements on the certification.

c. Use the material within 6 months of the date of the certification. If the material is not used within the 6 month period, re-testing and re-certification will be required. Use re-certified material within 45 days of the re-certification.

SECTION 1503

PREFORMED EXPANSION JOINT FILLER FOR CONCRETE

1503.1 DESCRIPTION

This specification covers redwood board expansion joint filler (Type A) for use in sidewalks, and preformed expansion joint filler (Type B) for concrete paving and structural construction.

1503.2 REQUIREMENTS

a. Type A. Provide redwood boards of sound heartwood. Occasional small sound knots and medium surface checks will be permitted provided the board is free of any defects that will impair its usefulness for the purpose intended.

The redwood board joint filler is composed of only one piece of board in the length of the joint, and with dimensions as shown in the Contract Documents. Positive tolerances of 1/16 inch thickness, 1/8 inch depth (or width) and ¼ inch length are permitted.

Immerse redwood board joint material in water for a minimum of 24 hours before being installed in the sidewalk. Do not allow the boards to dry out prior to installation.

b. Type B. Provide material that complies with AASHTO M 213.

1503.3 TEST METHODS

a. Type A. None specified.

b. Type B. As specified in AASHTO M 213.

1503.4 PREQUALIFICATION

None required.

1503.5 BASIS OF ACCEPTANCE

a. Type A. Visual inspection for the quality and dimensional requirements.

b. Type B.

(1) Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

(2) Visual inspection at destination for condition and compliance with dimensional and other requirements.

SECTION 1504

PREFORMED ELASTOMERIC COMPRESSION JOINT SEALS FOR CONCRETE

1504.1 DESCRIPTION

This specification governs the preformed elastomeric joint seals designed to operate under compression and intended for various applications. The specification also addresses certain components, such as lubricants and adhesives, required for installation of the seals.

1504.2 REQUIREMENTS

a. General.

(1) Unless specified otherwise in the Contract Documents, provide transverse pavement joint seals that comply with **TABLE 1504-1**.

TABLE 1504-1: DIMENSIONS FOR PREFORMED ELASTOMERIC COMPRESSION JOINT SEALS		
Joint spacing on centers.	**15 feet**	**30 feet**
Allowable range of non-compressed seal width across flat contact surfaces.	0.687 ⇔ 0.750 inch 0.719 inch nominal width	0.812 ⇔ 0.875 inch 0.843 inch nominal width
Vertical dimension of non-compressed seal flat contact surface, per side, minimum.	0.630 inch	0.800 inch
Maximum allowable overall vertical dimension of seal when compressed to width of 3/8 inch.	1.50 inch	1.50 inch

(2) Provide elastomeric seals for bridge deck expansion joints that comply with the dimensional requirements specified in the Contract Documents.

b. Material Specifications.

(1) Comply with AASHTO M 220 when the intended application is pavement joints and AASHTO M 297 when the intended application is bridge deck joints.

Durably label and mark seals in compliance with the requirements of those AASHTO standards inclusive of a unique identifier such as a batch or lot number and date of manufacture. Package seals to prevent damage during transport and durably label the packaging containment with all information required to properly identify the contents.

(2) All adhesives, lubricants, cementing agents, etc., that are required for installation of the seals are to be specified and provided by the manufacturer of the seal. All installation is to be in strict accordance with the specified procedures and practices of the seal manufacturer. These procedures and practices are to be provided with the component.

Properly package all of these components and provide instructions for safe storage, transport, proper disposal of component and container, emergency procedures, etc. Durably label all with the name and address of the manufacturer, date of manufacture, shelf life or expiration date if applicable, a unique identifier such as a batch or lot number, and any other relevant information.

1504.3 TEST METHODS

Using the applicable AASHTO material specification shown in **subsection 1504.2b.,** conduct all tests required according to the specified procedures with the following exceptions:

- Pavement and bridge deck seals when compressed to a width of 80 and 85 percent of nominal are to provide a load resistance of not less than 50 pounds per linear foot.
- Bridge deck seals when compressed to a width of 50 percent of nominal are not to produce a load resistance that exceeds 500 pounds per linear foot.

These properties are evaluated while conducting the compression deflection tests according to the procedures of the applicable AASHTO standard.

1504.4 PREQUALIFICATION

a. General. All manufacturers of elastomeric seals that intend to provide seals for KDOT projects must have their products prequalified by size and design configuration. To initiate this process provide a request for the evaluation of the product to the Bureau Chief of Construction and Materials along with the following documentation:

- The manufacturer's corporate name and address as well as the address of the facilities that are manufacturing the seals being prequalified,
- The method of traceability utilized for quality control such as lot or batch numbers, dates of manufacture, etc.,
- Typical material quantities represented by this method,
- A list of authorized distributors of the product(s) being prequalified if applicable**.**

b. Manufacturer Quality Control Requirements. The manufacturer must perform the quality control testing with an identified and adequately staffed section within its organization. The laboratory must have the proper calibrated equipment with which to adequately perform all testing required by **subsection 1504.3.** Provide a copy of the quality control plan to the Bureau Chief, Construction and Materials.

c. Sampling and Testing Procedure. The manufacturer is to provide a 6-foot length sample of each seal size and design configuration they desire to have evaluated for prequalification. Submit samples to the Engineer of Tests. The samples are to be representative of seal production and are to be provided with certified laboratory reports documenting the results of the tests required by **subsection 1504.3**.

The samples will be evaluated and tested by the central laboratory according to **subsection 1504.3** with the results compared to those of the manufacturer.

d. Manufacturer Status. A manufacturer will be notified by written documentation of the results of their application for prequalification and in the event of any change in prequalified status once it has been attained.

The manufacturer is to immediately notify the Bureau of Construction and Materials of any changes in the elastomeric compound, design configuration, dimensions, installation procedures and practices, etc., of the prequalified products. The Bureau of Construction and Materials will review the changes and determined whether the product is to remain prequalified. If the changes disqualify the product, an application for prequalification as a new product according to the preceding requirements may be submitted. The failure of random verification samples removed from seals delivered to projects may also disqualify the product.

The Bureau will maintain a list of all prequalified manufacturers by facility and the specific seal size(s) and design(s) that have been approved. Authorized distributors of the approved products, as provided by the manufacturer, will also be maintained on the prequalified list. A distributor may be added to the prequalified list if they can provide verifiable documentation to The Bureau of Construction and Materials that they are supplying a prequalified product.

1504.5 BASIS OF ACCEPTANCE

a. The manufacturer by facility and the specific seal size and design must be currently prequalified.

b. Receipt and approval of a Type C certification as specified in **DIVISION 2600** for the seals, adhesives, lubricants, cementing agents, and any other products specified by the seal manufacturer for proper installation of the seals.

c. The **final disposition** of all products and components will be completed at the final destination as the result of inspection for the quality of workmanship, the delivery condition, and approval of the associated required documentation.

SECTION 1505

MATERIALS FOR FILLING AND SEALING JOINTS IN PIPE

1505.1 DESCRIPTION

This specification covers the following five types of products:

a. Joint compound for filling and sealing joints in concrete and vitrified clay pipe.

b. Flexible gasket type joint material for filling and sealing joints in concrete and vitrified pipe.

c. Factory molded joint rings for use on standard or extra strength clay pipe.

d. Materials for sealing joints in cast iron pipe.

e. Expanded closed-cellular rubber gaskets for filling and sealing joints in reinforced concrete pipe and boxes used for drainage and storm water lines.

1505.2 REQUIREMENTS

a. Compound Type Joint Filler.

(1) General. Provide a compound that is a ready-mixed homogeneous blend of asphalt or tar, inert filler and a suitable solvent or solvents. The inert filler may include polyethylene, polypropylene or cellulose fibers, mica, slate or silica flour or clay. Do not use any type of asbestos material. Mix all ingredients thoroughly at the factory to a uniform workable consistency.

(2) Physical. Provide a compound that complies with **TABLE 1505-1**:

TABLE 1505-1: COMPOUND TYPE JOINT FILLER

Property	Min.	Max
Percent Ash	----	30
Penetration (Standard Cone) 150g, 5 sec., 77°F	125	250

(3) Packaging. Limit container size to 5 gallons of material.

(4) Sampling. Sample in accordance with applicable provisions of KT-27.

b. Flexible Gasket Type Joint Filler. Provide a flexible plastic gasket material supplied in extruded rope form for use where infiltration or exfiltration is a factor in design. Produce flexible plastic gaskets from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and containing no solvents. Provide a gasket joint sealer that does not depend on oxidizing, evaporating or chemical action for adhesive or cohesive strength. Supply the sealer in extruded rope form of suitable cross section and size to fill the joint space when the pipes are joined.

Provide material that complies with AASHTO M 198.

c. Factory Molded Joints. Provide factory-molded joints capable of being fused to both bell and spigot ends of pipe. Provide material that produces watertight joints when the pipe is joined in the trench. The material must comply with ASTM C 425.

d. Materials For Sealing Joints in Cast Iron Pipe.

(1) Packing. Provide material for packing that is twisted jute complying to the Federal Specification “Packing: Jute, Twisted” Serial No. HH-P-117-2, Type II.

(2) Caulking. Provide lead caulking complying to the Federal Specification “Lead, Caulking” Serial No. QQ-C-40.

(3) Rubber Seals. In lieu of lead and jute for sealing joints, the use of specially designed rubber seals will be permitted. Install rubber seals in accordance with the manufacturer’s recommendation.

e. Expanded Closed-Cellular Rubber Gaskets for Reinforced Concrete Pipe and Precast Boxes.

(1) Provide gaskets of tubular cross-section, manufactured from extruded closed-cellular rubber and complying to the physical requirements of ASTM D1056, Class 2C1. Each gasket must be a single continuous part and will conform to the joint size and shape. The outer surface must be completely covered with a smooth, impermeable natural skin of the same material.

(2) Gasket cross-sectional diameters and installation practices, including maximum and minimum joint gaps must be in accordance with the manufacturer's recommendations. Provide a copy of the manufacturer's installation instructions to the Field Engineer.

Do not use this type of gasket when the pipe is installed by jacking or boring methods.

1505.3 TEST METHODS

a. Compound Type Joint Filler. Test in accordance with **TABLE 1505-2**.

TABLE 1505-2: COMPOUND TYPE JOINT FILLER	
Property	**Method**
Penetration (Standard Cone, Unworked)	ASTM D 217
Use an 8-ounce gill can as the test container.	
Percent Ash	AASHTO T 111

1505.4 PREQUALIFICATION

None required.

1505.5 BASIS OF ACCEPTANCE

a. Compound Type Joint Filler. Satisfactory results of tests conducted at the Materials and Research Center. A representative of KDOT will sample each lot or batch of material. Each lot will be subjected to visual examination and testing in accordance with **subsection 1505.3** and for compliance with **subsection 1505.2a**.

b. Flexible Gasket Type Joint Filler, Factory Molded Joint Rings and Materials For Sealing Joints In Cast Iron Pipe (except Rubber Seals). Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

c. Rubber Seals. Visual inspection by the Engineer.

d. Expanded Closed-Cellular Rubber Gaskets.

(1) Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

(2) Visual inspection by the Engineer for workmanship, fit and final installation practices.

SECTION 1506

POLYVINYL CHLORIDE (PVC) PLASTIC WATERSTOP

1506.1 DESCRIPTION

This specification covers extruded polyvinyl chloride (PVC) plastic waterstop.

1506.2 REQUIREMENTS

a. General. Provide PVC waterstop with a ribbed or serrated cross section profile with center bulb that complies with all current requirements of Corps of Engineers Specification CRD-C-572.

b. Dimensions. PVC waterstop is either nominal 6 inch width or 9 inch width as shown in the Contract Documents. Other dimensions are as follows:

(1) 6 inch PVC Waterstop. Center bulb 5/8 to ¾ inch outside diameter (OD) and ¼ to 3/8 inch inside diameter (ID). Minimum thickness adjacent to center bulb 0.360 inch. Waterstop may be uniform in cross-section or uniformly tapered to a minimum thickness of 3/16 inch between serrations at edges.

(2) 9 inch PVC Waterstop. Center bulb 5/16 inch to 7/8 inch OD and ¼ inch to ½ inch ID. Minimum thickness adjacent to center bulb 0.375 inch. Waterstop may be uniform in cross-section or uniformly tapered to a minimum thickness of ¼ inch between serrations at edges.

1506.3 TEST METHODS

Test in accordance with the current Corps of Engineers Specification CRD-C-572.

1506.4 PREQUALIFICATIONS

None required.

1506.5 BASIS OF ACCEPTANCE

PVC waterstop is accepted based on receipt and approval of a Type D certification as specified in **DIVISION 2600** and visual inspection for conditions and dimensional requirements.

SECTION 1507

PRESSURE RELIEF JOINT FILLER

1507.1 DESCRIPTION

This specification covers materials for pressure relief joint filler and lubricant adhesive for use when installing the joint filler material.

1507.2 REQUIREMENTS

a. Polyurethane Pressure Relief Joint Filler (4 inch Joint Opening).

(1) General: This material is a flexible, low density, cellular polyurethane plank for use in pressure relief joints for concrete pavements. It is multicellular, homogeneous foam, having a specially designed cross section, which locks the filler in place.

(2) Physical Properties. Provide joint filler material that complies with **TABLE 1507-1**:

TABLE 1507-1: POLYURETHANE PRESSURE RELIEF JOINT FILLER (4 inch Joint Opening)

Property	Requirements
Compression (PSI):	
At 25% Deflection	5 ± 2
At 65% Deflection	12 ± 4
Water Absorption (% by Volume):	Less than 30
Density (lbs/cu ft):	7 - 10
Recovery (Percent, Min.):	90
Dimensions:	
Width	4 inches Nominal
Depth	7 3/4 inches Nominal*

*Include a supply (equal to the length of the order) of 1 inch X 4 inches polystyrene or polyurethane foam as spacers to insert in the bottom of the trench.

b. Polyethylene Pressure Relief Joint Filler (2 inch or 4 inch Joint Opening).

(1) General: This material is a flexible, low density, multicellular, closed cell, polyethylene plank for use as a highway pressure relief joint. Provide 2 inch or 4 inch width as specified in the Contract Documents.

(2) Physical Properties. The joint filler material complies with **TABLE 1507-2**.

TABLE 1507-2: POLYURETHANE PRESSURE RELIEF JOINT FILLER (2 or 4 inch Joint Opening)

Property	Requirements
Compression (PSI):	
At 10% Deflection	Less than 10
At 80% Deflection	Less than 125
Water Absorption (% by Volume):	Less than 0.5
Density (lbs/cu ft):	2.6 ± 0.2
Dimensions:	
Width	2 inches or 4 inches Nominal
Depth	9 inches Nominal

c. Lubricant Adhesive. Provide a lubricant adhesive recommended by the manufacturer of the joint filler for use when installing the joint filler material. It must have workable consistency at the temperatures the filler material will be installed, be compatible with the joint filler material and the concrete, and be relatively unaffected by the moisture in concrete.

1507.3 TEST METHODS

a. Polyurethane Pressure Relief Joint Filler.

(1) Compression - Deflection - In accordance with ASTM D 3574 (Test C) using a rate of compression of 2 inches/minute and a sample preflexed 75%.

(2) Water Absorption - In accordance with AASHTO T-42.

(3) Recovery. 65% deflection recovery calculated after 1-minute relaxation from deflection return.

b. Polyethylene Pressure Relief Joint Filler.

(1) Compression: In accordance with ASTM D 1056 except determine the compressive strength at 10% deflection and 80% deflection.

(2) Water Absorption: In accordance with ASTM C 272 using conditioning procedure 10.1.1 at a temperature of 120 ± 5^{o}F.

(3) Density: In accordance with ASTM D 3574 (Test A).

1507.4 PREQUALIFICATION

None required.

1507.5 BASIS OF ACCEPTANCE

a. Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

b. Visual inspection at destination for condition and dimensional requirements.

SECTION 1508

ELASTOMERIC CONCRETE

1508.1 DESCRIPTION

Elastomeric concrete is composed of a two-part rapid curing polymer binder material, aggregate and other ingredients as recommended by the binder manufacturer. Elastomeric concrete exhibits flexibility, suitable load carrying characteristics, ozone resistance, ultra-violet resistance and is not prone to cracking or spalling when exposed to ambient air temperatures of -30°F and warmer.

1508.2 REQUIREMENTS

Elastomeric concrete, when combined in the proportions and manner specified by the binder manufacturer, complies with the **TABLE 1508-1**:

TABLE 1508-1: ELASTOMERIC CONCRETE	
Property	**Requirements**
Elastomeric binder after 7-day cure.	
Impact Strength @ -20°F	7 ft-lb, min.
Tensile Strength	500 psi, min.
Ultimate Elongation	100 %, min.
Tear Resistance	80 lb/in., min.
Elastomeric binder after 30-day oven aging.	
Impact Strength @ -29°C	7 ft-lb, min.
Tensile Strength	500 psi, min.
Ultimate Elongation	50 %, min.
Elastomeric binder-aggregate mixture after 7-day cure.	
Bond Strength to Concrete	300 psi, min
Wet Bond Strength to Concrete	225 psi, min
Compressive Stress at 5 % deflection	300 psi min, 2000 psi max.
Resilience	70 %, min.

d. Use aggregates that are compatible with the elastomeric binder, as supplied with the system, or as specified by the binder manufacturer.

1508.3 TEST METHODS

a. Preparation of Specimens.

Prepare specimens by thoroughly mixing the components in the ratios specified by the manufacturer. Before mixing, heat the components to the temperatures recommended by the manufacturer during placement in order to provide a workable mixture and give an initial cure representative of field placement. Apply no heat after mixing. If heating is not specified, mix the components at ambient temperature.

Because of the high bond strength of these materials, mold surfaces such as Teflon or lubricant-coated metal are recommended. Pour binder mixtures into molds as soon as possible after thorough mixing so they will flow well. Minimize entrained air during mixing. It may be removed by the use of vacuum, physical means, or passing a soft flame over the surface. Allow specimens cure sufficiently before removal from molds so that they will not be damaged by removal.

Cure specimens at either 73 ± 3ºF for 7 days or at 140 ± 4ºF for 30 days, and test as specified. Stamp specimens for tensile strength, ultimate elongation and tear resistance from cast sheets of the proper thickness as soon as the binder is sufficiently cured. Sand these specimens to remove irregularities and provide true surfaces.

b. Tests on the Elastomeric Binder.

(1) Impact Resistance. The specimen is a cast disk 2.50 ± 0.05 inches in diameter and 0.375 ± 0.010 inches thick. Sand the faces flat and parallel. After 7 days cure, condition the specimens for 4 hours at -20°F. Remove the specimen from the freezer and placed on a dry machined steel plate. Immediately after placing the disk on the plate, drop a 1 pound steel ball onto the center of the specimen through a guiding tube from an initial drop height of 5 feet. The drop height is increased by ½ foot intervals until the specimen cracks, or until all specimens exceed the specification minimums. The result will be the average of 4 specimens. Any cracking of a specimen will constitute failure. Repeat the procedure with 4 specimens that have been oven cured for 30 days.

(2) Tensile Strength. This test is performed according to ASTM D 638 using the Type IV specimen with dimension WO of 1 inch, which corresponds to Die C of ASTM D 412. Perform Testing after 7 days of cure. Measure the thickness and width of the specimen neck using a dial gauge or caliper, and determine the cross sectional area. Use an initial test machine jaw separation of 2 inches and a crosshead speed of 2 inches per minute. Load the specimen to failure. Use the maximum load to determine the tensile strength. Test at least 8 specimens. Discard those with obvious flaws. Repeat the procedure with 8 specimens that have been oven cured for 30 days.

(3) Ultimate Elongation. Perform this test as a part of Tensile Strength using the same specimens. Determine ultimate elongation from the initial jaw separation and the amount of crosshead travel at failure. Report results as a percent of the original gauge length. Repeat the procedure with 8 specimens that have been oven cured for 30 days.

(4) Tear Resistance. Determine tear resistance according to ASTM D 624 using the Die C specimen. Perform testing after 7 days cure. Determine the thickness of the specimen at the point of tear with a dial gauge prior to testing. Use an initial testing machine jaw separation of 2 inches, and a crosshead speed of 2 inches per minute. Test a minimum of 5 specimens.

c. Tests on the Elastomeric Binder-Aggregate Mixture.

(1) Bond Strength to Concrete. Cast the elastomeric concrete against a mortar briquette half (briquette complies to AASHTO T 132). Saw the briquette in half so that the sawed surface area equals approximately 1 sq in. Sandblast the surface. Place the briquette in the mold and cast the elastomeric concrete against the sawed surface. Cure the specimens 7 days in air at 73 ± 3°F. Using the Riehle briquette tester, specimen failure is considered to occur at either the bond interface or in either of the two materials. Test a minimum of 4 specimens. Determine an average tensile breaking stress based on a 1 sq in cross-sectional area.

(2) Wet Bond Strength to Concrete. Prepare mortar briquette halves the same as for Bond Strength to Concrete. After a 5-day cure in air at 73 ± 3°F, immerse the specimens in 73 ± 3°F water for 2 days in a horizontal position. After the immersion period, remove the specimens from the water and subject them to tensile testing with the Riehle briquette tester while still damp. Test a minimum of 4 specimens. Determine an average tensile breaking stress based on a 1 sq in cross-sectional area.

(3) Compressive Stress at 5 % Deflection. The test specimens are cast 1 inch cubes, prepared so as to have flat, parallel opposing faces free from irregularities. Cure the specimens seven days in air at 73 ± 3°F. Determine the original thickness of the specimen within 0.001 inch without a load. Place the specimen in the compression machine, apply a 100 pound load, and zero a dial gauge. Load the specimen at a rate of 0.15 inch per minute until a deflection of 0.10 inch is reached, at which point the compressive load is recorded and removed. Test a minimum of four cubes and calculate an average compressive stress based on the original 4 in.^{2} area.

(4) Resilience. The Resilience test is a continuation of the Compressive Stress at 5 % Deflection test. After removal of the load, the specimen is allowed to recover for five minutes, after which the thickness is re-measured. Resilience is the percent recovery and is calculated as follows:

$$\text{Resilience} = \frac{(0.10\text{ in.} + \text{final thickness} - \text{initial thickness}) \times (100)}{(0.10\text{ in.})}$$

1508.4 PREQUALIFICATION

a. Manufacturers interested in prequalifying material under this specification must provide 3 sets of 2-component samples (2 for binder tests and 1 for binder-aggregate mixture tests) to the Engineer of Tests for laboratory testing. Provide 1 set of aggregate for binder-aggregate mixture testing. Include a copy of the quality control test report for the batch of material the sample represents, material safety data sheets, and a complete set of mixing and installation recommendations and instructions.

b. The material will be evaluated for compliance with this specification, and the manufacturer will be notified of the results. The Bureau of Construction and Materials will maintain a list of qualified materials. Products will remain on the prequalified list as long as the results of verification testing and field performance are satisfactory. Report any changes in formulation to the Engineer of Tests for review and evaluation to determine if re-qualification is necessary.

1508.5 BASIS OF ACCEPTANCE

a. Prequalification as required by **subsection 1508.4.**

b. Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

c. Visual observation of performance in the field.

SECTION 1509

MEMBRANE SEALANT

1509.1 DESCRIPTION

This specification covers the membrane sealant used in expansions joints as designated in the Contract Documents.

1509.2 REQUIREMENTS

a. Foam Sealant. Provide a foam sealant consisting of an open-cell high density polyurethane foam impregnated with either a polymer modified bitumen or a neoprene rubber suspended in chlorinated hydrocarbons. Precompress the foam sealant prior to packaging. Use a precompressed dimension as recommended by the sealant manufacturer to provide a water tight seal throughout a joint movement range of ±25% (minimum) from the specified joint opening dimension. Do not allow the precompressed dimension to exceed 75% of the joint opening width. Provide a foam sealant that is slowly self expanding to permit workers ample time to install the foam before the foam exceeds the joint opening width. Supply the foam in pieces 5 feet in length or longer. Miter the ends of each piece for ease of joining to the adjacent pieces.

Provide the foam sealant in 3 inch deep pieces (minimum). Provide foam sealant that is ultra-violet and ozone resistant. Provide the foam sealant that meets the requirements shown in **TABLE 1509-1**:

TABLE 1509-1 FOAM SEALANT		
Property	**Test Method**	**Requirements**
Tensile Strength	ASTM D3574	21 PSI min.
Elongation, Ultimate	ASTM D3574	125% ± 20%.
Density, Uncompressed		9 lb./cu. ft. min.
Compressed Density at Joint Width		45 lb./cu.ft. min.
Compression Set	ASTM D3574	3% max.
Softening Point	ASTM D816	140°F. min.
Low Temperature Flexibility (32°F to -10°F)	ASTM C711	No Cracking or Splitting

b. Bonding Adhesive. Provide a waterproof epoxy adhesive that is compatible with concrete and recommended by the manufacturer of the foam sealant.

c. Splice Adhesive. Provide any polyurethane adhesive recommended by the manufacturer of the foam sealant.

1509.3 TEST METHODS

Test in accordance with the requirements stated in **subsection 1509.2**.

1509.4 PREQUALIFICATION

None required.

1509.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

Visual inspection at destination for condition and compliance with dimensional and other requirements.

SECTION 1510

STRIP SEAL ASSEMBLY

1510.1 DESCRIPTION

This specification covers materials for a bridge expansion joint system using a strip seal assembly as shown in the Contract Documents.

1510.2 REQUIREMENTS

a. Type I.

(1) Provide a Type I Strip Seal assembly that consists of a single continuous neoprene strip or diaphragm seal element inserted into two wedge grips of extruded or rolled steel that are anchored to the bridge. The Engineer will consider other configurations of locking devices or grips to retain the diaphragm in place if the Contractor provides detailed information on the alternate device.

(2) Unless shown otherwise in the Contract Documents, provide grips that comply with the requirements of ASTM A 36 or A 242. The anchoring system for the grips must comply with the details shown in the Contract Documents.

(3) Provide a Polychloroprene (Neoprene) diaphragm that complies with the requirements of ASTM D 2628 (except for recovery requirements), or alternately, ASTM D 2000 3BC 615 A14 B14 C12 F17 (250% minimum ultimate elongation). In the preceding "line call-out", the "15" in 615 refers to minimum tensile strength in hundreds of psi.

(4) Provide a sealant for bonding the neoprene diaphragm to the steel grips that complies with the recommendations of the manufacturer of the assembly.

b. Type II

(1) Provide a Type II assembly that consists of separate units of elastomer and metal or integrally molded components cast under heat and pressure, and anchored to the bridge by bolts or studs.

(2) The assembly must contain a flexible convolution or diaphragm, with or without fabric reinforcement, which links the pads and spans the expansion joint. The diaphragm must be a continuous strip, molded in an upstanding arch, which will retain its shape during the expansion cycle and must permit horizontal, vertical, and skewed movements while still maintaining a watertight seal.

(3) Provide an elastomer manufactured from neoprene that complies with **TABLE 1510-1.**

TABLE 1510-1: TYPE II ELASTOMER		
Property	**ASTM Test Method**	**Requirement**
Tensile Strength	D 412	1500 psi, minimum
Elongation at Break	D 412	200% minimum
Hardness	D 2240	45±10 points, Durometer A
Compression Set, 22 hrs @ 70°C	D 395, Method B	35% maximum
Low Temperature	D 746 or D 2137	Not Brittle @ -40°C
Ozone Resistance, exposure @ 100 PPHM ozone for 70 hrs. @ 40°C, sample under 20% strain	D 1149	No Cracks
Oil Deterioration, volume increase after immersion in IRM 903 Oil for 70 hrs. @ 100°C	D 471	120% maximum

PPHM = Parts Per Hundred Million

(4) Provide a sealant that complies with the recommendations of the manufacturer of the assembly.

(5) Fasten the assembly to the bridge with bolts or studs that complies with details in the Contract Documents and are of a length recommended by the assembly manufacturer.

(6) Provide internal reinforcement plates that comply with the requirements of ASTM A 1011 SS Grade 36, A 36 or similar structural steel.

c. Type III

(1) Provide a Type III assembly that consists of a continuous cellular or strip type neoprene seal, geometrically designed to fasten to or be clamped by the extruded aluminum frames anchored to the bridge by bolts or cast-in-place anchors.

(2) Provide aluminum frame components that comply with the requirements of ASTM B 221 (Alloy 6061-T6).

(3) Fasten the assembly to the bridge with bolts or studs that complies with details in the Contract Documents and are of a length recommended by the assembly manufacturer.

(4) Provide an elastomer manufactured from preformed neoprene that complies with **TABLE 1510-2.**

TABLE 1510-2: TYPE III ELASTOMER

Property	ASTM Test Method	Requirement *
Tensile Strength	D 412	2000 psi, minimum
Elongation at Break	D 412	175% minimum
Hardness	D 2240	70±10 points, Durometer A
Compression Set, 22 hrs @ 70°C	D 395, Method B	25% maximum
Low Temperature	D 746	Not Brittle @ -40°C
Ozone Resistance, exposure @ 300 PPHM ozone for 70 hrs. @ 40°C, sample under 20% strain	D 1149	No Cracks
Oil Deterioration, volume increase after immersion in IRM 903 Oil for 70 hrs. @ 100°C	D 471	80% maximum

***** All test sections taken for the extruded section. PPHM = Parts Per Hundred Million

1510.3 TEST METHODS

Test the materials in accordance with the ASTM standards referenced above.

1510.4 PREQUALIFICATION

None required.

1510.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D Certification as specified in **DIVISION 2600**.

Visual inspection for condition at the point of usage.

SECTION 1511

BRIDGE JOINT SYSTEM - PREFORMED PRESSURIZED ELASTOMERIC NEOPRENE

1511.1 DESCRIPTION

This specification covers material for a bridge expansion joint system using a preformed, pressurized elastomeric neoprene seal as shown in the Contract Documents.

1511.2 REQUIREMENTS

a. Provide a polychloroprene (neoprene) elastomer profile that is preformed by extrusion and vulcanized into its definitive shape, and is supplied in several configurations and dimensions, ranging from 1/4 to 4 inches. See the Contract Documents for profile size requirements. The profile must comply with AASHTO M 297, except it must be capable of being pressurized during installation.

b. Use a double-component, epoxy-based adhesive mixed at the job-site. Apply it to thoroughly cleaned expansion gap walls and outside rough walls of the profile. Provide an epoxy-based adhesive that complies with **TABLE 1511-1**.

TABLE 1511-1: DOUBLE COMPONENT THIXOTROPIC PASTE

Property	Requirement
Tensile Strength	4140 PSI
Axial Compression	8760 PSI
Solids Hardness	5 MOHS
Pot Life	40 Minutes at 68ºF
Flash Point	> 200ºF
Curing Time/Strong Bond Within	24 Hours
Complete Cure	7 Days at 68ºF
(At higher ambient temperatures, the cure will be accelerated.)	

c. Pressurization is done through a valve with a cap system. The profile is pressurized only during installation and curing time of the adhesive, to verify complete bonding throughout the gap/profile surfaces. Air pressure will bleed itself with time or the air valve can be broken loose any time after 24 hours of installation.

1511.3 TEST METHODS

Test the material in accordance with AASHTO M 297.

1511.4 PREQUALIFICATION

None required.

1511.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D Certification as specified in **DIVISION 2600**.

SECTION 1601

STEEL BARS FOR CONCRETE REINFORCEMENT

1601.1 DESCRIPTION

This specification governs the steel bars for concrete reinforcement that are produced from billet steel.

1601.2 REQUIREMENTS

a. General.

(1) Any plant producing steel bars for concrete reinforcement through this specification must be currently prequalified. A plant is any facility that rolls or otherwise produces the bars from the basis steel.

(2) All the bars produced through this specification are to be deformed unless specified otherwise in the Contract Documents.

(3) When it is required to bend and cut bars in order to produce components for a project, conduct these operations in a fabrication shop before shipment to the project. This requirement applies unless it is specified otherwise in the Contract Documents or documented approval is obtained from the Engineer's representative. Heating of the bars to facilitate the bending operation is not permitted.

b. Material Specifications.

- Carbon steel bars . . . . AASHTO M 31
- Rail-steel and Axle-steel bars . . . . .AASHTO M 322

1601.3 TEST METHODS

Conduct all tests required by the applicable AASHTO material specification of **subsection 1601.2b**.

1601.4 PREQUALIFICATION

Follow the instructions on the AASHTO National Transportation Product Evaluation Program's (NTPEP) website to participate in the audit program for reinforcing steel mill.

Forward an official copy of the initial (and latest) NTPEP audit report, including split sample results, to the Bureau Chief of Construction and Materials for evaluation. Producing mills that have successfully met the requirements of the audit (including test results that comply with **subsection 1601.2b.**) and are listed on the NTPEP website as compliant will be prequalified.

In order to maintain prequalified status, send a copy of the annual NTPEP certificate of compliance as soon as it is received. Producing mills that have been removed from the NTPEP website listing will be removed from prequalified status.

For producing mills that attain "provisional" status on the NTPEP website, immediately forward a description of the failing material (sizes, grade, and heat) to the Bureau Chief of Construction and Materials.

Producing mills that fail to provide the annual certificate of compliance or descriptions of failing material associated with a "provisional" NTPEP status, or are no longer in compliance with the audit requirements may be removed from prequalified status.

1601.5 PREQUALIFICATION (Alternate Method)

a. General. Contact the Bureau Chief of Construction and Materials to arrange for the required sampling, observation of testing procedures and review of the plant quality control program.

The plant is to absorb all the Engineer's representative expenses associated with the inspection. This includes travel, subsistence and lodging, and the expenses of shipping the selected specimen bars to the KDOT Materials and Research Center for comparison testing.

It is the option of the Bureau Chief of Construction and Materials to grant approval status to a plant based upon the qualification test and inspection results of the transportation agencies of other states.

A plant will be notified by written documentation in the event of any change in their approval status. The Bureau of Construction and Materials will maintain a list of all plants that are prequalified and approved to provide bars to KDOT projects.

b. Plant Quality Control Requirements. The plant must have a quality control section identified within its organization that is adequately staffed to perform the required lot by lot testing. The plant laboratory must have proper equipment, calibrated according to AASHTO T 67 (ASTM E 4) annually as a minimum, with which to adequately perform all testing according to **subsection 1601.3**. Provide a copy of the plant quality control plan to the Engineer's representative during the plant inspection.

c. Sampling and Testing Procedure. The Engineer's representative will select the test samples, at random, at the plant. Provide access to all facilities necessary for the Engineer's representative to randomly select samples from all lots defined below. Provide plant personnel to cut and label the necessary specimens from the randomly selected bars.

(1) Lot size. The lot of reinforcing bars that is subject to sampling includes all sizes, grades, and heats in stock. Remove the samples from 3 different bars from each of 10 heats, i.e., 30 sample bars, unless exceptions are authorized by the Bureau Chief of Construction and Materials or their designated representative.

(2) The sample length needed by KDOT is 8 feet for all selected bars, #6 and smaller; 9 feet for all selected bars, #7 thru #11; and 10 feet for all selected bars larger than #11. Please note: These are minimum lengths needed for KDOT's use. Additional sample length will be needed to satisfy the plant's testing requirements.

(3) Sample preparation. Assign each sample bar a unique identification number. Durably affix this number to each end of the bar. Cut each sample bar into 2 specimen preparation sections. One section is for testing by the plant and the companion section, having the length specified above, is for the comparison testing by KDOT. Conduct all sample preparation operations in the presence of the Engineer's representative.

(4) Specimen testing. Test the specimens according to the procedures and requirements of the applicable AASHTO specification as referenced in **subsection 1601.2b**. For the purpose of comparing the plant and KDOT testing laboratories, one tensile and bend test specimen set from each sample is to be tested by each laboratory. Provide all the necessary facilities and test records required by the Engineer's representative to witness the tests.

The Engineer's representative will witness all relevant testing performed by the producer. Record the plant test results onto a KDOT form and sign the form. Provide these results to the Engineer's representative for submittal to the KDOT central laboratory.

Submit the remaining companion sections from each sample to the KDOT central laboratory. It is mandatory that these sections each have at least one occurrence of the plant's unique mill marking character set that identifies the bar.

(5) Comparison testing. The companion sections will each provide a tensile and bend test specimen set that will be tested by the KDOT central laboratory according to the procedures and requirements of **subsection 1601.2b**.

The KDOT results will be compared to the parallel plant data from each heat for variations and differences. These variations and differences may not exceed the following, based on the KDOT values as the reference where applicable:

TABLE 1601-1: STEEL BARS COMPARISON TESTING

Property	Individual Specimen	Average Specimen
Yield Strength	15%	6%
Tensile Strength	10%	4%
Δ Elongation, %	9	6

All variations and differences are absolute value based.

A heat that fails the comparison requirements may be resampled 1 time only, and on a 2 to 1 basis. It is preferred that the resample be removed from the same heat that failed. The initial test results will be replaced by those of the resample specimens.

d. Plant Status.

(1) Attainment of prequalified status. In order for a plant to be prequalified to provide bars to KDOT projects, the following requirements must be complied with:

(a) With the exceptions as noted in (b) and (c) to follow, no single heat of those tested is permitted to fail to comply with the applicable requirements referenced in **subsection 1601.2b**.

(b) No lot tested by the KDOT may have any of the individual test results for yield strength, tensile strength, or elongation below the AASHTO specified minimum values without the deficiency also being identified by the plant quality control section.

(c) It is permissible for one bend test specimen from one heat only to fail the bend test.

(d) The variations from the comparison testing are not to exceed the values stated in **subsection 1601.5c.(5)** for any heat.

(2) Renewal of prequalified status. The following schedule will apply to plants that have attained their initial prequalification status:

(a) One year after the initial prequalification, the plant will again be evaluated according to **subsection 1601.5.**

(b) For plants that retain prequalification after the second evaluation, the next evaluation will be required after a 2-year time interval.

(c) For plants that retain prequalification after the third evaluation, the required evaluation time interval will be extended to 3 years thereafter providing the plant is not disqualified.

(d) A prequalified plant that becomes disqualified must comply with all the requirements that apply to a plant that is attempting the initial prequalification, with the following exception. The disqualified plant may petition for an immediate reevaluation provided it can be demonstrated to the Bureau Chief of Construction and Materials that the disqualifying deficiencies have been corrected.

1601.6 VERIFICATION

a. Samples. All prequalified plants that are currently providing bars for KDOT projects will have their product quality monitored through the use of verification samples. The Regional Materials Laboratories will randomly select on average 1 verification sample per month from the bars being provided by each prequalified plant for use on KDOT projects. Special arrangements may be considered for plants providing small quantities during the course of a year. These samples are to include all bar grades and sizes that may be available for use on KDOT projects. These samples will be obtained from various shipments and at any fabrication, coating, or precast facility, or warehouse selected by the Regional Materials Engineer. On occasion, it will be necessary for the Regional Materials Engineer to notify the District to obtain verification samples at a project. Samples will be submitted to the MRC for testing according to the procedures and requirements of **subsection 1601.2b**. Reduction in sampling will follow the criteria established in Part V, Appendix A, Multi-level Sampling Frequency Chart, with the following exception: Reduced Frequency Approved by Regional Materials Engineer with Notification to Bureau of Construction and Materials.

b. Sample testing. The verification samples are to comply with the minimum requirements of the applicable AASHTO specification of **subsection 1601.2b.** with the exceptions as noted in the following.

- It will be permissible for the test results from only one annual verification sample from each prequalified plant to be less than the following:

TABLE 1601-2: STEEL BARS VERIFICATION TESTING	
Property	**Requirement**
Unit Weight:	99% of the specified minimum
Yield Strength:	95% of the specified minimum
Tensile Strength:	95% of the specified minimum
Elongation, %:	Specified minimum minus 2

- Not more than 10% of the annual verification samples from each prequalified plant will be permitted to have test results less than the applicable specification minimums.
- Not more than one annual verification sample from each prequalified plant will be permitted to fail the bend test.
- In the event that the verification samples fail to comply with the proceeding, the Engineer's representative may resample the failing heat(s) one time only on a 2 to 1 basis or reject the failing heat(s). The Contractor is to replace the rejected heats at no additional cost to the KDOT. The initial test results will be replaced by those of the resample specimens.

c. Disqualification. Failure of the verification sample bars from a plant to comply with **subsection**

1601.6b. will result in disqualification of the plant and removal from the prequalified source list. In the event of disqualification, the plant is subject to the prequalification requirements of **subsection 1601.5** even if originally prequalified under **subsection 1601.4**. A plant that fails to comply with **subsection 1601.6b.** 2 times, consecutive or otherwise, will be permanently disqualified.

1601.7 BASIS OF ACCEPTANCE

a. The plant must be currently prequalified.

b. Submit for approval a Type A certification (certified mill test report), as specified in **DIVISION 2600**, that governs the analysis of all bar steel heats delivered to the project.

c. The Engineer’s representative of the project must be provided with shipping orders, an invoice, or cover letter that documents the project number, bar sizes and grades, heat, job, or mill order number(s), and the total weight of each heat of the represented bars delivered to the project.

d. The Engineer’s representative of the project must be provided with a document stating that the bars delivered to the project comply with this specification. This documentation must bear the signature and title of an official of the plant with Contract Document binding authority, and must be notarized. This requirement may be included on the certified mill test report referenced in **subsection 1601.7b**.

e. Single or bound groups of bars must be tagged or otherwise marked in a durable manner. At a minimum, this identification must list the bar manufacturer’s corporate identification and plant location, the heat number, and job or mill order number. Display a copy of the plant’s unique mill marking character set that identifies the bar on the tag.

f. The final disposition of the bars will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition.

SECTION 1602

EPOXY COATED STEEL FOR CONCRETE REINFORCEMENT

1602.1 DESCRIPTION

This specification covers the requirements for epoxy coated steel for concrete reinforcement. The protective epoxy coating is applied to the reinforcing steel by the electrostatic spray or the electrostatic fluidized-bed method.

1602.2 REQUIREMENTS

a. General.

(1) Appendices to the standards cited below that are identified as non-mandatory information in those standards, are to be considered mandatory information for the purposes of this specification.

(2) Applicators must be certified under the Concrete Reinforcing Steel Institute (CRSI) Epoxy Coating Plant Certification program.

b. Epoxy Coated Steel Bars.

(1) Unless shown otherwise in the Contract Documents, use uncoated steel bars that comply with **SECTION 1601** for straight bars or **SECTION 1604** for helical reinforcement.

(2) Apply an epoxy coating that complies with ASTM A 775.

(3) Fabricators must comply with the provisions of ASTM D 3963, "Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars."

c. Epoxy Coated Steel Wire and Welded Wire Fabric.

(1) Unless shown otherwise on the Contract Documents, use material which complies with **SECTION 1603** for welded wire fabric or **SECTION 1604** for steel wire.

(2) Apply an epoxy coating that complies with ASTM A 884, Type 1 with Class A coating thickness. Prestressed beams may utilize preformed welded wire fabric having an ASTM A 884, Type 2 coating. Do not re-bend after applying the Type 2 coating.

d. Dowel Bars and Straight Tie Bars* for Pavement.

(1) Use steel bars that comply with **SECTION 1601**.

(2) Apply an epoxy coating that complies with ASTM A 775.

(3) Coating or patching material need not be applied to the cut end faces of the bars. For dowel bars to be mounted in baskets, coating will not be required within 2 inches of the end that will be fixed in the supporting basket by welding.

(4) Cut the bars by a method that minimizes heat input and surface damage and results in no appreciable deformation of the ends.

* Refers to straight bars that are not bent after being epoxy coated. For field straightened tie bars (delivered bent), provide uncoated Grade 40 steel bars that comply with **SECTION 1601**. Do not use epoxy coated steel for field straightened tie bars.

1602.3 TEST METHODS

As specified in the ASTM standards referenced above.

1602.4 PREQUALIFICATION

a. Applicators. Epoxy coating applicator plants supplying material to KDOT projects must be prequalified. Follow the instructions on CRSI's website to participate in the Epoxy Coating Plant Certification program. Send a copy of the most recent yearly certification, grade sheets and inspection notes, as well as audit responses when applicable, to the Bureau of Construction and Materials for review.

In order to maintain prequalified status, send copies of the yearly certification, grade sheets and inspection notes, as well as audit response when applicable, each year as soon as they are received from CRSI. Failure to provide copies of this information may result in removal from prequalified status.

b. Organic Coatings. Organic coatings used for protection of reinforcing steel under this specification must be prequalified under ASTM A 775 or in the case of dowel bars or straight tie bars for pavement, ASTM A 934 if applicable. Manufacturers desiring to supply material should submit a certified test report by an independent laboratory regularly inspected by the Cement and Concrete Reference Laboratory (CCRL) to the Bureau of Construction and Materials.

c. Patching Material for Organic Coatings. Patching material for organic coatings used for protection of reinforcing steel under this specification must be prequalified under ASTM D 3963. Manufacturers desiring to supply material should submit a certified test report by an independent laboratory regularly inspected by the Cement and Concrete Reference Laboratory (CCRL) to the Bureau of Construction and Materials.

d. Prequalified Lists. The Bureau of Construction and Materials will maintain lists of prequalified applicators, organic materials and patching materials for use on KDOT projects.

1602.5 BASIS OF ACCEPTANCE

Receipt and approval by the Regional Materials Laboratory of the documents required for the uncoated reinforcing steel.

Receipt and approval by the Regional Materials Laboratory of a certification prepared by the Plant that applied the coating, stating that all bars have been coated in accordance with this specification. Provide this certification to the KDOT representative at the coating plant.

Satisfactory results of bend tests (if applicable), coating thickness and continuity tests conducted on the coated material by representatives of KDOT.

Visual inspection at destination for proper tagging of each bundle to enable identification of each heat or lot, for condition and for other properties.

SECTION 1603

WELDED STEEL WIRE FABRIC FOR CONCRETE REINFORCEMENT

1603.1 DESCRIPTION

This specification governs the welded steel wire fabric for concrete reinforcement that is produced from deformed or non-deformed steel wire or a combination thereof.

1603.2 REQUIREMENTS

a. General.

(1) Any plant producing welded steel wire fabric for concrete reinforcement through this specification must be currently prequalified. A plant is any facility that welds the steel wire fabric from wire produced internally or obtained from an external source.

(2) The fabric provided through this specification can be produced from deformed or non-deformed wire or a combination of both unless specified otherwise in the Contract Documents.

(3) The fabric is to be produced to the dimensions and sizes as specified the Contract Documents. Deviations from this requirement must have the documented approval of the Engineer's representative.

b. Material Specifications.

- Non-deformed steel wire ....AASHTO M 32
- Deformed steel wire ....AASHTO M 225
- Fabric produced from non-deformed steel wire ....AASHTO M 55
- Fabric produced from deformed wire or a combination of deformed and non-deformed wire ....AASHTO M 221

1603.3 TEST METHODS

Conduct all tests as specified in **subsection1603.2b**.

1603.4 PREQUALIFICATION

Follow the instructions on the AASHTO National Transportation Product Evaluation Program's (NTPEP) website to participate in the welded wire producing mill audit program.

Forward an official copy of the initial (and latest) NTPEP audit report, including split sample results, to the Bureau Chief of Construction & Materials for evaluation. Producing mills that have successfully met the requirements of the audit (including test results that comply with **subsection 1603.2b.**) and are listed on the NTPEP website as compliant will be prequalified.

In order to maintain prequalified status, send a copy of the annual NTPEP certificate of compliance as soon as it is received. Producing mills that have been removed from the NTPEP website listing will be removed from prequalified status.

For producing mills that attain "provisional" status on the NTPEP website, immediately forward a description of the failing material (sizes, grade, and heat) to the Bureau Chief of Construction & Materials.

Producing mills that fail to provide the annual certificate of compliance or descriptions of failing material associated with a "provisional" NTPEP status, or are no longer in compliance with the audit requirements may be removed from prequalified status.

1603.5 PREQUALIFICATION (Alternate Method)

a. General. Contact the Bureau Chief of Construction and Materials to arrange for the required sampling, observation of testing procedures and review of the plant quality control program.

The plant is to absorb all the Engineer's representative's expenses associated with the inspection. This includes travel, subsistence and lodging, and the expenses of shipping the selected wire and fabric specimens to the KDOT Materials and Research Center for comparison testing.

It is the option of the Bureau Chief of Construction and Materials to grant prequalified status to a plant based upon the qualification test and inspection results of the transportation agencies of other states.

A plant will be notified by written documentation in the event of any change in their prequalified status. The Bureau of Construction and Materials will maintain a list of all plants that are prequalified to provide fabric to KDOT projects.

b. Plant Quality Control Requirements. The plant must have a quality control section identified within its organization that is adequately staffed to perform the required lot by lot testing. The plant laboratory must have proper equipment, calibrated according to AASHTO T 67 (ASTM E 4) annually as a minimum, with which to adequately perform all testing required through **subsection1603.3**. Provide a copy of the plant quality control plan the Engineer's representative during the plant inspection.

c. Sampling and Testing Procedure. The Engineer's representative will select the test samples, at random, at the plant. Provide access to all facilities necessary for the Engineer's representative to randomly select samples from all lots defined below. Provide plant personnel to cut and label the necessary specimens from the randomly selected wire and fabric.

(1) Lot size. The reinforcing fabric and wire that is subject to sampling includes all sizes and production lots of fabric, and heats or lots of wire in stock. Remove the fabric samples from 10 different production lots. Remove 3 wire samples from each of 10 different lots, heats when available, of wire being utilized to produce fabric at the plant. Vary the size of the fabric and wire that is sampled to the greatest extent that availability permits. This is for the purpose of obtaining a representative cross-section of the plant production. These sampling requirements apply unless exceptions are authorized by the Bureau Chief, Construction and Materials, or their designated representative.

(2) Fabric samples are to be contiguous sections, i.e., all wires and welds intact, that are 6 longitudinal or 'running' wires in width by 10 transverse wires in length. Wire tensile samples are to be 2 m in length.

(3) Sample preparation. Assign each fabric and wire sample a unique identification number. Durably affix this number to each end of the wire tensile and fabric samples. For definition purposes, the length direction of a fabric sample is parallel to the longitudinal wires. Cut each fabric and wire sample into 2 equal length specimen preparation sections. This cut is perpendicular to the longitudinal wires for the fabric samples. Each wire section provides a tensile and bend test specimen and each fabric section provides 4 weld shear test specimens. The specimens from one section are for testing by the plant and the specimens from the companion section are for the comparison testing by the KDOT. Leave the KDOT's specimen preparation sections in one piece. Conduct all sample preparation operations in the presence of the Engineer's representative.

(4) Specimen testing. Test the specimens according to the procedures and requirements of the applicable AASHTO specification as referenced in **subsection 1603.2b**. For the purpose of comparing the plant and KDOT testing laboratories, one tensile and bend test set from each sample and one weld shear test specimen set from each sample is to be tested by each laboratory. Provide all the necessary facilities and test records required by the Engineer's representative to witness the tests.

The Engineer's representative will witness all relevant testing performed by the producer. Record the plant test results onto a KDOT form and sign the form. Provide these results to the Engineer's representative for submittal to the KDOT central laboratory.

Submit the remaining companion sections from each sample to the KDOT central laboratory. It is mandatory that these sections retain their unique identification number during shipment and when delivered to the central laboratory.

(5) Comparison testing. The companion sections will each provide a tensile and bend test specimen set and a set of 4 weld shear test specimens that will be tested by the KDOT central laboratory according to the procedures and **subsection 1603.2b**.

The KDOT results will be compared to the parallel plant data from each heat or lot for variations and differences. These variations and differences may not exceed the following, based on the KDOT values as the reference where applicable:

TABLE 1603-1: WELDED STEEL WIRE FABRIC COMPARISON TESTING		
Property	**Individual Specimen Test Results**	**Average Test Results for the Heat or Lot**
Tensile Strength	10%	5%

All variations and differences are absolute value based.

A heat or lot that fails the comparison requirements may be resampled one time only, and on a 2 to 1 basis. It is preferable that the resample be removed from the same heat or lot that failed. The initial test results will be replaced by those of the resample specimens. A lot that fails the weld shear test requirements may be resampled in accordance with the procedures of **subsection 1603.2b**.

d. Plant Status.

(1) Attainment of prequalified status. In order for a plant to be prequalified to provide welded wire fabric to KDOT projects, the following requirements must be complied with:

(a) With the exceptions as noted in (b) and (c) to follow, no single heat of those tested is permitted to fail to comply with the applicable requirements referenced in **subsection 1603.2b**.

(b) No heat or lot tested by the KDOT may have any of the individual test results for yield strength, tensile strength, reduction of area (when applicable), or the average weld shear strength below the AASHTO specified minimum values without the deficiency also being identified by the plant quality control section.

(c) It is permissible for one bend test specimen from 1 heat or lot only to fail the bend test.

(d) The variations from the comparison testing are not to exceed the values stated in **subsection 1603.5c(5)** for any heat or lot of wire.

(2) Renewal of prequalified status. Plants that have attained their initial prequalification status will remain prequalified unless the results of verification samples indicate quality control deviations, or there are significant changes in production methods or material characteristics. Any variations in production methods or material characteristics must be immediately brought to the attention of the Bureau Chief, Construction and Materials, to determine if a subsequent prequalification evaluation is required.

A prequalified plant that becomes disqualified must comply with all the requirements that apply to a plant that is attempting the initial prequalification, with the following exception. The disqualified plant may petition for an immediate reevaluation provided it can be demonstrated to the Bureau Chief, Construction and Materials, that the disqualifying deficiencies have been corrected.

(3) Disqualification. All prequalified plants that are currently providing welded steel wire fabric for KDOT projects will have their product quality monitored through the use of verification samples.

(a) Verification samples. During the course of each calendar year, every KDOT District will randomly select a minimum of one verification sample from the fabric being provided by each prequalified plant for use on KDOT projects in the District. These samples will be drawn from various shipments and heats and may be obtained at the project, fabrication, or warehouse locations or any other location approved by the Engineer's representative. These samples will be submitted to the KDOT central laboratory for testing according to the procedures and requirements of **subsection 1603.2b**.

(b) Verification sample testing. The verification samples are to comply with the minimum requirements of the applicable AASHTO specification of **subsection 1603.2b** with the exceptions as noted in the following.

- It will not be permissible for the test results from any annual verification sample from a prequalified plant to be less than the following:

TABLE 1603-2: WELDED STEEL WIRE FABRIC VERIFICATION TESTING	
Property	**Requirement**
Unit Weight, Deformed Wire only:	98% of the specified minimum
Weld Shear Strength, Average	95% of the specified minimum
Tensile Strength	95% of the specified minimum
Reduction of Area,%, Non-deformed Wire only:	Specified minimum minus 2

- No annual verification sample from a prequalified plant will be permitted to fail the bend test.
- In the event that the verification sample fails to comply with the preceding, the Engineer's representative may resample the failing lot one time only on a two to one basis or reject the failing lot. The contractor is to replace the rejected lot at no additional cost to the KDOT. The initial test results will be replaced by those of the resample specimens.

Failure of the verification sample fabric from a plant to comply with the sample requirements of **subsection 1603.5d(3)(b)** will result in disqualification of the plant and removal from the prequalified source list. In the event of disqualification, the plant is subject to **subsection 1603.5**. A plant that fails to comply with **subsection 1603.5d(3)(b)** 2 times, consecutive or otherwise, will be permanently disqualified.

1603.6 BASIS OF ACCEPTANCE

The plant must be currently prequalified.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Single sections, bound sections or rolls, or otherwise grouped fabric must be tagged or otherwise marked in a durable manner. At a minimum, this identification must list the fabric manufacturers corporate identification and plant location, the heat, lot, job, or mill order number, and display a copy of the of the identification markings attached to the delivered materials.

The final disposition of the fabric will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition.

SECTION 1604

HELICAL REINFORCEMENT

1604.1 DESCRIPTION

This specification covers steel wire and steel bars intended for use in helical reinforced members.

1604.2 REQUIREMENTS

Provide materials that comply with AASHTO M 32 for plain, uncoated wire, or AASHTO M 31 for carbon steel bars.

1604.3 TEST METHODS

Test methods as cited in the AASHTO references.

1604.4 PREQUALIFICATION

Manufacturers desiring to provide material under this specification must be prequalified under the provisions of:

- Steel bars .... SECTION 1601
- Uncoated wire .... SECTION 1603
- Epoxy coated reinforcement .... SECTION 1602

1604.5 BASIS OF ACCEPTANCE

Prequalification as required by **subsection 1604.4**.

Submit for approval a Type A certification (certified mill test report), as specified in **DIVISION 2600**, that governs the analysis of all bar or wire steel heats delivered to the project.

Receipt and approval by the Engineer of a copy of the shipping orders or invoice showing the project number, heat or lot number, steel size and quantity in the shipment.

Tag each bundle of helical reinforcement sent to the project with a plastic or metal tag which lists the plant name and the heat or lot number, or other identification tying the material to the certifications and invoices as stated above in this subsection.

SECTION 1605

REINFORCING STEEL SPLICES

1605.1 DESCRIPTION

This specification covers devices and systems for splicing steel bars for concrete reinforcement.

Thermomechanical splices are produced by a process that introduces molten filler metal into an annular space around the bars created by a high strength steel sleeve of larger diameter than the bars.

Make the mechanical splices with any mechanical device or system which will meet the physical requirements cited below.

1605.2 REQUIREMENTS

When tested in tension, develop all splices to at least 125% of the minimum yield strength specified for the bars being spliced.

After loading in tension to 30 ksi then relaxing to 3 ksi, the total slip of the bar within the splice sleeve shall not exceed 0.01 inch for #14 bars and smaller, and 0.03 inch for #18 size bars. Displacements will be measured between gage points clear of the splice sleeve.

For those splicing systems to be prequalified in the "fatigue resistant" group, provide splices capable of withstanding a load range of 12 ksi (3 ksi to 15 ksi, tension) for a minimum of 1,000,000 cycles.

Prepare and mount splices on bars in a fabricator's shop for shipment to the project that meet **SECTION 1601** including prequalified plant status.

1605.3 TEST METHODS

Splicing devices or systems will be tension tested according to the procedures of AASHTO M 31, "Deformed and Plain Carbon Steel Bars for Concrete Reinforcement" and slip tested according to **subsection 1605.2**.

1605.4 PREQUALIFICATION

Prepare 3 fully assembled test specimens each for bar sizes number 4, 6 and 8, and forward them to the Engineer of Tests along with the following information:

- Name, address and telephone number of the manufacturer. Include the name of the preferred contact person.
- Brand name of the splice.
- Type and description of the splice.
- Information regarding recommended usage and splicing instructions.
- Material Safety Data Sheets (if applicable).
- For those splicing systems to be prequalified in the "fatigue resistant" group, submit test results from an independent testing laboratory demonstrating that the splice meets the fatigue requirements described above. Test splices for #4, #8, and #11 size, Grade 60 reinforcing steel. These sizes represent the small, medium, and large sizes common in construction.

Exceptions to the bar sizes specified above may be authorized by the Engineer of Tests.

The samples provided will be tested to destruction and test reports prepared. During testing, the Engineer of Tests will determine if operator prequalification is required for field and/or fabricator shop splicing, and enter that information on the test reports. The test reports and the information supplied will be reviewed by the Bureau Chief of Construction and Materials. The manufacturer will be advised as to whether or not the product is prequalified.

The Bureau of Construction and Materials will maintain a list of prequalified splicing systems. Products will remain prequalified as long as the manufacturing processes remain unchanged, and field experience indicates that the product functions appropriately. Changes in manufacturing processes require new prequalification testing. Failure of the product to function appropriately in the field will be cause for removal from prequalified status. Products removed from prequalified status will be considered for requalification if the manufacturer can provide evidence that the cause of failure has been positively identified, and necessary changes and quality control measures have been implemented to eliminate that cause. Complete prequalification testing will be required for products that have been removed from prequalified status.

1605.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1605.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Satisfactory results of testing by lot during construction, as outlined in **DIVISION 700**. Samples submitted should be fully assembled in the field by personnel that will be performing the assembly operation.

SECTION 1606

STRAND FOR PRESTRESSED CONCRETE

1606.1 DESCRIPTION

This specification covers 7-wire, non-coated steel strand for use in pre-tensioned, pre-stressed concrete construction.

1606.2 REQUIREMENTS

Provide wire strand for use in bonded and pre-tensioned concrete that complies with ASTM A 416. Provide low relaxation, Grade 270 strand unless otherwise specified.

Store strand provided under this specification under conditions which maintains the strand in a dry condition and not in direct contact with the soil. When properly stored, the strand may remain in storage for a period not to exceed 6 months from the date of delivery to the pre-stress concrete production plant. Strand in storage in excess of 6 months must be re-tested by the manufacturer or an independent laboratory and a new certification issued before using it.

1606.3 TEST METHODS

Test material as specified in ASTM A 416.

1606.4 PREQUALIFICATION

None Required.

1606.5 BASIS OF ACCEPTANCE

Acceptance of strand provided under this specification will be based on satisfactory results of tests conducted at the MRC on samples representing each lot of material.

SECTION 1607

STRUCTURAL STEEL

1607.1 DESCRIPTION

This specification governs the structural steel shapes, plates, bars, and bearing pins utilized for construction purposes.

1607.2 REQUIREMENTS

a. General. Dimensions, standard ASTM/AISC shapes, and specific fabrication requirements are as specified in the Contract Documents. Property requirements for the base steel are governed by the classification, designation, or grade of steel specified in the Contract Documents and in accordance with **subsection 1607.2b**. If a steel component is utilized in a fracture critical application, this must be designated in the Contract Documents according to the provisions of AASHTO M 270 inclusive of Supplementary Requirement S84.

b. Structural Steel.

(1) Provide steel that complies with AASHTO M 270 or ASTM A 709. Miscellaneous structural items may utilize ASTM A 36 or A 500; etc., but material changes to the Contract Documents require the approval of the State Bridge Office or the Bureau of Construction and Materials, Operations Engineer. When AASHTO M 270 is specified, and unless shown otherwise in the Contract Documents, the requirements for toughness testing, Zone 2 or Zone 3 level as specified in the Contract Documents, are mandatory whether the steel component is subject to tensile stress or utilized in a fracture critical application or not. When ASTM A 709 followed by the letter “T” or “F” and a temperature zone number is specified, the supplementary requirements for toughness described above for AASHTO M 270 are required.

(2) Steel component edges that are produced by methods, such as mechanical shearing, that induce significant residual stress fields are to be stress relieved by machining not less than ¼ inch of material from the edge if the component is over 5/8 inch in thickness and subject to a calculated stress field. Fabrication procedures that produce low radius edge intersections are to have these stress concentration effects reduced by a fillet at the intersection of not less than 1 inch radius in accordance with the requirements and procedures of AASHTO/AWS D1.5. Discontinuities such as seams, rolling laps, tears, gas porosity etc. observed in steel components and weldments are subject to the detection methods, acceptability criteria, repair methods and procedures, and other requirements of AASHTO/AWS D1.5. Unless specified otherwise, steel components and fabrications are subject to AASHTO/AWS D1.5 for the quality of the final product. In addition, all structural steel components are subject to the quality requirements of ASTM A 6 throughout the fabrication process.

(3) Produce bearing pins from steel that complies with ASTM A 108, SAE 1018, or **subsection 1607.2b.(1)** unless specified otherwise in the Contract Documents.

c. Structural Steel (Merchant Quality). This is a hot-rolled carbon steel in shapes or bars for use in non-critical parts of a structure or facility. It must be suitable for moderate cold bending, moderate hot forming, punching and welding, and capable of serving it’s intended purpose.

1607.3 TEST METHODS

Conduct all tests required by the applicable AASHTO, ASTM, AISC, AWS, or other component or material specifications of **subsection 1607.2b**.

1607.4 PREQUALIFICATION

Not applicable.

1607.5 BASIS OF ACCEPTANCE

a. Structural Steel. Submit for approval a Type A certification (certified mill test report), as specified in **DIVISION 2600**, that governs the analysis of all bar steel heats delivered to the project.

b. Structural Steel (Merchant Quality). Acceptance will be based on visual inspection for condition and compliance with dimensional requirements.

c. The final disposition of steel components provided through this specification will be completed at the final destination as the result of inspection by field personnel for the quality of workmanship, the delivery condition, compliance with dimensional requirements and receipt. Certain fabricated structural components may also require inspection during the production process at the fabrication facility.

SECTION 1608

STRUCTURAL STEEL TUBING

1608.1 DESCRIPTION

This specification governs cold and hot formed welded and seamless steel structural tubing. This includes round, square, rectangular, or special shape structural tubing, tapered or nontapered, for welded, riveted, or bolted construction of bridges, buildings, and general applications.

1608.2 REQUIREMENTS

a. General.

(1) Unless specified otherwise in the Contract Documents, welds in tubing and structures fabricated from tubing are to comply with AWS D1.1. Circumferential welds and longitudinal welds within the area of a slip joint are to exhibit complete joint penetration. Other longitudinal welds are permitted partial joint penetration as a percentage of the governing plate thickness. This value is not permitted to be less than 60% for a plate thickness of 0.4 inch or less and not less than 80% for a plate thickness greater than 0.4 inch. Discontinuities such as hot and cold cracks, craters, undercut, gas porosity, inclusions, etc. observed in welds are subject to the detection methods, acceptability criteria, repair methods and procedures, and AWS D1.1. Nonstandard or special shape tubing is to comply with the design specified in the Contract Documents.

(2) If not governed by the component specification, when corrosion protection coatings are specified for tubing and tubing structures, these components are to be zinc coated by hot dip galvanizing after fabrication in compliance with ASTM A 123, Thickness Grade 85. Aluminum coating application after fabrication is acceptable when permitted and regulated by the specification that governs the component.

Grade 85 should still be a valid designation.

b. Materials Specifications.

- Cold formed welded and seamless structural steel tubing .... ASTM A 500
- Hot formed welded and seamless structural steel tubing .... ASTM A 501

1608.3 TEST METHODS

Conduct all tests required by the applicable ASTM, AWS, or other component or material specifications of **subsection 1608.2**. Coating thickness may be measured by any one of the methods specified in ASTM B 633 and by eddy current methods, ASTM B 244, provided that appropriate calibration procedures and standards have been applied. The magnetic induction and eddy current methods are nondestructive in nature and are preferred. Destructive techniques, i.e., coating removal, may be utilized as referee methods.

1608.4 PREQUALIFICATION

Not applicable.

1608.5 BASIS OF ACCEPTANCE

Submit for approval to the project Engineer and Materials Regional Laboratory a Type A certification (certified mill test report), as specified in **DIVISION 2600**, that governs the analysis of all heats delivered to the project.

Inspection, and testing when applicable, by field personnel of steel structural tubing and structures fabricated from this tubing for compliance with corrosion protection coating thickness, weld quality, and dimensional requirements.

The final disposition of tubing and structures fabricated from tubing will be completed at the final destination as the result of inspection for the quality of workmanship, the delivery condition.

Certain fabricated tubing and tubing structures may also require inspection during the production process at the fabrication facility.

SECTION 1609

STEEL PILING AND PILE POINTS

1609.1 DESCRIPTION

This specification governs structural steel piles, steel shells to be utilized as forms for in situ cast concrete piles, steel sheet piling, and fabricated or cast steel pile points.

1609.2 REQUIREMENTS

a. General. Dimensions, standard ASTM/AISC shapes, pipe and tubing sizes, weights, wall thickness, and specific fabrication requirements are as specified in the Contract Documents. Comply with nationally accepted size standards whenever possible. Property requirements for the base steel are governed by the classification, designation, or grade of steel specified in the Contract Documents and with **subsection 1609.2b.**

b. Materials Specifications.

(1) Unless specified otherwise, provide steel piles that comply with the ASTM/AISC standard shape dimensions and ASTM A 6. The majority of the AISC shapes are also governed by the ASTM specification, in that instance, the ASTM requirements prevail. Unless specified otherwise, provide steel that complies with ASTM A 709 Grade 50 or ASTM A 572 Grade 50. As a minimum, each pile section must have the heat number durably affixed to it.

(2) Steel shells with respect to their longitudinal dimension may be of a uniform or tapered section, fluted, helix corrugated, or a non-deformed surface round pipe.

Pipe may be seamless, electric resistance welded longitudinally, or welded in a helix pattern by gas metal arc welding (GMAW) or other acceptable method. Furnace welding is not permitted. Provide pipe or pipe piles for shells that complies with ASTM A 252 Grade 3. Unless specified otherwise, provide steel for fluted and corrugated shells that complies with ASTM A 568 cold rolled carbon steel sheet SAE 1010, maximum carbon level.

The dimensional and weight tolerances of ASTM A 252 apply to all steel shells with the diameter of fluted and helix corrugated shells defined by the flute or helix crown diameter. Specify wall thickness in thousandths of an inch. The degree of taper for tapered shells is as defined in the Contract Documents with the outside diameter at any location as previously defined.

Any completed shell, with point, is to be of sufficient rigidity so as to as to retain the original shape profile, resist the soil pressure, and not permit the influx of water after it and the adjacent shells have been driven into place. As a minimum, each pile section must have the heat number durably affixed to it.

(3) Provide steel sheet piling that complies with AASHTO M 202. As a minimum, each section must have the heat number durably affixed to it.

(4) Pile points may be fabricated or cast from steel as specified in the Contract Documents. For steel piles, provide only cast steel points that comply with ASTM A 148, Grade 80-50. For steel shells, fabricate points out of steel that complies with ASTM A 36 or provide cast steel points that comply with ASTM A 27, Grade 65-35. Other steels and fabrication procedures may be used if granted prior approval by the KDOT. Submit shop drawings that provide detailed dimensions, steel designation, point attachment methods, and any other pertinent information to the KDOT for approval. As a minimum, each point must have the heat or lot number durably affixed to it.

1609.3 TEST METHODS

Conduct all tests required by the applicable AASHTO, ASTM, AISC, or other component or material specifications of **subsection 1609.2b**.

1609.4 PREQUALIFICATION

Not applicable.

1609.5 BASIS OF ACCEPTANCE

Submit for approval a Type A certification (certified mill test report), as specified in **DIVISION 2600**, that governs the analysis of all heats delivered to the project. Components are to be identified according to **subsection 1609.2b**.

The final disposition of structural steel pile sections and points provided through this specification will be completed at the final destination as the result of inspection by field personnel for the quality of workmanship, the delivery condition, the condition after being driven, compliance with dimensional requirements, receipt and approval of the associated required documentation, and proper identification of the components.

SECTION 1610

STEEL FOR BRIDGE DRAIN SYSTEMS

1610.1 DESCRIPTION

This specification governs steel drainage systems applied to bridges.

1610.2 REQUIREMENTS

a. General. The drainage system design, dimensions, method of corrosion protection, and specific fabrication requirements are to be as specified in the Contract Documents. Each method of corrosion protection dictates the use of certain steels. Only 1 method of corrosion protection is allowed for a structure. Property requirements for the steels and components are governed by the classifications, designations, or grades of steel, and the component specifications designated in the Contract Documents and in accordance with **subsection 1610.2b**.

b. Material Specifications.

(1) When it is specified that corrosion protection be provided by zinc coatings applied by hot dip galvanizing, identified as HDG, use structural steel and pipe that complies with ASTM A 36 and A 53 respectively. The testing requirements of **DIVISION 1600** for A 53 pipe are not required. Coat the pipe with zinc in accordance with A 53. Furnace welded pipe is not acceptable and the hydrostatic and flattening tests are not required. Coat components produced from structural steel and or pipe with zinc by hot dip galvanizing, preferably after fabrication, in compliance with ASTM A 123. When coating by this method after fabrication is not practical, protect all areas where the coating is removed by welding or other procedures by application of a zinc or zinc alloy coating as specified in **DIVISION 1800**. Thoroughly clean the damaged areas before application of the coating.

(2) When it is specified that corrosion protection be provided by copper bearing weathering steels, identified as CBW, use structural steel and pipe that complies with ASTM A 242 or A 588 and ASTM A 618, Grade II, respectively. The minimum acceptable copper content is 0.20%.

(3) When it is specified that corrosion protection be provided through the use of stainless steels, identified as SST, use basis stainless structural steel and pipe that complies with ASTM A 240, AISI/SAE designations 302, 304 or 305, or ASTM A 358, Class 2, Grade 304 and A 312 respectively. Hydrostatic testing is not required. Weld stainless steels according to the procedures of the applicable specification in order to avoid cracking and weld area sensitization to corrosion.

1610.3 TEST METHODS

Conduct all tests required by the applicable ASTM or other component or material specifications of **subsection 1610.2b**. Measure the coating thickness by any one of the methods specified in ASTM B 633 and by eddy current methods, ASTM B 244, provided that appropriate calibration procedures and standards have been applied. The magnetic induction and eddy current methods are nondestructive in nature and are preferred. Destructive techniques, i.e., coating removal, may be utilized as referee methods.

1610.4 PREQUALIFICATION

Not applicable.

1610.5 BASIS OF ACCEPTANCE

Submit for approval to the Regional Materials Laboratory a Type A certification (certified mill test report), as specified in **DIVISION 2600**, for all drainage system components, excluding pipe, when the HDG or CBW corrosion protection method is specified and all components, including pipe, when the SST method is specified.

Receipt and approval of a Type D certification as specified in **DIVISION 2600** for pipe when the HDG or CBW corrosion protection method is specified.

Inspection and testing by field personnel of all components for compliance with dimensional requirements for all drainage system components and corrosion protection coating thickness when the HDG protection method is specified. Coating thickness is to be measured according to any of the procedures of **subsection 1610.3**.

The final disposition of all drainage system components will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition.

SECTION 1611

PIPE FOR SONIC TESTING

1611.1 DESCRIPTION

This specification governs the pipe used for sonic testing as part of the construction of drilled shafts as shown in the Contract Documents.

1611.2 REQUIREMENTS

Provide 2-inch diameter steel pipe that complies with ASTM A 53 or ASTM A 500, Grade B, Standard Weight. Provide clean pipe (both internal and external surfaces) with watertight joints. If any lacquer or other coating is present, sand blast the pipe prior to installation into the rebar cage. The internal joints shall be flush. Provide screw-on watertight shoes, couplers and caps for the pipes.

As an alternative, provide clean, non-threaded pipe, and provide smooth shoes, couplers and caps. Fillet weld each seam.

1611.3 TEST METHODS

Test according to the requirements of **subsection 1611.2**.

1611.4 PREQUALIFICATION

Not applicable.

1611.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

The final disposition of all components will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition.

SECTION 1612

GRAY-IRON CASTINGS

1612.1 DESCRIPTION

This specification governs gray-iron castings that are subject to strength requirements.

1612.2 REQUIREMENTS

a. Physical. The cast alloy is to comply with AASHTO M 105, Class 30B.

b. Dimensions. The finished cast products are to comply with the dimensional requirements in the Contract Documents.

c. Finish.

(1) Provide all the cast products in the as-cast and as-machined condition.

(2) Weld repairing of casting flaws will not be permitted without the express written consent of the KDOT.

1612.3 TEST METHODS

Tension testing of specimens representative of the cast products is mandatory. Perform the testing in accordance to AASHTO M 105.

Any additional tests will be according to the agreement procedures of AASHTO M 105 and the associated methods and requirements.

1612.4 PREQUALIFICATION

Not applicable.

1612.5 BASIS OF ACCEPTANCE

Submit for approval a Type A certification (certified mill test report), as specified in **DIVISION 2600**, that governs the analysis of all heats delivered to the project.

The KDOT reserves the right to call for and test specimens from certified lots to verify the certification results. Specimens may be cast test bars from the manufacturer or sections cut from actual castings if test bars are not available, or there is reason to suspect their validity.

SECTION 1613

MALLEABLE CAST IRON PRODUCTS

1613.1 DESCRIPTION

This specification governs products for various applications cast from malleable iron.

1613.2 REQUIREMENTS

a. General. Provide castings that comply with the design, dimensions, requirement for corrosion protection, and specific fabrication requirements specified in the Contract Documents. Unless corrosion protection is specified, the cast products are to be provided in the as-cast and as-machined condition.

b. Material Specifications.

(1) Provide ferritic malleable iron castings that comply with ASTM A 47. Weld joining or repair of these castings is permitted only with prior approval of the KDOT and must be in compliance with ASTM A 47.

(2) When corrosion protection is specified, zinc coat the castings by the hot dip galvanizing process in compliance with ASTM A 47, Supplementary Requirement S5.

1613.3 TEST METHODS.

Conduct all tests required by the applicable ASTM specifications of **subsection 1613.2b**. Measure coating thickness by any one of the methods specified in ASTM B 633 and by eddy current methods, ASTM B 244, provided that appropriate calibration procedures and standards have been applied. The magnetic induction and eddy current methods are nondestructive in nature and are preferred. Destructive techniques, i.e., coating removal, may be utilized as referee methods.

1613.4 PREQUALIFICATION

Not applicable.

1613.5 BASIS OF ACCEPTANCE.

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

Inspection and testing by field personnel of all components for compliance with dimensional requirements and corrosion protection coating thickness when corrosion protection is specified. Coating thickness is to be measured according to any of the procedures of **subsection 1613.3**.

The final disposition of all components will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition.

SECTION 1614

CAST STEEL PRODUCTS

1614.1 DESCRIPTION

This specification governs products for various applications cast from steel.

1614.2 REQUIREMENTS

a. General. Provide castings that comply with the design, dimensions, and specific fabrication requirements as specified in the Contract Documents. Provide the products in the as-cast and as-machined condition.

b. Material Specifications. The steel castings provided through this specification are to comply with ASTM A 27. Unless specified otherwise, annealed Grade 65-35 is required with the Class as specified on the Contract Documents. Comply with ASTM A 27 for all weld joining or repair of these castings.

1614.3 TEST METHODS

Conduct all tests required by the applicable ASTM specifications of **subsection 1614.2b**.

1614.4 PREQUALIFICATION

Not applicable.

1614.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

The KDOT reserves the right to request and test specimens from delivered casting lots to verify specification compliance. Specimens may be cast test bars from the manufacturer or sections removed from castings if test bars are not available, or there is reason to suspect their validity.

The final disposition of all castings will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition.

SECTION 1615

ANCHOR BOLTS FOR STRUCTURAL USES

1615.1 DESCRIPTION

This specification governs the threaded and non-threaded fastener components utilized for anchoring structural components to a concrete foundation or base.

1615.2 REQUIREMENTS

a. General. Fastener components and coatings governed through this specification must comply with **subsection 1615.2b** unless specified otherwise in the Contract Documents. For threaded fastener components, comply with the thread series requirements of ANSI/ASME B1.1 Coarse Thread Series, with a tolerance class that accommodates the corrosion protective coating when applicable.

b. Material Specifications.

(1) Provide externally threaded steel rods or anchor bolts that comply with AASHTO M 314 with the thread series as denoted in **subsection 1615.2a**. Provide cut or rolled threads for bridge bearing applications. Provide rolled threads for all other applications. The Grade and coating for corrosion protection is dictated by the intended application and specified in the Contract Documents. Provide nuts intended for use with these anchor bolts that comply with ASTM A 563 inclusive of the Appendices. They also must be compatible with the strength requirements for the Grade of anchor bolt specified according to the guidelines of ASTM A 563 for the Property Class and design style of the nut. All nuts must comply with their respective Property Class requirements of ASTM A 563. Plain, or flat, washers for use with these fastener components must comply with ASTM F 436. The washer type and series are determined by the intended application.

(2) Provide swedge anchor bolts with deformations that comply with the following requirements.

- Depth - no more than 1/8 inches.
- Radius – not less than ½ inches.
- No more than one deformation occurring in any plane perpendicular to the shaft of the bolt.
- At least one deformation within each 1 inch length of bolt.
- Adjacent deformations shall be out of phase by a minimum of 90 degrees.

(3) If not governed by the component specification, when corrosion protection coatings are specified for fastener components, zinc coat these components in compliance with ASTM F 2329 for hot dip galvanizing or by the mechanical deposition of a zinc coating in compliance with ASTM B 695, Class 50. Aluminum coating is acceptable when permitted and regulated by the specification that governs the component.

1615.3 TEST METHODS

Conduct all tests required by the applicable AASHTO, ASTM, ASME, ANSI, or other component or material specifications of **subsection 1615.2b**. Measure the coating thickness by any one of the methods specified in ASTM B 633 and by eddy current methods, ASTM B 244, provided that appropriate calibration procedures and standards have been applied. The magnetic induction and eddy current methods are nondestructive in nature and are preferred. Destructive techniques, i.e., coating removal, may be utilized as referee methods.

1615.4 PREQUALIFICATION

Not applicable.

1615.5 BASIS OF ACCEPTANCE

Submit for approval a Type A certification (certified mill test report), as specified in **DIVISION 2600**, for all fastener components.

In the event **subsection 1615.5a** cannot be complied with, submit samples representative of the lot(s) and heat(s) of the components and materials provided to the Engineer of Tests for testing. These samples must comply with **subsection 1615.2**.

Inspection by field personnel of all fastener components for compliance with corrosion protection and dimensional requirements.

The final disposition of fastener components will be completed at the final destination as the result of inspection for the quality of workmanship, the delivery condition.

SECTION 1616

STEEL FASTENERS

1616.1 DESCRIPTION

This specification governs threaded and non-threaded fastener components and the requirements for their corrosion protection.

1616.2 REQUIREMENTS

a. General. Provide fastener components and coatings that comply with **subsection 1616.2b** unless specified otherwise on the Contract Documents. For threaded fastener components, comply with the thread series of ANSI/ASME B1.1 Coarse Thread Series, with a tolerance class that accommodates the corrosion protective coating when applicable.

b. Material Specifications.

(1) Provide externally threaded steel fasteners intended for general applications that comply with ASTM A 307 inclusive of the Appendices. The property grade specified is to be dictated by the intended application, nominal size, and availability, however Grade A is recommended for most purposes. Provide nuts intended for use with these fasteners that comply with ASTM A 563 inclusive of the Appendices. Provide nuts that are also compatible with the Grade of externally threaded fastener according to the guidelines of ASTM A 563 for the property grade and design style of the nut. Test all nuts for compliance with their respective property grade requirements of ASTM A 563 regardless of application. Provide plain, or flat, washers for use with these fastener components that comply with ANSI/ASME B18.22M, Type A or Type B, and ASTM F 844. Determine the washer type and series by the intended application. When atmospheric corrosion resistant steel is required, all fastener assembly components are to be produced from weathering steel.

(2) Provide externally threaded steel fasteners for applications where high strength is a prerequisite that meet ASTM A 325 for Type 1, or Type 3 when the formation of a protective oxide coating is required for protection from atmospheric corrosion. Provide nuts intended for use with these fasteners are to be of a property grade specified by ASTM A 325 that comply with ASTM A 563 inclusive of the Appendices. Provide nuts that are also compatible with the Grade of externally threaded fastener according to the guidelines of ASTM A 563 for the property grade and design style of the nut. Test all nuts for compliance with their respective property grade requirements of ASTM A 563 regardless of application. Provide plain, or flat, washers for use with these fastener components as specified by ASTM A 325 and comply with ASTM F 436. Externally threaded steel fasteners that comply with ASTM A 490, magnetic particle inspection (MPI) requirement waived, and nuts that comply with ASTM A 194 may be utilized in lieu of A 325 and A 563 components. When atmospheric corrosion resistant steel is required, all fastener assembly components are to be produced from weathering steel.

(3) Provide all high strength steel bolts, nuts, and washers that comply with the rotational capacity test requirements of the 3rd edition (with Interim Specifications) of the AASHTO LRFD Bridge Construction Specifications, Section 11.5.6.4.2. The rotational capacity test procedures, as developed by the FHWA, are presented in KT-MR11, Rotational Capacity Testing of High Strength Fasteners.

(4) When specified, provide lock washers that comply with ASME B18.22.1. Determine the washer type and series by the intended application.

(5) Provide Direct Tension Indicators (DTI) for high strength applications, or when specified in the contract documents, that comply with the requirements of ASTM F 959. Use “plain” Type 325 and Type 490 DTI’s with ASTM A 325 Type 1 and A 490 Type 1 structural bolts, respectively. Use “weathering steel” Type 325-3 and Type 490-3 DTI’s with ASTM A 325 Type 3 and A 490 Type 3 structural bolts, respectively.

Incorporate circumferential indentations or edge notches on the exposed face of the DTI which are aligned with feeler gage entry points. Indentations or notches shall be clearly visible after installation of the DTI, but not so large as to interfere with the function of the DTI.

(6) Provide steel structural rivets that comply with ASTM A 502 for Grade 1 or Grade 2, or Grade 3 when the formation of a protective oxide coating is required for protection from atmospheric corrosion. Dimensions and design type are to be as specified for the intended application.

(7) Miscellaneous fastener components not specifically addressed in this subsection are to comply with the applicable AASHTO, ASTM, ASME, ANSI, or other governing component or material specifications with the consensus of the component manufacturer and the KDOT.

(8) When corrosion protection coatings are specified for fastener components, provide components that are zinc coated and in compliance with ASTM F 2329 for hot dip galvanizing or by the mechanical deposition of a zinc coating in compliance with ASTM B 695, Class 50. Fastener components of nominal size of less than 13 mm diameter may be zinc coated by an electrodeposition process. The coating is to be uniform, comply with ASTM B 633, and have a thickness in the range of 5 to 8 micrometers for use under mild to moderate service conditions, SC 1 to SC 2. Note that an electrodeposited zinc coating thickness in excess of 8 micrometers may result in thread fit interference. Electrodeposited cadmium coating is also permitted when in compliance with ASTM B 766 and the same thickness range constraints as for electrodeposited zinc coating. Aluminum coating is acceptable when permitted and regulated by the specification that governs the component.

(9) In lieu of a separate nut, washer, and DTI, provide a combined nut and DTI assembly for use with high strength structural bolts. The nut component shall comply with **subsection 1616.2b.(2)** and the DTI component shall comply with **subsection 1616.2b.(5)**. Manufacture each lot of assemblies using a single DTI lot and a single nut lot. Identify assembly lots using the lot of the component DTIs.

Unless the contract documents indicate otherwise, an F 436 washer need not be used when a bolt and combined nut/DTI assembly are used and all of the following are satisfied:

- The fastener is used with a standard size hole.
- The bolt is <u>not</u> the turned fastener component.
- The combined nut/DTI manufacturer's installation instructions and product literature demonstrate satisfactory performance without the use of a hardened washer.
- The pre-installation verification testing demonstrates satisfactory performance without the use of a hardened washer.

(10) Provide all high strength structural bolts and combined nut/DTI assemblies that comply with the rotational capacity test requirements of **subsection 1616.2b.(3)**, modified to account for the flattening of protrusions on the DTI component of the assembly.

1616.3 TEST METHODS

Conduct all tests required by the applicable AASHTO, ASTM, ASME, ANSI, or other component or material specifications of **subsection 1616.2b**. Coating thickness may be measured by any one of the methods specified in ASTM B 633 and by eddy current methods, ASTM E 376 (B 244 may also be useful as a technique guideline), provided that appropriate calibration procedures and standards have been applied. The magnetic induction and eddy current methods are nondestructive in nature and are preferred. Destructive techniques, i.e., coating removal, may be utilized as referee methods.

Conduct rotational capacity testing on all coated and non-coated high strength threaded fastener component assemblies referenced in **subsection 1616.2b(3)**.

1616.4 PREQUALIFICATION

Not applicable.

1616.5 BASIS OF ACCEPTANCE

Submit for approval a Type A certification, as specified in **DIVISION 2600**, for all fastener components provided through this specification. In addition, provide certifications for DTI's showing the results of ASTM F 606 testing. A combined nut/DTI assembly requires a certification for each of its components.

Compliance of samples of all fastener components utilized for overhead lighting and signing, sign supports, bridge beam connections and splices, and any other application considered relevant by the Engineer's representative with **subsection 1616.2b**. Provide representative samples of the lot(s) and heat(s) of the components and materials, including combined nut/DTI assemblies (but not separate DTIs). Submit the samples to the Engineer of Tests for testing. Samples for testing are not required for fastener components used to attach sign panels to ground mounted sign supports nor for components used in break-away connections on ground mounted sign supports.

The KDOT representative will inspect all fastener components for compliance with corrosion protection, marking, and dimensional requirements.

The final disposition of fastener components will be completed at the final destination as the result of inspection for the quality of workmanship, the delivery condition.

SECTION 1617

WELDED STUD SHEAR CONNECTORS

1617.1 DESCRIPTION

This specification governs welded stud shear connector intended for shear load resistance applications.

1617.2 REQUIREMENTS

a. General. Weld and test these studs in accordance with the procedures and AWS (ANSI/AASHTO) D1.5. The welding process is stud arc welding (SW), although other procedures in accordance with AWS D1.5 may be utilized when specified. The studs may be applied either at a fabrication facility or at the construction site. The design and dimensions of the studs are as specified in the Contract Documents.

b. Material Specifications. The flux requirements for studs applied by the SW process are governed by AWS D1.5. Use steel for the studs that complies with ASTM A 108, Grade Designation 1010 through 1020 (AISI/SAE), and AWS D1.5. The cold finished steel or the finished studs, at the stud manufacturer's option, must comply with the mechanical property requirements of AWS D1.5, Type B.

1617.3 TEST METHODS

Conduct all tests required by the applicable ASTM and AWS specifications of **subsection 1617.2**.

1617.4 PREQUALIFICATION

A manufacturer's studs, flux, and welding process are to be qualified as a system according to AWS D1.5. Submit this qualification test data to the Bureau Chief of Construction and Materials. The data will be reviewed and the manufacturer notified of the results. Those systems that comply with this specification will be included on a list of qualified systems maintained by the Bureau of Construction and Materials.

1617.5 BASIS OF ACCEPTANCE

Prequalification as required by **subsection 1617.4**.

Submit for approval a Type A certification (certified mill test report), as specified in **DIVISION 2600**.

The final disposition of the installed studs provided through this specification will be completed at the point of installation as the result of inspection and testing by KDOT personnel for the quality of workmanship, the delivery condition, proper installation, compliance with dimensional requirements.

SECTION 1618

STEEL PLATE GUARDRAIL

1618.1 DESCRIPTION

This specification governs corrugated sheet steel beams and related components utilized in the construction of highway guardrail systems.

1618.2 REQUIREMENTS

a. General. The guardrail system design, dimensions, method of corrosion protection, end terminals, and specific fabrication requirements are specified in the Contract Documents.

Property requirements for the steels and components are governed by the classifications, designations, or grades of steel, and the component specifications designated on the Contract Documents and **subsection 1618.2b**.

Proprietary energy dissipating end terminal systems may be supplied only if prequalified by the KDOT.

For threaded fastener components, comply with the thread series requirements of ANSI/ASME B1.1 Coarse Thread Series, with a tolerance class that accommodates the corrosion protective coating when applicable.

Provide corrosion protection for all steel components utilized in guardrail systems by a nonmagnetic metal coating. Non-coated copper bearing weathering steel is not an acceptable alternative.

Store guardrail components to prevent water retention and condensation, intimate contact between individual components, and contact with the soil.

b. Material Specifications.

(1) Unless specified otherwise, provide beams, transition sections, end terminals other than proprietary, beam washers, backing and splice plates that comply with AASHTO M 180, Class A, Type I beams. End terminals that are of KDOT design are to comply with the basis steel property and corrosion protection requirements of AASHTO M 180.

(2) Threaded fastener components are to comply with **SECTION 1616**. All fastener components are to be metal coated for corrosion protection in accordance with **SECTION 1616** and mechanical properties are to be equivalent to or greater than those specified within AASHTO M 180.

(3) Guardrail components produced from structural steel stock, tubing, or pipe are to comply with **SECTIONS 1607, 1608, or 1619** respectively. Steels not governed by these subsections may be utilized providing prior approval is granted by the KDOT and proper welding procedures are adhered to. These components include posts and offset blocks, soil, anchor, and bearing plates, etc. If not governed by the component specification or subsection, when corrosion protection coatings are specified, zinc coat these components by hot dip galvanizing after fabrication in compliance with ASTM A 123, Thickness Grade 85, minimum. Aluminum coating application after fabrication is acceptable when permitted and regulated by the specification that governs the component.

(4) Use wire rope that complies with AASHTO M 30, Type II, Class B zinc coating.

(5) Provide shackles and turnbuckles that comply with AASHTO M 269 with the thread series as specified in **subsection 1618.2a.**

(6) Use wood components, e.g., posts, blocks, etc., that comply with the applicable subsection of **DIVISION 2300**.

(7) Proprietary energy dissipating end terminal systems may be supplied only if prequalified by the KDOT. The prequalification process is specified in **subsection 1618.4**.

1618.3 TEST METHODS

Conduct all tests required by the applicable AASHTO, ASTM, or other component or material specifications of **subsection 1618.2**. Coating thickness may be measured by any one of the methods specified in ASTM B 633 and by eddy current methods, ASTM B 244, provided that appropriate calibration procedures and standards have been applied. The magnetic induction and eddy current methods are nondestructive in nature and are preferred. Destructive techniques, i.e., coating removal, may be utilized as referee methods.

1618.4 PREQUALIFICATION

a. All guardrail system components provided by the manufacturer of the beam, except for proprietary energy dissipating end terminal systems, must be prequalified before approval for installation on KDOT projects. The prequalification procedure is to be in accordance with AASHTO M 180, section 5.3, "Acceptance by Brand Registration and Guarantee." Submit the information required by section 5.3 to the Bureau Chief, Construction and Materials, for evaluation. For components not specifically addressed by section 5.3, provide the information relevant to the component that is required by **subsection 1618.2**. Include all FHWA notifications of acceptance relevant to the components or system.

b. Proprietary energy dissipating end terminal systems must be prequalified as a unit. The prequalification procedure requires that complete evaluation data, including design and test information and materials list, and the FHWA notification of acceptance, be submitted to the Bureau of Road Design.

c. All manufacturers will be notified of their prequalification status upon evaluation of the submitted information. When granted approval, the manufacturer, components, and or system will be placed on a listing of prequalified manufacturers and providers of guardrail system components and or energy dissipating end terminal systems. The list will be maintained by the Bureau of Construction and Materials.

1618.5 BASIS OF ACCEPTANCE

a. Receipt and approval of a Type C certification as specified in **DIVISION 2600** for all components governed by **subsection 1618.2b.(1), (3), (4), (5), and (7)**. This supersedes the certification requirements of the specific **SECTIONS 1607, 1608, and 1619**.

b. Submit for approval a Type A certification as specified in **DIVISION 2600** for all threaded fastener components, **subsection 1618.2b(2)**, , and required by **SECTION 1616**.

c. The disposition of wood components, e.g., posts, blocks, etc., **subsection 1618.2b.(6)**, is to be in accordance with the applicable subsection of **DIVISION 2300**.

d. The KDOT reserves the right to request and test specimens from certified component lots to verify the certification results or when there is reason to suspect their validity.

e. Inspection and testing by field personnel of all steel components for compliance with dimensional requirements and corrosion protection coating thickness. Coating thickness will measured according to any of the procedures of **subsection 1618.3**.

f. The final disposition of all components will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition.

SECTION 1619

STEEL PIPE

1619.1 DESCRIPTION

This specification governs steel pipe intended for various applications including protective encasements.

1619.2 REQUIREMENTS

a. General. The pipe is to comply with the design, dimensions, requirement for corrosion protection, and specific fabrication requirements as specified in the Contract Documents. Unless corrosion protection is specified, the pipe is to be provided in the as produced and as machined condition.

b. Material Specifications.

(1) Steel pipe for applications other than encasement is to comply with ASTM A 53, Types E and S, Grade B. As noted, the pipe may be electric resistance welded, Type E, or seamless, Type S. Furnace welded pipe, Type F, is not acceptable.

(2) When corrosion protection is specified, zinc coat the pipe by the hot dip galvanizing (HDG) process in compliance with ASTM A 53. Perform all welding and forming operations prior to HDG unless the size or configuration of the final product makes this impractical. If deviation from the desired sequencing is necessary, submit a request detailing the circumstances requiring the deviation and the procedures for repairing the damages to the coating, to the Engineer of Tests for review and approval prior to proceeding with the assembly.

(3) Steel pipe utilized for protective encasement is to comply with ASTM A 139, Grade B. The minimum acceptable wall thickness is 0.25 inch. The pipe ends are to be machined, chamfered, for welding according to the specifications of A 139.

1619.3 TEST METHODS

Conduct all tests required by the applicable ASTM specifications of **subsection 1619.2b**. Coating thickness may be measured by any one of the methods specified in ASTM B 633 and by eddy current methods, ASTM E 376 (B 244 may also be useful as a technique guideline), provided that appropriate calibration procedures and standards have been applied. The magnetic induction and eddy current methods are nondestructive in nature and are preferred. Destructive techniques, i.e., coating removal, may be utilized as referee methods.

1619.4 PREQUALIFICATION

Not applicable.

1619.5 BASIS OF ACCEPTANCE

a. Pipe other than encasement pipe.

(1) Submit for approval a Type A certification (certified mill test report), as specified in **DIVISION 2600**, that complies with **subsection 1619.2**. Submit samples to the Engineer of Tests for evaluation and testing.

(2) Inspection and testing by field personnel of pipe for compliance with dimensional requirements and corrosion protection coating thickness when corrosion protection is specified. Measure the coating thickness according to any of the procedures of **subsection 1619.3**.

b. **Encasement Pipe**. Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

c. The final disposition of all pipe will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition.

SECTION 1620

MATERIALS FOR FENCING

1620.1 DESCRIPTION

This specification governs the ferrous and nonferrous materials and components utilized in the construction of fences of various types.

1620.2 REQUIREMENTS

a. General. Fencing materials and components governed through this specification must comply with **subsection 1620.2b** unless specified otherwise in the Contract Documents. The height and design of any fence is to be as specified in the Contract Documents. This also applies to, but is not restricted to, wire diameters, mesh size, tension bar dimensions, selvage type, brace and tension bands, post caps, sleeves, rail ends, and other miscellaneous and accessory components associated with the type of fence specified.

b. Material Specifications.

(1) Chain Link Fence. Provide chain link fence that complies with AASHTO M 181. Provide framework (post and rail) components that comply with ASTM F 1043 for heavy industrial fence with only pipe Group IA or IC permitted.

When polymer-coating is specified in the contract documents, provide chain link fence that complies with AASHTO M 181, Type IV, Class A, extruded and bonded; or Type IV, Class B. Use the color specified in the Contract Documents that complies with AASHTO M 181 or ASTM F 934.

Provide accessory and miscellaneous components that comply with ASTM F 626. Components not specifically addressed in this or the other specifications must comply with the Chain Link Fence Manufacturer's Institute (CLFMI) Product Manual, CLF 2445. Tension bars are to have nominal dimensions of not less than 3/16 inch by 3/4 inch and may not be more than 2 inches shorter than the height of the chain link fabric they are applied to. Brace and tension bands are to have nominal dimensions of not less than 3/32 inch by 7/8 inch and comply with the cross section profile of the posts they are to be applied to. Truss rods are to have a minimum nominal diameter of 3/8 inch.

The terminology applied to chain link fencing is to be consistent with ASTM F 552.

The corrosion protection coating requirements of AASHTO M 181 apply to all components and supersede less stringent requirements that may occur in other specifications.

(2) Chain Link Fence (Special). Provide Chain Link Fence (Special) that complies with **subsection 1620.2b.(1)**, except provide pipe or tubing for framework that complies with the following:

- Nominal Pipe Size (NPS) as shown on the Contract Documents.
- Outside diameter and wall thickness corresponding to Extra Strong Pipe (Schedule 80).
- ASTM A 53, Grade B; ASTM A 500, Grade B, C or D; ASTM A 501, Grade A; or ASTM F 1083 Intermediate Strength Grade (use only for size NPS 5 or larger). ASTM F 1083 High Strength 83,000 Grade may be used for framework that is not welded to a base plate or other component.
- Other pipe or tubing will be approved provided it meets the dimensional requirements and the tensile and chemical requirements of one of the materials listed above.

Do not use continuous, furnace butt-welded (Type F) pipe.

(3) Barbed Wire. Provide zinc-coated and aluminum-coated steel barbed wire that complies with AASHTO M 280.

All barbed wire is to have dual line wires, each of 0.1 inch minimum nominal diameter, with four point round wire barbs, 0.08 inch minimum nominal diameter wire, at a nominal spacing of 5 inches. The dual line wires must have a unidirectional twist and have the barbs applied to one line wire only unless they are interwoven through the line wires. A Class 3 coating level is required for zinc coated barbed wire.

(4) Woven Wire Fabric (horizontal line wires, vertical stay wires). Provide zinc-coated and aluminum-coated steel woven wire fence fabric that complies with AASHTO M 279. A Class 3 coating level is required for zinc-coated woven wire fence fabric, and the minimum permissible line wire breaking strength is 960 pounds.

(5) Steel Fence Posts and Assemblies. Except as addressed previously in **subsection 1620.2b.(1)** and **(2)**, provide posts and assemblies that comply with AASHTO M 281.

(6) Zinc-Coated Steel Wire Strand. Provide strand for use in conjunction with fences that complies with

ASTM A 475.

(7) Swing or Slide Type Gates. Provide gates that comply with ASTM F 900 for swing type and ASTM F 1184 for slide type. The wire or fabric utilized in the fence construction is to be applied to the gate frame unless specified otherwise through **subsection 1620.2a**. It will be an option to require hot dip galvanizing of the frame after weld construction.

(8) Accessory and miscellaneous components not referenced previously in a specification or this subsection must be zinc coated in compliance with ASTM A 153 for hot dip galvanizing or ASTM B 633 for electrodeposited zinc on threaded fastener components of nominal size of less than 1/2 inch diameter. Mechanically deposited zinc coatings on larger fastener components is permitted, however, other than the zinc coating application method, all requirements of ASTM F 2329 must be complied with. Fastener components must comply with **SECTION 1616**. Aluminum coating is acceptable when permitted and regulated by the specification that governs the component.

c. Fence (Chain Link) (Special) (Duplex/PVC).

(1) All posts, hardware, etc. Perform the following duplex protection requirements in order listed:

- Use Fence (Chain Link) (Special) as specified in this specification, and galvanize according to **subsection 1620.2b.**
- smooth out any drips, dross or ash inclusions
- Do not quench bath galvanized surfaces that are to be duplex coated. Clean using alkaline cleaners, ammonia cleaners or solvent. Passivating film is prohibited;
- Rinse with clean water;
- Dry completely;
- Prepare the surface according to ASTM D 6386 and the following:
  - Blast clean with SSPC-SP-7 using abrasives softer than zinc;
    - Aluminum-Magnesium Silicates;
    - Walnut shells;
    - Sand with a Mhos hardness equal to or less than 5, and between 200-500 grit;
    - Temperature must be > 70° and less than 50% humidity;
- After blasting, leave a minimum of 3.3 mils of galvanizing with a + tolerance of 2 mils;
- Powder coat;
  - Use polyester powder with degassing agents;
  - Preheat materials to be powder coated;
  - Powder coat a thickness of 3.5 to 4 mils;
  - Measure and report galvanizing thickness before and after blasting and report the powder coat thickness;
  - Perform Methyl Ethyl Ketone (MEK) test, and report the results; and
  - Perform Cross Hatch test according to ASTM D 3359, and report the results.

(2) Woven Chain Link. Use the same specified color that was used for the posts, hardware, etc. When no color is specified, use black. The PVC coating shall conform to AASHTO M 181 Type IV Class A.

1620.3 TEST METHODS

Conduct all tests required by the applicable AASHTO, ASTM, or other material specifications of **subsection 1620.2b** and **c**. Coating thickness may be measured by any one of the methods specified in ASTM B 633 and by eddy current methods, ASTM E 376 (B 244 may also be useful as a technique guideline), provided that appropriate calibration procedures and standards have been applied. The magnetic induction and eddy current methods are nondestructive in nature and are preferred. Destructive techniques, i.e., coating removal, may be utilized as referee methods.

1620.4 PREQUALIFICATION

Not applicable.

1620.5 BASIS OF ACCEPTANCE

a. Submit for approval a Type B certification, as specified in **DIVISION 2600**, that governs all wire utilized in the construction of the fence or fence components, regardless of application.

b. Submit for approval a Type B certification, as specified in **DIVISION 2600**, that governs all post and rail utilized in the construction of Chain Link Fence (Special). Provide certifications that show all information necessary to verify compliance with the dimensional requirements of this specification.

c. Submit for approval a Type B certification as specified in **DIVISION 2600**, that governs the Duplex/PVC Protection utilized in the construction of Fence (Chain Link) (Special). Provide certifications that show all information necessary to verify compliance with the requirements of this specification.

d. Receipt and approval of a Type D certification as specified in **DIVISION 2600** for all other fencing components.

e. Inspection and testing by field personnel of all fencing components for compliance with corrosion protection coating thickness, dimensional requirements, quality of workmanship and the delivery condition.

SECTION 1621

STEEL SIGN POSTS

1621.1 DESCRIPTION

This specification governs steel posts intended for sign support and other various applications.

1621.2 REQUIREMENTS

a. General.

(1) Channel or 'U" Type. Provide posts that have the symmetrical cross section profile of a channel with flared and extended flanges as displayed in AASHTO M 281 for the channel or 'U' type post cross section with a cross section that is uniform throughout the post length. The post length(s), weight per unit length, and specific fabrication requirements are as specified in the Contract Documents.

Perforate the web center of the post with 3/8 inch diameter holes on one-inch centers initiating at one inch from one end of the post relative to the first hole center. Perforate the post not less than 36% of the post length for posts up to 11 feet in length and not less than 50% of the length for posts of 11 feet or greater in length. Perforating the total length of the post is permitted. The method of perforation is at the discretion of the post manufacturer; however, the holes must be uniform in diameter, de-burred, and smooth sided. Perform all perforating and machining operations prior to application of the corrosion protection coating.

Provide posts with steel weight per unit length for posts of either 2.0 lb/ft or 3.0 lb/ft, as specified in the Contract Documents. The tolerance on this requirement is −3, +10%. It is preferable that the weight per unit length be determined on non-perforated, non-coated posts. If this is not possible or practical, the unit length mass may be near the lower end of the tolerance band. Compensate for any coating that is present during determination of the unit length weight.

(2) Perforated Square Steel Tube (PSST). Provide posts, post anchors, anchor sleeves, and anchor extensions that have a square cross section which is uniform throughout the post length.

Perforate the total length (all four sides) of sign posts, post anchors, and anchor sleeves with 7/16 inch diameter holes on one inch centers initiating one inch from one end of the post relative to the first hole center. Embossed rings or die-cut knockouts are an acceptable substitute for perforated holes. The method of perforation is at the discretion of the post manufacturer; however, the holes must be uniform in diameter, de-burred, and smooth sided. Perform all perforating, cutting, and machining operations prior to application of the corrosion protection coating.

Anchor extensions are used in sign post square coupler footings and are not perforated.

Provide posts, post anchors, anchor sleeves, and anchor extensions with dimensions shown on the Contract Documents.

b. Material Specifications.

(1) Channel or 'U' Type. The selection of the steel for production of the posts is at the discretion of the post manufacturer. However, the finished product must comply with **TABLE 1621-1** when center point loaded as a simple beam. The test post beam is to span 48 inches and have the channel web placed upward.

TABLE 1621-1: LOAD DEFLECTION REQUIREMENTS – CHANNEL OR 'U' TYPE

Post Weight per Unit Length (lbs/ft)	Applied Load (lbf)	Center Deflection Acceptable Range at Applied Load (inches)	Maximum Retained (plastic) Deflection after Test (inches)
2.0	700	0.30 ↔ 0.60	0.01
3.0	1200	0.27 ↔ 0.60	0.01

After all fabricating operations have been performed, protect posts from corrosion by application of a zinc coating by the hot dip galvanizing (HDG) process in accordance with ASTM A 123, Thickness Grade 85 minimum.

(2) Perforated Square Steel Tube (PSST). Manufacture posts, post anchors, anchor sleeves, and anchor extensions from steel sheet or strip that conform to ASTM A 1011 SS Grade 50 and which is zinc coated in accordance with ASTM A 653, coating designation G90. The finished tubing, prior to perforating, shall have a

minimum yield strength of 60 ksi.

1621.3 TEST METHODS

Conduct all tests required through **subsection 1621.2** and by the applicable ASTM specifications of **subsection 1621.2**. Coating thickness may be measured by any one of the methods specified in ASTM B 633 and by eddy current methods, ASTM B 244, provided that appropriate calibration procedures and standards have been applied. The magnetic induction and eddy current methods are nondestructive in nature and are preferred. Destructive techniques, i.e., coating removal, may be utilized as referee methods.

1621.4 PREQUALIFICATION

Not applicable.

1621.5 BASIS OF ACCEPTANCE

Submit for approval a Type A certification (certified mill test report), as specified in **DIVISION 2600**, that comply with **subsection 1621.2**. Submit the channel or ‘U’ type samples to the Engineer of Tests for evaluation and testing. Also submit for approval a Type B certification covering results of tests on tubing for PSST that comply with **subsection 1621.2**.

Inspection of posts, including applicable anchor pieces, by field personnel for compliance with dimensional requirements and for the quality of the corrosion protection coating.

The final disposition of all posts will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition.

SECTION 1622

STEEL POSTS FOR DELINEATOR MARKERS

1622.1 DESCRIPTION

This specification governs steel posts intended for the support of delineator markers.

1622.2 REQUIREMENTS

a. General. Provide posts that have the symmetrical cross section profile of a channel with flared and extended flanges as displayed in **FIGURE 1622-1** for the channel or 'U' type post cross section. Make the cross section uniform throughout the post length. Specific fabrication requirements are as specified in the Contract Documents. The nominal post length is 7 feet unless specified otherwise in the Contract Documents. The post weight per foot is governed by this subsection.

Perforate the web center of the post with 3/8 inch diameter holes on 1 inch centers, initiating at 1 inch from one end of the post relative to the first hole center. Perforate the post for not less than 2 feet. Perforating the total length of the post is permitted. The method of perforation is at the discretion of the post manufacturer; however, the holes must be uniform in diameter, de-burred, and smooth sided.

Provide posts with a mass per unit length of 1.1 lbs/ft. The tolerance on this requirement is −3, +10%. It is preferable that the weight per unit length be determined on non-perforated, non-coated posts. If this is not possible or practical, the unit length weight may be near the lower end of the tolerance band. Compensate for any coating that is present during determination of the unit length weight.

FIGURE 1622-1, Channel or 'U' Type Post Cross Section

b. Material Specifications. The selection of the basis steel for production of the posts is at the discretion of the post manufacturer.

Protect posts from corrosion by application of an organic zinc coating or a zinc coating by the hot dip galvanizing (HDG) process or produced from HDG sheet steel. Perform all perforating and machining operations prior to application of the organic zinc coating or HDG of the finished post. Non-coated edges on posts produced from HDG sheet steel are acceptable. The method of corrosion protection utilized is at the discretion of the post manufacturer.

Remove all burrs, fins, sharp projections, etc. from all finished posts.

1622.3 TEST METHODS

Not applicable.

1622.4 PREQUALIFICATION

Not applicable.

1622.5 BASIS OF ACCEPTANCE

Inspection of delivered posts for compliance with dimensional and corrosion protection coating requirements, quality of workmanship, delivery condition, and any other requirements as may be specified in the Contract Documents.

SECTION 1623

STEEL PERMANENT DECK FORMS

1623.1 DESCRIPTION

This specification governs the requirements for the steel utilized to fabricate permanent deck forms.

1623.2 REQUIREMENTS

a. General. These forms are, by design, incorporated into the structure as an integral component. They contain the concrete during placement and add support to the deck of the finished structure. The design, dimensions, steel designation and thickness in inches, and specific fabrication requirements are to be as specified in the Contract Documents, or on the shop drawings.

b. Material Specifications. Use steel in these forms that complies with ASTM A 653, structural steel (SS) and high strength low alloy steel (HSLAS), zinc coated to the Coating Designation G210 requirements. All HSLAS Type A and B Grades are acceptable. All SS Grades, except 50, are acceptable. Certain HSLAS require specific welding procedures. If welding of these steels is required, consult the steel producer.

1623.3 TEST METHODS

Conduct all tests required by the applicable ASTM specifications of **subsection 1623.2b**. Coating thickness may be measured by any one of the methods specified in ASTM B 633 and by eddy current methods, ASTM B 244, provided that appropriate calibration procedures and standards have been applied. The magnetic induction and eddy current methods are nondestructive in nature and are preferred. Destructive techniques, i.e., coating removal, may be utilized as referee methods.

1623.4 PREQUALIFICATION

Not applicable.

1623.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

Inspection and testing by field personnel of delivered permanent deck forms for compliance with dimensional and corrosion protection coating requirements, quality of workmanship, delivery condition, approval of required associated documentation, and any other requirements as may be specified in the Contract Documents. Coating thickness will be measured according to any of the procedures of **subsection 1623.3**.

SECTION 1624

ZINC COATINGS

1624.1 DESCRIPTION

This specification governs the requirements for zinc coatings applied to wrought and cast steel or cast iron products and components that are not specifically addressed within **DIVISION 1600**.

1624.2 REQUIREMENTS

Wrought and cast steel products not specifically governed by **DIVISION 1600** may be zinc coated in compliance with ASTM A 153 for hot dip galvanizing.

Cast iron products may be zinc coated by the hot dip galvanizing process in compliance with ASTM A 153, also refer to **SECTION 1613** and ASTM A 47, Supplementary Requirement S5, with regard to ferritic malleable iron castings. When hot dip galvanizing cast iron products, exercise caution to avoid galvanizing embrittlement.

Wrought and cast steel or cast iron products may also be corrosion protected by the mechanical deposition of a zinc coating in compliance with ASTM B 695 as an alternative method, particularly when galvanizing embrittlement may be a factor. The Class required for ASTM B 695 is to be determined from the ASTM A 153 minimum coating requirement for the product Class of Material.

When corrosion protection by zinc coating is required, it must be specified in the Contract Documents. The method of coating, however, is to be at the discretion of the product manufacturer and selected from the alternatives addressed within this subsection.

1624.3 TEST METHODS

The tests required for a product are to be based upon the consensus of the manufacturer and the KDOT. Conduct these tests as required by the applicable ASTM, or other material specifications of **subsection 1624.2**. Coating thickness may be measured by any one of the methods specified in ASTM B 633 and by eddy current methods, ASTM E 376 (B 244 may also be useful as a technique guideline), provided that appropriate calibration procedures and standards have been applied. The magnetic induction and eddy current methods are nondestructive in nature and are preferred. Destructive techniques, i.e., coating removal, may be utilized as referee methods.

1624.4 PREQUALIFICATION

Not applicable.

1624.5 BASIS OF ACCEPTANCE

Inspection and testing by field personnel of delivered products and components for compliance with dimensional and corrosion protection coating requirements, quality of workmanship, delivery condition, approval of any required associated documentation, and any other requirements as may be specified in the Contract Documents.

Measure coating thickness according to any of the procedures of **subsection 1624.3**.

SECTION 1625

CAST BRONZE PRODUCTS

1625.1 DESCRIPTION

This specification governs products for various applications cast from copper alloys generally classified as bronze.

1625.2 REQUIREMENTS

a. General. Provide castings that comply with the design, dimensions, requirement for supplemental corrosion protection, and specific fabrication requirements as specified in the Contract Documents. Unless corrosion protection is specified, provide the cast products in the as-cast and as-machined condition.

Bridge number plates are to be of the design and dimensions as specified in the Contract Documents and cast from a copper alloy identified in **subsection 1625.2b**. as a type to be utilized for general purpose castings. Relief cast the background of the plate relative to the letters, numbers, and border. Make the surfaces of the letters, numbers, and border lie in a single plane and polish them. Provide a relief from plane to background of about 1/8 inch. Make letters and numbers of the condensed Roman style approximately 1 ½ inches in height. Provide a matte non-reflective surface texture for the background. Coat the finished plates for corrosion protection with a clear organic coating that is durable and ultraviolet resistant.

b. Material Specifications. The copper alloy utilized for bearing devices where the nominal contact pressure does not exceed 2500 psi, e.g., bridge bearing plates, complies with ASTM B 22, Copper Alloy UNS No. C91100.

The copper alloy utilized for bearing devices where the nominal contact pressure does not exceed 1000 psi is to comply with ASTM B 22, Copper Alloy UNS No. C93700.

Other copper alloys governed by ASTM B 22 may be utilized providing the KDOT grants prior approval.

Use copper alloys for general purpose castings with a minimum copper content of 80%, and enhanced castability for the production of accurate castings with a high quality surface finish and a low level of discontinuities.

Avoid beryllium copper alloys if at all possible. If they must be utilized, it is the manufacturer's responsibility to provide adequate warnings concerning the high toxicity of beryllium released to the atmosphere and potentially ingested during machining, grinding, welding, etc. operations. It is also the manufacturer's responsibility to document the precautionary procedures required to avoid exposure to beryllium if these operations must be conducted.

1625.3 TEST METHODS

Not applicable.

1625.4 PREQUALIFICATION

Not applicable.

1625.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

Inspection by field personnel of all products and components for compliance with dimensional and supplemental corrosion protection coating requirements when corrosion protection is specified, quality of workmanship, delivery condition, approval of the required associated documentation, and any other requirements as may be specified in the Contract documents.

SECTION 1626

ALUMINUM ALLOYS

1626.1 DESCRIPTION

This specification governs wrought and cast aluminum alloys with associated welding practices and standards for products intended for applications other than sign fabrication.

1626.2 REQUIREMENTS

a. General. The products are to comply to the design, dimensions, requirement for supplemental corrosion protection, alloy and temper designation, and specific fabrication requirements as specified in the Contract Documents. Tolerances are designated in the Contract Documents or as specified by the applicable ASTM or other referenced standard. The alloys and tempering treatments are to be selected from **subsection 1626.2b** as a recommendation guideline. A selected alloy and treatment may be utilized as the final product listed in the guideline or as the base metal for the fabrication of other products. Other alloys and temper designations may be specified providing that the KDOT grants prior approval.

b. Material Specifications.

(1) Fasteners.

The threaded and non-threaded fastener components governed through **subsection 1627.2b(1)** are applicable for and subject to this subsection.

(2) General product classification.

Recommended aluminum alloys and tempering treatments according to general product classification. The specific alloy and temper designation selected is to be in accordance with the governing ASTM standard and contingent upon the intended application of the final product.

TABLE 1626-1: ALUMINUM ALLOYS

Product Classification	Standard
Cast products	ASTM B 26
	ASTM B 108
	ASTM B 618
Alloys (cast): 356.0, A356.0, B443.0, A444.	
Temper designations: F, T4*, T51, T6, T61, T7, T71	
Sheet and plate products.	ASTM B 209
Alloys (wrought): 1100, 3003, 5083, 5456, 6061.	
Temper designations: H12, H14, H16, H116, H321, O, T6.	
Pipe and tubular products.	ASTM B 210
	ASTM B 241
Alloys (wrought): 6061, 6063.	
Temper designations: T6, T832.	
Bar, rod, wire, profiled (shaped), and tubular products.	ASTM B 211
	ASTM B 221
	ASTM B 316
Alloys (wrought): 1100, 5083, 5456, 6005, 6053, 6061, 6063, 6351.	
Temper designations: H111, O, T5, T6, T61.	
Structural profile, and structural pipe and tubular products.	ASTM B 308
	ASTM B 429
Alloys (wrought): 6061, 6063.	
Temper designations: T6.	

*Radiograph all products cast from alloy A444, temper designation T4, through ASTM B 108 to an acceptance level Grade C as a minimum and have a matte non-reflective surface finish texture

(3) Welding of aluminum alloy products.

Welding is to be conducted according to the recommendations of the ASTM standard that governs the product or basis metal and in accordance with the specifications and recommended procedures and practices of ANSI/AWS A5.10 and D1.2.

1626.3 TEST METHODS

Conduct all tests required by the applicable ASTM or ANSI/AWS specification of **subsection 1626.2b**.

1626.4 PREQUALIFICATION

Not applicable.

1626.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type B certification as specified in **DIVISION 2600**.

Inspection by field personnel of all products and components for compliance with dimensional and supplemental corrosion protection coating requirements when corrosion protection is specified, quality of workmanship and delivery condition.

SECTION 1627

ALUMINUM SIGNING MATERIALS

1627.1 DESCRIPTION

This specification covers aluminum alloy materials and hardware items for fabricating signs.

1627.2 REQUIREMENTS

a. General. Provide materials that comply with the dimensions shown in the Contract Documents. Tolerances are as shown in the Contract Documents or as specified by ASTM or other referenced specifications.

Provide aluminum alloys that comply with **TABLE 1627-1**.

TABLE 1627-1: ALUMINUM ALLOYS FOR SIGNS

Material	Test Method	Alloy
Fasteners		
Bolts and Screws	ASTM B 211	Alloys 2024-T4* or 6061-T6
Nuts, ¼ inch tap and under	ASTM B 211	Alloy 2024-T4*
Nuts, 5/16 inch tap and over	ASTM B 211	Alloys 6061-T6 or 6262-T9
Washers, Flat	ASTM B 209	Alloy 2024 with 1230, T4 temper (Alclad 2024-T4)
Washers, Spring Lock	ASTM B 211	Alloy 7075-T6
Locknuts	ASTM B 211	Alloy 2017-T4*
Rivets, blind (Front entry, expanding)	ASTM B 316	Alloys 2017-F* or 2117-F*
Post Clips	ASTM B 108	Alloys (cast) 356.0-T6, A356.0-T61 or 356.0-F
Structural Panels	ASTM B 209	Alloy 3003-H18 or 5052-H38
Structural Panel Stiffeners	ASTM B 221	Alloy 6063-T6
Sign Blanks	ASTM B 209	Alloys 6061-T6, 6063-T6, 5154-H38 or 5052-H38
Detachable Legend for Signing	ASTM B 209	Alloy 3003-H14

* Anodize to produce an oxide coating not less than 0.0002 inch thick and seal to decrease permeability.

1627.3 TEST METHODS

As specified in the various ASTM standards referenced in **TABLE 1627-1**

1627.4 PREQUALIFICATION

None Required.

1627.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

Visual inspection at destination for condition and compliance with dimensional and other requirements.

SECTION 1628

HEADED REINFORCING ANCHORS

1628.1 DESCRIPTION

This specification covers rebar with headed anchors attached to one or both ends of the bars for concrete reinforcement. Equivalent types of headed reinforcing anchors may also be referred to as headed reinforcement, headed rebar, rebar end anchors, or rebar terminators.

1628.2 REQUIREMENTS

a. Mount anchors on bars that meet all requirements of **SECTION 1601** including prequalified plant status.

b. Mount anchors on bars in a fabricator's shop prior to delivery to a project. Forging, swaging, and threading are acceptable methods of attaching the anchors on bars.

c. Unless otherwise shown, use only headed reinforcing anchors with heads having a net area of at least 9 times the area of the reinforcing bar.

d. Use anchors complying with the requirements of ASTM A 970, Class A with the following exception:

(1) Rejection based on testing done at the KDOT in accordance with this specification may be reported at any time after the samples are delivered. Samples tested for prequalification which are rejected are not eligible for a rehearing.

1628.3 TEST METHODS

Test according to the requirements of **subsection 1628.2d**.

1628.4 PREQUALIFICATION

a. Prepare 3 test specimens each bar size to be prequalified and forward them to the Engineer of Tests along with the following information:

- Name, address and telephone number of the manufacturer. Include the name and e-mail address of the preferred contact person.
- Brand name of the anchor.
- Type and description of the anchor.
- Method of attachment of the reinforcing anchor to the rebar (forged, swaged, or threaded).
- Information regarding recommended usage and instructions.
- Material Safety Data Sheets (if applicable).

b. The samples provided will be tested to destruction and test reports prepared. During testing, the Engineer of Tests will determine if operator prequalification is required for fabricator shop attachment, and enter that information on the test reports. The test reports and the information supplied will be reviewed by the Bureau Chief of Construction and Materials. The manufacturer will be advised as to whether or not the product is prequalified.

c. The Bureau of Construction and Materials will maintain a list of prequalified anchors. Products on the list will be classified by the method of attachment to the bar as listed in **subsection 1628.2b** and the approved bar sizes.

Products will remain prequalified as long as the manufacturing processes remain unchanged, and field experience indicates that the product functions appropriately. Changes in manufacturing processes require new prequalification testing. Failure of the product to function appropriately in the field will be cause for removal from prequalified status. Products removed from prequalified status will be considered for requalification if the manufacturer can provide evidence that the cause of failure has been positively identified, and necessary changes and quality control measures have been implemented to eliminate that cause. Complete prequalification testing will be required for products that have been removed from prequalified status.

1628.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1628.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

SECTION 1701

BEARINGS AND PADS FOR STRUCTURES

1701.1 DESCRIPTION

This specification covers the following types of pads and bearings for use on bridge seats:

- Plain Elastomeric bearing pads are non-reinforced pads consisting of elastomer only.
- Steel reinforced elastomeric bearings consist of layers of elastomer restrained at their interfaces by bonded, non-elastic laminates. Provide bearings with the dimensions, material properties, elastomer grade and type of laminates shown in the Contract Documents.
- Polytetrefluoroethylene (PTFE)/elastomeric bearings consist of a stainless steel sliding plate and a steel reinforced elastomeric bearing. Bond a stainless steel or structural steel back-up plate to the top of the steel reinforced elastomeric bearing. Bond the other side of the back-up plate with a layer of teflon.
- Steel bearings consist of rocker, roller and sliding bearings.
- Pot and disc bearings consist of a circular, non-reinforced neoprene, elastomer, or rubber pad, of relatively thin section. For a pot bearing, this pad is confined and sealed in a stell pot or hydraulic cylinder. For a disc bearing, this pad is not confined.
- Spherical bearings consist of bearing with spherical elements for unidirectional deflection rotation.

1701.2 REQUIREMENTS

a. General. Use only one type of pad throughout any one structure, unless otherwise noted in the Contract Documents.

Provide the type(s) of bearings shown in the Contract Documents.

Provide pads or bearings that comply with the Bearings section requirements of AASHTO's LRFD Bridge Design Specifications and LRFD Bridge Construction Specifications.

b. Plain Elastomeric Pads. Provide a virgin neoprene (Polychloroprene) pad. A Shore A Durometer hardness of 60 ± 5 and an AASHTO low temperature grade 3 elastomer is required, unless shown otherwise in the Contract Documents. Leveling pads used in Continuous Prestressed Beam Bridges are exempt from the low temperature grade requirements.

c. Steel Reinforced Elastomeric Bearings. Except as modified by the material, testing and acceptance requirements of this specification, provide steel reinforced elastomeric bearings that satisfy the requirements of AASHTO M 251.

Provide a virgin neoprene (polychloroprene) elastomer. A Shore A Durometer hardness of 60 ± 5 and an AASHTO low temperature Grade 3 elastomer is required, unless shown otherwise in the Contract Documents.

Provide laminates for the bearings that comply with ASTM A 36, AASHTO M 270 (ASTM A 709) Grade 36, ASTM A 1011 SS Grade 36 or A 1008 SS Grade 40, unless otherwise specified in the Contract Documents.

Refer to the Contract Documents for the design method used:

(1) For steel reinforced elastomeric bearings designed using Design Method A, provide bearings that conform to and are tested according to the requirements of AASHTO M 251, sections 8.6 and 8.8.2, and Appendices X1 and X2. The testing requirements of section 8.8.1 will apply if a maximum value for compressive strain is shown in the Contract Documents. Follow the test procedure described in section 8.8.2, except load the sampled bearing to 1500 psi.

(2) For steel reinforced elastomeric bearings designed using Design Method B, provide bearings that conform to and are tested in accordance with AASHTO M 251, sections 8.6 and 8.8, including the shear modulus test of section 8.8.4. Report the test method used to determine shear modulus. The testing requirements of section 8.8.1 will apply if a maximum value for compressive strain is shown in the Contract Documents. Report the percent creep at 25 years (section 8.8.3) if an allowable value is shown in the Contract Documents. Follow the test procedure described in section 8.8.2, except load the sampled bearing to 2400 psi.

For sampling and testing of finished bearings, a lot is defined as being of the same size, thickness, design, and type - manufactured in a reasonably continuous manner for a single bridge.

d. PTFE/Elastomeric Sliding Bearings. Provide an elastomeric portion satisfying **subsection 1701.2(c)**.

Provide a sliding surface for the PTFE that is chromium-nickel stainless steel sheet or plate that complies with ASTM A 240, UNS S31600 or UNS S30400. Polish the surface to an 8 micro-inch RMS (#8 mirror) finish.

Provide special bearing quality polytetrafluoroethylene (PTFE) unfilled sheets having a static loading coefficient of friction of not more than 0.03 at a bearing pressure of 3.0 ksi or greater and a temperature of 68°F.

e. Steel Bearings. Face the bearing surfaces of the bearings as required by **DIVISION 700**.

When specified on the Contract Documents, provide structural steel that is hot dip galvanized in accordance with ASTM A 123.

When specified on the Contract Documents, paint the surfaces of the bearings as required by **DIVISION 700**.

f. Pot Bearings. Provide an elastomeric portion satisfying **subsection 1701.2c.** except that the nominal hardness will lie between 50 and 60 on the Shore A scale. Fabricate the pot and piston of structural steel that complies with AASHTO M 270 Grade 36, 50 or 70 as shown in the Contract Documents. Do not use weathering steel for any of these components. Provide brass seal rings that comply with ASTM B 36 for rectangular cross-sections or Federal Specification QQB62 Composite 2 for circular cross-sections.

g. Disc Bearings. Provide PTFE and stainless steel materials satisfying **subsection 1701.2d**. Construct disc from polyether urethane with a Shore A Durometer hardness of 55 ± 10. Provide steel satisfying **subsection 1701.2f**. Do not use weathering steel for any of these components. Design and use materials consistent with limitations and criteria from AASHTO's "LRFD Bridge Construction Specifications".

h. Speherical Bearings. Use woven PTFE material. Do not use weathering steel for any of these components. Design and use materials consistent with limitations and criteria from AASHTO's "LRFD Bridge Construction Specifications".

i. Anchor Bolts. Provide AASHTO M 314 Grade 36 or Grade 55 anchor bolts that comply with **DIVISION 1600**. When specified on the Contract Documents, provide anchor bolts, nuts, and washers that have been hot dip galvanized in accordance with ASTM F 2329.

1701.3 TEST METHODS

As specified in the various AASHTO and ASTM standards cited in this specification.

1701.4 PREQUALIFICATION

None required.

1701.5 BASIS OF ACCEPTANCE

a. Plain Elastomeric Pads. Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

b. Bearings (all types except Steel) Accepted on the basis of the following:

(1) Receipt and approval of a Type A certification as specified in **DIVISION 2600**.

(2) Receipt and approval of a certification from the bearing producer describing the results of a visual examination by QC personnel performed during the testing of AASHTO M 251, section 8.8.2. Reject bearings having cracks exceeding the criteria of section 8.8.2, having bulging that suggest poor laminate bond, or bulging patterns that imply laminate placement does not meet the tolerance requirements of M 251, section 6. Include the following with the certification:

(a) A statement certifying the bearings conform to the design, material, and manufacturing requirements of this specification.

(b) High resolution pictures of all four sides of the loaded bearing. Take the pictures from an angle and distance, using appropriate lighting, to clearly indicate the amount of bulging and bulging patterns.

(c) A detailed description of any surface cracks

(3) Visual inspection for condition and compliance with the shop drawings by the Field Engineer at the project site.

c. Steel Bearings. Accepted on the basis of the following:

- Receipt and approval of a Type A certification as specified in **DIVISION 2600** for all steel components provided through this specification.
- Visual inspection for compliance with the shop drawings and fabrication requirements of **SECTION 705** at either the point of production, at the bridge fabricator's facility, or at the project site, as determined by the Field Engineer.

SECTION 1702

CALCIUM CHLORIDE

1702.1 DESCRIPTION

This specification covers calcium chloride to be added to bases or surfaces as a stabilizer or dust palliative.

1702.2 REQUIREMENTS

a. Provide calcium chloride that complies with AASHTO M 144 with the exception that "Impurities Content" does not apply. Supply one of the types listed below:

(1) Type S (Flake, pellet or granule)

(a) Grade 1 (77% $CaCl_2$)

(b) Grade 2 (90% $CaCl_2$)

(2) Type L (Liquid)

b. Base the application rate used in the Contract Documents on Type S, Grade 2 calcium chloride. Increase the rate by 20% when using Grade 1. Calculate the application rate of Type L based on the concentration of the material supplied.

1702.3 TEST METHODS

Sample and test according to the applicable provisions of AASHTO T 143.

1702.4 PREQUALIFICATION

Not required.

1702.5 BASIS OF ACCEPTANCE

a. Receipt and approval of a Type D certification as specified in **DIVISION 2600**. Include the concentration of $CaCl_2$ if certifying a Type L material.

b. Satisfactory performance in the field.

SECTION 1703

ELECTRIC LIGHTING AND TRAFFIC SIGNAL EQUIPMENT

1703.1 DESCRIPTION

This specification covers general materials, electrical conduit and miscellaneous hardware for highway lighting and traffic signal systems. Construct these systems in accordance with, and at locations indicated in the Contract Documents or designated by the Engineer.

1703.2 REQUIREMENTS

a. General Materials. Whether the installation involves a single Contract or tied contracts, use a single manufacturer when purchasing all major items of electrical equipment to be used on the project(s). Make all attempts to maintain the same type and consistency of products to promote uniformity, singular responsibility and serviceability. Provide equipment that is new, the best standard product of a manufacturer regularly engaged in the production of this type of equipment, the manufacturer's latest approved design and of best quality and workmanship.

Provide a complete lighting/traffic signal system. Provide and install all equipment necessary for the complete and satisfactory operation of the lighting/traffic signal system whether specifically mentioned or not.

b. Electrical Conduit.

(1) Metallic Conduit and Fittings. Provide a rigid steel conduit suitable for use as a raceway for wires or cables of an electrical system. Comply with all requirements of American National Standards Institute (ANSI) C80.1. Protect the exterior surface with a metallic zinc coating and on the interior surface with zinc, enamel or other equivalent corrosion–resistant coating. Metallic conduit fittings are to be zinc coated and comply with ANSI C80.4.

(2) Nonmetallic Conduit and Fittings.

(a) Polyvinyl Chloride (PVC) Conduit. Provide a Schedule 40 or Schedule 80 rigid polyvinyl chloride conduit complying with the latest edition of the National Electrical Manufacturing Association (NEMA) Standard TC-2. Comply with NEMA Standard TC-3 on all PVC conduit fittings. Fabricate from polyvinyl chloride having the same chemical and physical properties as the conduit, which is made in accordance with the manufacturer's recommendations. Underwriters, Inc. (UL) labels are required on all conduit and fittings.

(b) Polyethylene Conduit. Provide a smooth wall, Schedule 40 or Schedule 80, high-density polyethylene duct complying with NEMA Standard TC-7.

(3) Supply conduits complying with the dimensional requirements shown in the Contract Documents.

c. Miscellaneous Hardware. Hot dip galvanize or electroplate with zinc or cadmium all miscellaneous hardware such as bolts, nuts, washers, studs, pins, terminals, springs and similar fastenings in accordance with the following requirements:

(1) Hot Dipped Galvanized. Comply with to requirements stated in ASTM A 153. Complying with the requirements stated under Class C or D for threaded fittings.

(2) Electroplated Articles. Provide sufficient coating to complying with ASTM B 633.

1703.3 TEST METHODS

For hot dipped galvanized materials, determine acceptable coating thickness as stated in ASTM A 90, ASTM B 499 or methods stated in ASTM B 633.

For electroplated articles, measure thickness by any one of the methods specified in ASTM B 633 and, in addition, by eddy current techniques. The eddy current methods, ASTM B 244 may be utilized provided appropriate calibration procedures and standards have been applied. The ASTM B 659 provides a guide to these methods. The magnetic methods of ASTM B 499, referenced in ASTM B 633, and eddy current techniques are nondestructive and are preferred.

1703.4 PREQUALIFICATION

a. Traffic Signals. Prequalification or preapproval by the Bureau of Traffic Engineering is required of all materials stated in the Contract Document's Bill of Materials before use on KDOT projects. Upon approval by the Bureau of Traffic Engineering, the material will be added to the prequalified list of materials maintained by the Bureau of Construction and Materials. When a manufacturer or supplier is intending to supply traffic signal materials under these specifications, proceed as follows:

(1) Submit an original catalog cut, shop drawing, drawing and/or data sheets on the material.

(2) Send a signed certification letter from the manufacturer or fabricator certifying that the material complies with the applicable specifications. Submit this information to:

KDOT
Bureau of Transportation Safety and Technology
Eisenhower State Office Building
700 SW Harrison Street
Topeka, Kansas 66603-3754

b. Lighting. Not Applicable.

1703.5 BASIS OF ACCEPTANCE

Acceptance of material provided under this specification will be based on the following:

a. Traffic Signals.

(1) Prequalification for traffic signal materials as specified in **subsection 1703.4**.

(2) Traffic Signal Materials List: Before the installation of traffic signals, submit for the approval of the Engineer a complete list of traffic signal materials proposed for installation. Submit the list as soon as practicable. Include items on the list for all quantities which are indicated in the Bill of Materials. Include the make, model and other descriptive data as may be required by the Engineer to identify the product. Sign the list certifying that the project-provided materials fulfill the requirements above. The Engineer will compare the items on the traffic signal materials list to the prequalified list. If all of the items match, the Engineer will sign the traffic signal materials list attesting that the materials are approved for use on the project. Forward a copy of the list to each of the following: Bureau Chief of Construction and Materials, Bureau Chief of Transportation Safety & Technology, and the maintaining agency's contact person indicated in the Contract Documents.

In the event the Contractor wishes to provide any item that is not on the prequalified list, provide the Engineer with the information for prequalification per **subsection 1703.4**. Forward this information to the Bureau of Transportation Safety & Technology for review and approval, along with possible addition to the prequalified list.

(3) Electrical conduit: Receipt and approval of a Type D certification as specified in **DIVISION 2600** and visual inspection for condition and compliance with dimensional or other requirements.

(4) Structural steel poles and mast arms:

(a) Receipt and approval of a copy of the certified mill test reports for each heat or lot of material showing process of manufacture and compliance with chemical and physical requirements of the applicable specifications. Submit these reports to the Engineer of Tests.

(b) Satisfactory results of tests performed at destination to determine the weight of the zinc coating.

(c) Provide detailed shop drawings on all poles from the traffic signal pole manufacturer. Include drawings of the poles, mast arm and luminaire arm (on combination poles) dimensions, arm attachment details, handhole details, and anchor bolt details. Include the signal weight, projected areas and mounting arrangement the poles are designed to accommodate. Submit design calculations along with the shop drawings. Approved shop drawings will be included on the prequalified list.

For traffic signal poles that are not covered by the approved manufacturer's standard shop drawings, submit 3 copies of the detailed shop drawings, along with the design calculations to the Engineer for approval by the Bureau of Transportation Safety & Technology.

(d) Along with the traffic signal materials list, submit the necessary traffic signal pole ordering information. The Engineer will review the information for compliance with the plan dimensions for pole height, mast arm length/mounting height and luminaire arm length/mounting height.

(e) Visual inspection at destination for condition, compliance with dimensions and requirements as indicated by the approved documents.

(5) Materials such as ferrous-and non-ferrous metals or other materials are governed by other sections of these specifications.

b. Lighting.

(1) Electrical conduit: Receipt and approval of a Type D certification as specified in **DIVISION 2600** and visual inspection for condition and compliance with dimensional or other requirements.

(2) Structural steel poles and mast arms:

(a) Receipt and approval of a copy of the certified mill test reports for each heat or lot of material showing process of manufacture and compliance with chemical and physical requirements of the applicable specifications. Submit these reports to the Engineer of Tests.

(b) Satisfactory results of test performed at destination to determine the mass of the zinc coating.

(c) Visual inspection at destination for condition and compliance with dimensions or other requirements.

(3) Materials such as ferrous-and non-ferrous metals or other materials are governed by other sections of these specifications.

(4) Materials for electric lighting installations not covered elsewhere in these specifications are shown in the Contract Documents. Base acceptance of these materials on the following:

(a) Approval of shop drawings, catalog cuts, brand names or other requirements as shown in the Contract Documents. Submit 7 copies of all catalog cuts, shop drawings, etc. to the following address for approval:

KDOT
Bureau of Transportation Safety and Technology
Eisenhower State Office Building
700 SW Harrison Street
Topeka, Kansas 66603-3754

(b) Visual inspection at destination for condition and compliance with requirements as indicated by the approved documents.

SECTION 1704

WARNING LIGHTS

1704.1 DESCRIPTION

This specification covers warning lights for use on traffic control devices.

1704.2 REQUIREMENTS

a. General. Provide warning lights of the type or types shown in the Contract Documents and complying with the latest edition of the MUTCD, Part VI, Warning Lights and the Institute of Transportation Engineers (ITE) Purchase Specification for Flashing and Steady Burn Warning Lights.

Clearly mark the manufacturer's name, type and model number on the outside of each unit used on the project.

Provide lights that comply with the crashworthy criteria contained in the testing and acceptance guidelines of the National Cooperative Highway Research Program (NCHRP) Report 350.

b. Batteries. Use batteries that are recommended by the light manufacturer. Replace batteries when they no longer provide satisfactory performance as determined by the Engineer.

1704.3 TEST METHODS

As specified in ITE Purchase Specification for Flashing and Steady Burn Warning Lights. Test lights as specified by NCHRP Report 350.

1704.4 PREQUALIFICATION

Supply test data from an approved testing laboratory for each type and model of warning light showing compliance with the specification. Submit test results, along with the brand, model and type of warning light to the Engineer of Tests. Requalify any unit that has been modified or changed in such a way as to affect the performance of the unit. Submit a NCHRP Report 350 crashworthy certification to the Engineer of Tests.

The Bureau of Construction and Materials will maintain a list of prequalified warning lights.

1704.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1704.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Satisfactory performance in the field.

SECTION 1705

EPOXY-RESIN-BASE BONDING SYSTEMS FOR CONCRETE

1705.1 DESCRIPTION

This specification covers two-component, epoxy-resin bonding systems for application to portland cement concrete, which are able to cure under humid conditions and bond to damp surfaces, and comply with the AASHTO M 235 (ASTM C 881).

a. Seven types of systems are covered by this specification.
(1) Type I - For use in non-load bearing applications for bonding hardened concrete to hardened concrete and other materials, and as a binder in epoxy mortars or epoxy concretes.
(2) Type II - For use in non-load bearing applications for bonding freshly mixed concrete to hardened concrete.
(3) Type III - For use in bonding skid-resistant materials to hardened concrete, and as a binder in epoxy mortars or epoxy concretes used on traffic bearing surfaces (or surfaces subject to thermal or mechanical movements).
(4) Type IV - For use in load bearing applications for bonding hardened concrete to hardened concrete and other materials, and as a binder for epoxy mortars and concrete.
(5) Type V - For use in load bearing applications for bonding freshly mixed concrete to hardened concrete.
(6) Type VI - For bonding and sealing segmental pre-cast elements with internal tendons and span-by-span erection when temporary post tensioning is applied.
(7) Type VII - For use as a non-stress carrying sealer for segmental pre-cast elements when temporary post tensioning is not applied as in span-by-span erection.

b. Three grades of systems are covered by this specification.
(1) Grade 1 - Low viscosity (0-2.0 Pa)
(2) Grade 2 - Medium viscosity (2.0-10 Pa)
(3) Grade 3 - Non-sagging consistency.

c. Classes A, B, and C are defined for Types I through V, and Classes D, E, and F are defined for Types VI and VII, according to the range of temperatures for which they are suitable. The temperature in question is usually that of the surface of the hardened concrete to which the bonding system is to be applied. This temperature may be considerably different from that of the air. Where unusual curing rates are desired, it is possible to use a class of bonding agent at a temperature other than that for which it is normally intended. For example, a Class A system will cure rapidly at room temperature. Any deviation of this sort must be approved by the Engineer before application. Classes are defined as follows:
(1) Class A - For use below 40ºF. The lowest allowable temperature is defined by the manufacturer of the product.
(2) Class B - For use between 40 and 60ºF.
(3) Class C - For use above 60ºF. The highest allowable temperature is defined by the manufacturer of the product.
(4) Class D - For use between 40 and 65ºF.
(5) Class E - For use between 60 and 80ºF.
(6) Class F - For use between 75 and 90ºF.

1705.2 REQUIREMENTS

Provide material that complies with AASHTO M 235 (ASTM C 881), is the type and grade specified in the Contract Documents, and is the class appropriate for the temperature at the time of use, as designated by the manufacturer.

1705.3 TEST METHODS

As specified in AASHTO M 235 (ASTM C 881).

1705.4 PREQUALIFICATION

a. All epoxy resin systems intended for use under this specification must be prequalified on the basis of Type, Grade and Class prior to use. Manufacturers desiring to supply material for KDOT jobs must submit a written request to the Bureau Chief of Construction and Materials, with the following information for each type and brand name:

(1) Name, address and telephone number of the manufacturer. Include the name of the preferred contact person.

(2) Brand name of the material.

(3) Type, Grade and Class of the material.

(4) Information regarding recommended usage and application instructions.

(5) Material Safety Data Sheets.

(6) One copy of a certified test report prepared by a laboratory regularly inspected by the Cement and Concrete Reference Laboratory (CCRL) of the National Institute of Standards Technology or other approved reference laboratory, showing test results complying with AASHTO M 235 (ASTM C 881). Include evidence that the laboratory is inspected regularly.

b. The information and test reports will be reviewed by the Bureau Chief of Construction and Materials. The manufacturer will be advised as to whether or not the product is prequalified.

c. The Bureau of Construction and Materials will maintain a list of prequalified epoxy resin systems. Products will remain prequalified as long as the formulation and manufacturing processes remain unchanged, and field experience indicates that the material functions appropriately. Changes in formulation or manufacturing processes will require new prequalification testing. Failure of the material to function appropriately in the field will be cause for removal of the product from prequalified status. Products removed from prequalified status will be considered for requalification if the manufacturer can provide evidence that the cause of failure has been positively identified, and necessary formulation changes and quality control measures have been implemented to eliminate that cause. Complete prequalification testing may be required for products that have been removed from prequalified status.

1705.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1705.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Observation of performance at the project to verify that the epoxy is effective for the specified purpose.

SECTION 1706

ABUTMENT STRIP DRAIN

1706.1 DESCRIPTION

The abutment strip drain is a prefabricated geocomposite system used to provide drainage behind abutment backwalls, wing walls, retaining walls or under slopes.

1706.2 REQUIREMENTS

a. General. The system is preformed using a lightweight, high impact polymeric core with an attached geotextile (filter fabric). The composite polymer core is bonded to the geotextile at intervals not exceeding 1 1/8 inch in any direction. The preformed system permits the flow of water through the core. The geotextile fabric is thermal (heat) bonded or fungicide glue bonded to the polymeric core. The composite product sheets or rolls have a minimum width of 3 feet with a minimum area of 40 square feet. Store and handle the system in accordance with manufacturer's recommendations, except that in no case may geotextile be exposed to direct sunlight, ultraviolet rays, temperature greater than 140ºF, mud, dirt, dust, and debris. Do not use any core section that becomes torn or punctured. All material delivered to the project must meet or exceed the physical requirements based on minimum average roll or sheet values in **TABLE 1706-1**.

TABLE 1706-1: COMPOSITE SYSTEM PROPERTIES

Property	Requirement	Test Method
Thickness (mils)	250 min., 500 max	ASTM D 1777
Peel Strength (lbs/ft)	5 minimum	ASTM D 1876
Transmissivity at hydraulic gradient of 1.0 and normal stress of 3,600 lbs / sq ft		
Wall Drain (gals/min/ft)	7 minimum	ASTM D 4716
Slope Drain (gals/min/ft)	10 minimum	ASTM D 4716

b. Core. The core is a lightweight polymer plastic composition of either polystyrene, polyethylene, polypropylene, or PVC, with a convexity structure and complies with **TABLE 1706-2**.

TABLE 1706-2: CORE PROPERTIES

Property	Requirement	Test Method
Std. Crush Strength:		
Wall Drain (lbs/sq ft)	Min. 8,000	ASTM D 1621
Slope Drain (lbs/sq ft)	Min. 17,000	ASTM D 1621
Deflections (%)	Max. 20	ASTM D 1621
Thickness (mils)	Min. 230	ASTM D 1777

c. Geotextile Filter Fabric. Provide fabric that complies with AASHTO M 288 for subsurface drainage geotextiles with properties for Class 2 geotextile with elongation greater than or equal to 50%, and percent in-situ soil passing the No. 200 sieve of greater than 50%.

NOTE: Use backfill soils with a liquid limit less than 50.

1706.3 TEST METHODS

Test the composite and individual components according to the standards cited in **subsection 1706.2**.

1706.4 PREQUALIFICATION

For prequalification, supply samples of the finished product from production to the KDOT Engineer of Tests for testing and evaluation. Submit separate samples of the core material and the filter fabric. All samples must be 10 feet long by nominal roll width. Submit a manufacturer's or independent laboratory test report addressing the properties in **subsection 1706.2**.

When it becomes available, test results for the product will be accepted from the AASHTO National Transportation Product Evaluation Program (NTPEP) without submitting samples. Forward an official copy of the test report to the Bureau Chief of Construction and Materials for evaluation. Prequalification will be based on satisfactory compliance of NTPEP results with this specification.

If the KDOT test or NTPEP results comply with **subsection 1706.2**, the name of the product will be placed on a list of prequalified products maintained by the Bureau of Construction and Materials. No geocomposite drainage system will be used on KDOT projects unless it has been prequalified.

1706.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1706.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

A visual inspection in the field for damage and to verify compliance with these specifications.

SECTION 1707

MANHOLE STEPS

1707.1 DESCRIPTION

This specification covers the requirements for steps for use in precast or cast in place manholes. The steps may be either Type 1 or Type 2 unless otherwise shown in the Contract Documents.

1707.2 REQUIREMENTS

a. Type 1. Provide a manhole step made of a No. 3 or larger deformed steel reinforcing bar encapsulated in a copolymer polypropylene plastic possessing good impact and load-bearing properties and corrosion resistance.

Use a steel bar that complies with ASTM A 615 and make it continuous throughout the entire length of the legs and tread. Use a copolymer polypropylene plastic coating that complies with ASTM D 4101, Group 2.

b. Type 2. All steps not complying with Type 1 are considered Type 2 and require prequalification. Provide steps that comply with ASTM C 478, Sections 13.4 and 13.6. Galvanize ferrous metal steps, or encapsulate them in a plastic, which possesses good impact, load bearing, and corrosion resistant properties.

1707.3 TEST METHODS

Test in accordance with the ASTM methods shown for each step type.

1707.4 PREQUALIFICATION

Submit a sample and a certified test report, listing the results of all applicable tests, from a qualified laboratory, for each model and size of Type 2 step to be prequalified to the Engineer of Tests. The Engineer of Tests will review the test results and inspect and/or test the sample, and will notify the manufacturer in writing of the status of each type of step submitted.

The Bureau of Construction and Materials will maintain a list of prequalified Type 2 manhole steps.

1707.5 BASIS OF ACCEPTANCE

a. **Type 1 manhole steps**. Receipt and approval of a Type D certification as specified in **DIVISION 2600** and visual inspection for conditions and dimensional requirements.

b. Type 2 manhole steps. Receipt and approval of a Type C certification as specified in **DIVISION 2600** and visual inspection for conditions and dimensional requirements.

SECTION 1708

BRIDGE BACKWALL PROTECTION SYSTEM

1708.1 DESCRIPTION

This specification covers waterproofing protection systems to be applied to the face of a concrete abutment against which a backfill will be placed. Requirements for the systems other than the coal-tar membrane are performance oriented, and not limited to any single methodology to accomplish the desired results.

1708.2 REQUIREMENTS

a. General. Make bridge backwall protection systems of permanent non-biodegradable materials possessing the waterproofing protection qualities outlined below. All materials incorporated into a system must be environmentally acceptable, and not prohibited by any regulatory body. Handle, store and install bridge backwall protection systems in strict compliance with the manufacturer's recommendations.

b. Properties.

(1) The system provides an impermeable layer that adheres to the concrete surface. Such adherence may require the presence of water to activate the system. The activated system prevents lateral movement of water at the interface between the concrete and the impermeable layer.

(2) The system is self healing when punctured by sharp objects. It has the capability to flex and bridge over, or move into and seal any cracks which may develop in the concrete.

(3) Acceptable bentonite based systems contain a minimum of 9 lb of evenly distributed bentonite per square yard of system surface area.

1708.3 TEST METHODS

None required.

1708.4 PREQUALIFICATION

a. Bridge backwall protection systems that are intended for use under this specification must be prequalified. Submit a written request to the Bureau Chief of Construction and Materials, with the following information for each type and brand name being offered:

(1) Name, address and telephone number of the manufacturer. Include the name of the preferred contact person.

(2) Brand name of the system.

(3) Complete technical information on the system, including test reports addressing requirements cited above. Include small sales samples of the system. Larger samples will be requested if further testing is necessary.

(4) Information regarding recommended usage and application instructions. Specifically identify any concrete surface or system curing requirements.

(5) Material Safety Data Sheets.

b. The information will be reviewed by the Bureau Chief of Construction and Materials, and the manufacturer will be advised as to whether or not the product is prequalified.

c. The Bureau of Construction and Materials will maintain a list of prequalified bridge backwall protection systems. Products will remain prequalified as long as the formulation and manufacturing processes remain unchanged, and field experience indicates that the material functions appropriately. Changes in formulation or manufacturing processes will require a new prequalification review.

1708.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1708.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Visual inspection at destination for condition and compliance with dimensional and other requirements.

SECTION 1709

SUBSTRUCTURE WATERPROOFING MEMBRANE

1709.1 DESCRIPTION

Material covered by this specification forms a waterproofing system to be applied to selected areas of a bridge substructure.

1709.2 REQUIREMENTS

a. General.

(1) Provide a flexible coating which is moisture insensitive, and which seals the surface to which it is applied to prevent the penetration of water.

(2) When applied to a concrete substrate and given 500 hours of exposure in an accelerated weathering apparatus (ASTM G 153, Table X1.1, Cycle 1) the waterproofing membrane system must be continuous, free of deep cracks and give complete protection from moisture intrusion.

(3) Prepare surfaces and apply each component in accordance with the manufacturer's instructions. Provide a copy of the manufacturer's literature including mixing, thickness of application, and installation instructions to the Field Engineer prior to application of the system.

b. Epoxy Primer/Urethane Mastic System.

(1) Primer. The primer is a two-part penetrating epoxy polyamide specially formulated for use on concrete surfaces to improve adhesion before application of one or two-part polyurethane coatings, with a minimum solids content of 20 percent.

(2) Mastic. The mastic is a one or two-part modified urethane elastomer, formulated as a weather resistant membrane, with a minimum solids content of 80 percent.

c. Epoxy System. Epoxy systems comply with AASHTO M 235 (ASTM C 881) Type III, grade and class as required for work to be performed. Epoxy systems must be prequalified under **SECTION 1705**, "Epoxy-Resin-Base Bonding Systems for Concrete."

1709.3 TEST METHODS

None specified.

1709.4 PREQUALIFICATION

a. All substructure waterproofing systems intended for use under this specification must be prequalified. Submit a written request to the Bureau Chief of Construction and Materials, with the following information for each type and brand name being offered:

(1) Name, address and telephone number of the manufacturer. Include the name of the preferred contact person.

(2) Brand name of the system.

(3) Complete technical information on the system, including test reports addressing requirements cited above. For epoxy systems, submit complete AASHTO M 235 (ASTM C 881) test reports if the material has not already been prequalified under **SECTION 1705**. Include small sales samples of the system. Larger samples will be requested if further testing is necessary.

(4) Information regarding recommended usage and application instructions. Specifically identify any concrete surface or system curing requirements.

(5) Material Safety Data Sheets.

b. The Bureau Chief of Construction and Materials will review the information, and the manufacturer will be advised as to whether or not the product is prequalified.

c. The Bureau of Construction and Materials will maintain a list of prequalified substructure waterproofing systems. Products will remain prequalified as long as the formulation and manufacturing processes remain unchanged, and field experience indicates that the material functions appropriately. Changes in formulation or manufacturing processes will require a new prequalification review.

1709.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1709.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Visual inspection of performance in the field.

SECTION 1710

GEOSYNTHETICS

1710.1 DESCRIPTION

This specification covers the requirements for paving fabrics and geosynthetics and securing pins installed for subsurface drainage, separation, base course reinforcement and subgrade stabilization. This also covers the requirements for separation geotextile for erosion control.

1710.2 REQUIREMENTS

a. General.

(1) Compose all geosynthetics of at least 85% by weight polyolefins or polyesters.

(2) Use geosynthetics resistant to chemical attack, mildew and rot.

(3) Package in protective wrapping, store, handle and identify all geosynthetics according to ASTM D 4873.

(4) Do not use torn or punctured geosynthetics.

(5) Woven geotextiles with slit-tape or slit-film filaments in both the machine direction (MD or warp) and the cross-machine direction (CD, weft or fill) are prohibited.

(6) When seams are required for geotextiles, use "Butterfly" seams that have a Federal Standard designation of Type SSD-1. Place the stitching approximately 1 inch from the fold. Make sure the two fabric edges are even and have been completely penetrated by the seam. Use polyester, polypropylene or Kevlar thread with durability equal to or great than the material used in the fabric. Seam strength requirements shall be as specified in the Contract Documents.

b. Securing Pins. When required, provide steel securing pins that are nominally 1/4 inch diameter, 18 inches long, pointed at one end and fitted with a 1-1/2inch outside diameter steel washer at the other end.

c. Paving Fabric. Provide a nonwoven geotextile that complies with the general physical and the geotextile property requirements for an AASHTO M 288 paving fabric unless otherwise specified in the Contract Documents. Use a paving grade asphalt recommended by the manufacturer and conforming to the provisions in the AASHTO M 288 Appendix Section 1.6, unless otherwise specified in the Contract Documents, to saturate the paving fabric, as well as bond it to the existing pavement.

d. Subsurface Drainage. Provide a woven or nonwoven geotextile that complies with the general physical and the geotextile property requirements for an AASHTO M 288, Class 2, subsurface drainage geotextile unless otherwise specified in the Contract Documents.

e. Separation Geotextile. Provide a woven or nonwoven geotextile that complies with the general physical and the geotextile property requirements for an AASHTO M 288, Class 2, separation geotextile unless otherwise specified in the Contract Documents. See **subsection 1710.2a.(5)** regarding the use of slit-tape geotextiles.

f. Base Course Reinforcement. Provide a single-layer geogrid or woven geotextile that complies with the properties in **TABLE 1710-1** for reinforcement of an aggregate base course. MD: Machine Direction, CD: Cross-machine Direction.

TABLE 1710-1: BASE COURSE REINFORCEMENT GEOSYNTHETIC MIMIMUM AVERGE ROLL VALUES			
Property	**Test Method**	**Requirements**	
Tensile Strength (at 5% strain)	ASTM D 4595	580 lb/ft MD	900 lb/ft CD
Tensile Strength (at 2% strain)	ASTM D 4595	280 lb/ft MD	450 lb/ft CD
Coefficient of Soil Interaction	GRI-GT6/GG5	0.8	
Junction Strength (geogrid)	GRI:GG2	25 lbs	
Permittivity (geotextile)	ASTM D 4491	0.40 sec^{-1}	
Apparent Opening Size* (geotextile)	ASTM D 4751	30 U.S. Sieve (0.0232 inches)	
Aperture Stability (geogrid)	**	Minimum of 0.32 m-N/Deg (MD direction)	

* ASTM D 4751: AOS IS A MAXIMUM OPENING DIAMETER VALUE
** The Aperture Stability is based on resistance to in-plane rotational movement measured by applying a 20 kg-cm (2 m-N) moment to the central junction of a 9 inch by 9 inch specimen restrained at its perimeter in accordance with U.S. Army Corps of Engineers Methodology for measurement of Torsional Rigidity.

The coefficient of interaction is based on the soil being a granular, non-cohesive material with less than 10% fines. If these base soils are not available, perform a site specific design and increase the base course thickness, accordingly.

g. Subgrade Stabilization. Provide a woven geotextile, geogrid or geogrid/geotextile combination, as specified in the Contract Documents, for subgrade stabilization that complies with the properties in **TABLE 1710-2**. This table is only applicable for subgrades with CBR values greater than 1. For subgrades with CBR values less than 1, a site specific design will be required.

TABLE 1710-2: SUBGRADE STABILIZATION GEOSYNTHETIC MIMIMUM AVERGE ROLL VALUES			
Property	**Test Method**	**Requirements**	
Tensile Strength (at 5% strain)	ASTM D4595	810 lb/ft MD	1340 lb/ft CD
Tensile Strength (at 2% strain)	ASTM D4595	410 lb/ft MD	620 lb/ft CD
Coefficient of Soil Interaction	GRI-GT6/GG5	0.8	
Junction Strength (geogrid)	GRI:GG2	25 lbs	
Permittivity (geotextile)	ASTM D4491	0.40 sec^{-1}	
Apparent Opening Size[a] (geotextile)	ASTM D4751	30 U.S. Sieve (0.0232 inches)	

[a]ASTM D 4751: AOS is a Maximum Opening Diameter Value

h. Pavement Waterproofing Membrane. Provide an asphalt saturated paving fabric coated with a rubberized asphalt adhesive that complies with the properties in **TABLE 1710-3**.

TABLE 1710-3: PAVEMENT WATERPROOFING MEMBRANE MIMIMUM AVERGE ROLL VALUES		
Property	**Test Method**	**Requirements**
Permeance-Perms	ASTM E 96 Method B	0.10 perms (max)
Pliability (180° bend on a 1/4” mandrel @ -25°F)	ASTM D 146	No cracking in fabric or rubber
Puncture Resistance	ASTM E 154	200 lbs
Tensile Strength	ASTM D 882	50 lbs/in

If required, provide a material for a prime coat (comprised of refined asphalt and a rapidly drying solvent) that complies with the requirements of **DIVISION 1200.**

1710.3 TEST METHODS

Test geosynthetic materials according to the ASTM test methods cited in **subsection 1710.2**.

1710.4 PREQUALIFICATION

a. All material provided under this specification must be prequalified through the Engineer of Tests.

b. Manufacturers interested in prequalifying material under this specification must provide, to the Engineer of Tests, at least a 1 foot by 1 foot sample of the material, installation instructions for the material, certification that the properties of the type of material submitted meet the requirements of this specification, current NTPEP testing results associated with the type of material submitted and any other information requested by the Engineer of Tests.

c. The submittals will be evaluated for compliance with this specification, and the manufacturer will be notified of the results.

d. Approved materials will be placed on the prequalified list maintained by the Bureau of Construction and Materials. Products will remain on the prequalified list as long as the field performance and NTPEP test results of the product are satisfactory.

1710.5 BASIS OF ACCEPTANCE

a. Prequalification as specified in **subsection 1710.4**.

b. Receipt and approval of a Type C certification as specified in **DIVISION 2600** for each shipment. A shipment consists of all material arriving at the job site at substantially the same time but in no instance greater than 1 week. Each week will constitute a new time period requiring a new Type C certification even if the site has been supplied continuously from the previous week.

c. Visual inspection of the material at the job site for quality of workmanship and damage incurred during shipping or job site storage.

SECTION 1711

GABIONS

1711.1 DESCRIPTION

This specification covers gabion fabricated in accordance with this specification and as shown in the Contract Documents. Gabions manufactured from both twisted and welded wire are described here. Provide the type that is specified in the Contract Documents. If neither is specified, either may be provided.

1711.2 REQUIREMENTS

a. General. The following applies, regardless of the method of manufacture. Make the mesh openings with a maximum dimension less than 5 inches, and area less than 11 square inches, and a size less than the gabion or revet mattress rock to be used with the mesh.

b. Twisted Wire Mesh. Provide gabions and permanent fasteners, lacing, stiffeners and other assembly components that comply with ASTM A 975 with the following specific designations.

(1) Provide Style 1 unless polyvinyl chloride (PVC) coating is specified.

(2) If PVC coating is specified, provide Style 3.

c. Welded Wire Fabric. Provide gabions and permanent fasteners, lacing, stiffeners and other assembly components that comply with ASTM A 974 with the following specific designations.

(1) Provide Style 2 (zinc coating after welding) unless polyvinyl chloride (PVC) coating is specified.

(2) If PVC coating is specified, provide Style 5 made from Style 2 components.

1711.3 TEST METHODS

Test gabion materials according to the ASTM's cited in **subsection 1711.2**.

1711.4 PREQUALIFICATION

a. All material provided under this specification must be prequalified.

b. Manufacturers interested in prequalifying material under this specification must provide 1 gabion that are galvanized and 1 gabion that is PVC coated to the Engineer of Tests for laboratory testing and evaluation. Include samples of all fasteners used to assemble the units and incorporate them into a structure. Include test reports for the same type of units being submitted, a copy of all technical data, and a complete set of installation recommendations and instructions.

c. The submittals will be evaluated for compliance with this specification, and the manufacturer will be notified of the results.

d. The Bureau of Construction and Materials will maintain a list of qualified materials and a file of installation instructions. Products will remain on the prequalified list as long as the field performance is satisfactory.

1711.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1711.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600** for each shipment. A shipment consists of all material arriving at the job site at substantially the same time.

Visual inspection at the job site for quality of workmanship and coatings, and for compliance to dimensions and dimensional tolerances.

SECTION 1712

PRE-FABRICATED VERTICAL DRAIN

1712.1 DESCRIPTION

This specification covers the requirements for prefabricated vertical drains.

1712.2 REQUIREMENTS

Provide a prefabricated polypropylene channeled core wrapped in a non-woven polypropylene continuous filament geotextile complying with the minimum, minimum average roll values in **TABLES 1712-1 and 1712-2**.

TABLE 1712-1: PREFABRICATED VERTICAL DRAIN FABRIC, MINIMUM AVERAGE ROLL VALUES

Property	Requirement	Test Method
Grab Tensile Strength	130 lbs	ASTM D4632
Grab Elongation at Failure	> 50%	ASTM D4632
Trapezoidal Tear	60 lbs	ASTM D4533
Permittivity	0.5 sec^{-1}	ASTM D4491
Apparent Opening Size (AOS)	≤ 0.3 mm	ASTM D4751

TABLE 1712-2: PREFABRICATED VERTICAL DRAIN COMPOSITE, MINIMUM AVERAGE ROLL VALUES

Discharge	Capacity Requirement	Test Method
1.5 gpm	1.5 psi	ASTM D4716
1.5 gpm	43.5 psi	ASTM D4716

1712.3 TEST METHODS

Test in accordance with the requirements stated in **subsection 1712.2**.

1712.4 PREQUALIFICATION

None required.

1712.5 BASIS OF ACCEPTANCE

The Engineer will accept the geosynthetic material upon the basis of satisfactory test results for each lot. A lot is defined as 10,000 feet. If the material fails to comply with the requirements, the entire lot will be rejected.

Any geosynthetic material proposed for use must be evaluated by the Bureau of Structures and Geotechnical Services, Geotechnical Unit, Soils Section. The entire lot of geosynthetic material must be on site before samples are taken and laboratory testing performed.

Allow a minimum of 15 working days for the approval process. After sufficient data has been collected, the testing frequency may be modified upon approval by the Chief Geotechnical Engineer.

SECTION 1713

INERTIAL BARRIER SYSTEM AND REPLACEMENT MODULES

1713.1 DESCRIPTION

This specification covers inertial barrier systems and replacement modules.

1713.2 REQUIREMENTS

Provide an inertial barrier system and replacement modules as shown in the Contract Documents. Inertial barrier systems may be previously used.

1713.3 TEST METHODS

None specified.

1713.4 PREQUALIFICATION

All inertial barrier systems must be prequalified as a unit. Manufacturers wishing to supply inertial barrier systems to KDOT projects must send a complete evaluation package including the FHWA letter of acceptance and all design and testing information to the KDOT Bureau of Road Design. The information will be reviewed and the manufacturer will be notified of the results. Those systems that are satisfactory for use will be placed on a prequalified list maintained by the Bureau of Construction and Materials.

1713.5 BASIS OF ACCEPTANCE

Inertial barriers and repair modules will be accepted as a complete system or module on the basis of a prequalified brand name, a Type C certification and visual inspection of the completed installation.

SECTION 1714

CEMENTITIOUS GROUT

1714.1 DESCRIPTION

This specification covers cementitious grouts used to bond anchor bolts and reinforcing steel to hardened concrete. This includes self-contained grouts, which are cementitious materials encapsulated in a water permeable layer. This includes the backfilling of CSL tubes.

1714.2 REQUIREMENTS

a. Provide material that complies with ASTM C 1107 or Corps of Engineers CRD-C 621.

b. For self-contained grouts, provide material complying with **TABLE 1714-1**:

TABLE 1714-1: SELF-CONTAINED GROUTS		
Property	**Test Method**	**Requirement**
Soaking Time		1 to 3 min.
Initial Set Time, min.	ASTM C 1102	20 min.
Compressive Strength 28-day min.	ASTM C 39	4,000 psi
Shrinkage	ASTM C 1090	0.00%
Expansion	ASTM C 1090	1.5%
Pull Out Strength	ASTM E 488	9,000 lbf
Freeze-Thaw, min.	ASTM C 666, 300 cycles	95%

1714.3 TEST METHODS

Test as specified in **subsection 1714.2**.

1714.4 PREQUALIFICATION

a. Manufacturers interested in prequalifying material under **subsection 1714.2a**. must submit the following to the Bureau of Construction and Materials:

(1) A complete description, literature, and set of instructions and recommendations,
(2) A copy of test results performed in accordance with ASTM C 1107 or CRD-C 621,
(3) Certificate stating results comply with ASTM C 1107 or CRD-C 621, and
(4) Material Safety Data Sheets (MSDS).

b. Manufacturers interested in prequalifying material under **subsection 1714.2b**. must submit the following to the Bureau of Construction and Materials:

(1) A complete description, literature, and set of instructions and recommendations,
(2) A copy of test results performed as outlined in **subsection 1714.2b.**,
(3) Certificate stating results comply with the values outlined in **subsection 1714.2b.**, and
(4) Material Safety Data Sheets (MSDS).

c. The Bureau of Construction and Materials will maintain a list of qualified materials. Products will remain on the list as long as field performance is satisfactory.

1714.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1714.4**.
Receipt and approval of a Type C certification as specified in **DIVISION 2600**.
Visual inspection by the Field Engineer.

SECTION 1715

CONCRETE MASONRY COATING

1715.1 DESCRIPTION

This specification covers cement based polymer or acrylic polymer water seal for use in coating and sealing the exterior face of exterior prestressed concrete beams, joints between concrete overlays, bridge curb faces, masonry and other applications as stated in the Contract Documents.

1715. 2 REQUIREMENTS

Provide materials with the following properties:

- Coats and waterproofs concrete and masonry.
- Does not produce a vapor barrier (breathes).
- Is thermally compatible with portland cement mortar and concrete.
- Exhibits no chalking, checking, cracking, scaling, blistering or other deleterious effects after 5000 hours in a Xenon Arc Light Apparatus. (ASTM G 155).
- Color is to be gray to retain a natural concrete appearance, unless otherwise specified in the Contract Documents.

1715.3 TEST METHODS

As specified in ASTM G 155 for the Xenon Arc Light Apparatus only.

1715.4 PREQUALIFICATION

All concrete masonry coatings must be prequalified. Manufacturers interested in prequalifying material under this specification must submit the following to the Bureau of Construction and Materials:

- A complete description, technical data, and set of instructions and recommendations.
- A copy of test results from an independent laboratory regularly inspected by a national reference organization (CCRL, AMRL, etc) confirming the various properties outlined above.
- Material Safety Data Sheets (MSDS).

The Bureau of Construction and Materials will maintain a list of qualified materials. Products will remain on the list as long as field performance is satisfactory.

1715.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1715.4**.
Receipt and approval of a Type C certification as specified in **DIVISION 2600**.
Visual inspection by the Field Engineer.

SECTION 1716

RAPID-SET CONCRETE PATCHING MATERIAL

1716.1 DESCRIPTION

This specification covers requirements for rapid setting cementitious materials for concrete repairs.

1716.2 REQUIREMENTS

a. Provide material that complies with ASTM C 928.

b. Freeze-thaw durability will be determined using ASTM C 666, Procedure B. At the end of 300 freeze-thaw cycles, acceptable products must exhibit expansion of less than 0.10%, and a calculated durability factor of 90.0% minimum.

c. When allowed in the Contract Documents, extender aggregate may be combined with the neat rapid setting material according to the manufacturer's recommendations. The resulting combined material is subject to the foregoing requirements. Products will be tested neat as received, and also extended to the full amount allowed by the manufacturer, and will be classified as Rapid Hardening (R1), Very Rapid Hardening (R2) or Ultra Rapid Hardening (R3) based on the results. A product may be classified in one category when tested neat as received, and another when tested extended the maximum amount. All extender aggregate used on Contracts must be from a source that has a current Official Quality approval status for Mixed Aggregate per **SECTION 1102**.

d. Provide material classified as Rapid Hardening, Very Rapid Hardening or Ultra Rapid Hardening as specified in the Contract Documents. Any prequalified higher class of material may be substituted for a lower class specified at no additional cost. If no class is specified, any prequalified product may be supplied.

e. Provide the same product as prequalified under the AASHTO National Transportation Product Evaluation Program (NTPEP), including water/cement ratio and proportion of aggregate (if applicable). If the product was prequalified using a manufacturer-provided aggregate, then the aggregate may be substituted by using an approved local source at the same proportioning established during prequalification.

1716.3 TEST METHODS

Test material in accordance with the applicable parts of ASTM C 928 and ASTM C 666, Procedure B.

1716.4 PREQUALIFICATION

Supply samples for prequalification to the AASHTO National Transportation Product Evaluation Program (NTPEP). Forward an official copy of the test report to the Bureau Chief of Construction and Materials for evaluation. Include information regarding the soluble chloride content of the material, and the mandatory statement from ASTM C 928 if it exceeds 1 lb/cu yd. Include the metallic iron content and the mandatory statement from ASTM C 928 if it exceeds 1% by mass. Prequalification will be based on satisfactory compliance of NTPEP results with this specification. Products will be classified as Rapid Hardening, Very Rapid Hardening or Ultra Rapid Hardening in both the neat and extended mixes based on the NTPEP results.

If the NTPEP laboratory results comply with **subsection 1716.2** and if, after 300 freeze-thaw cycles, the laboratory test specimens exhibit no cracking and only very slight scaling or spalling (minimum 1/8 inch depth) with no coarse aggregate visible, the name of the product will be placed on a list of prequalified products maintained by the Bureau of Construction and Materials. No rapid setting concrete patch material will be used on KDOT projects unless it has been prequalified.

Manufacturers are required to resubmit their products for testing at intervals stipulated by NTPEP. Failure to resubmit products may be cause for removal from the prequalified listing.

1716.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1716.4**.

Receipt and acceptance of a Type C certification as specified in **DIVISION 2600**.

SECTION 1717

PRECAST PANEL BEDDING MATERIALS

1717.1 DESCRIPTION

This specification covers material for bedding prestressed concrete panels used as a slab in bridge construction.

1717.2 REQUIREMENTS

a. Provide bedding material for precast units that complies with **TABLE 1717-1** for expanded or extruded polystyrene.

TABLE 1717-1: BEDDING MATERIAL FOR PRECAST UNITS	
Property	**Test Method**
Compressive Strength, 60 psi, min.	ASTM D 1621
Water Absorption, 2% by vol. max.	ASTM D 2842
Oxygen Index, 24 min.	ASTM D 2863

b. Use a type of glue recommended by the bedding material manufacturer to secure the bedding material to the girder.

1717.3 TEST METHODS

ASTM tests as specified above.

1717.4 PREQUALIFICATION

Manufacturers desiring to provide material under this specification are to submit a 2 x 2 ft prequalification sample of each product which they wish to prequalify.

Provide complete instructions on the use of the material and a Material Safety Data Sheet (MSDS). State the type of glue which is acceptable for use with the material.

Provide a test report from an independent laboratory for the properties cited above.

Forward the prequalification samples and information to the Engineer of Tests. The Material will be tested as necessary to verify the information on the independent laboratory test report. Manufacturers will be notified of the test results.

If the prequalification samples comply with **subsection 1716.2**, the name of the product, along with the allowable type of glue to be used, will be placed on a list of prequalified products maintained by the Bureau of Construction and Materials. No precast bedding material may be used on KDOT projects unless it has been prequalified.

1717.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1717.4**.

Receipt of a Type C certification as specified in **DIVISION 2600**.

Observation of performance in the field.

1718 – BOND-BREAKER FOR PORTLAND CEMENT CONCRETE PAVEMENT DOWEL BARS

SECTION 1718

BOND-BREAKER FOR PORTLAND CEMENT CONCRETE PAVEMENT DOWEL BARS

1718.1 DESCRIPTION

Bond-breaker is applied to dowel bars to be placed in contraction joints in rigid pavement before placement of the concrete. The material serves to prevent the concrete from bonding to the dowel bars, thus preserving the joint as a working one.

1718.2 REQUIREMENTS

a. Bond-breaker must have an average pull out resistance less than 3400 lbs.

b. Bond-breaker must not have any detrimental effects on portland cement concrete or the epoxy coating on the dowel bars.

c. Apply bond-breaker according to the manufacturer's instructions. Do not apply bond-breaker with a thickness value greater than 24 mils. The thickness value is the average of 3 measurements taken at ¼, ½ and ¾ bar length spaced 120 degrees apart. No measurements are permitted to exceed 24 mils.

d. Dowels that have bond-breaker applied in the plant by the dowel supplier must be stored in such a way as to prevent dust, dirt or any other contaminant that would impair the bond-breaking action, from accumulating on the treated surface. Pre-coated dowels that have been stored in the field for any length of time will be inspected to verify that the coating is still active and will perform as required.

1718.3 TEST METHODS

Test pull out resistance using KDOT Test Method KTMR-16, Testing of Dowel Bars Placed in Concrete for Resistance to Removal (Pull Out).

1718.4 PREQUALIFICATION

a. All bond-breakers intended for use under this specification must be prequalified before use. Submit a written request to the Bureau Chief of Construction and Materials with the following information for each type and brand name:

(1) Name, address and telephone number of the manufacturer. Include the name of the preferred contact person.

(2) Brand name of the material.

(3) Information regarding recommended usage and application instructions.

(4) Material Safety Data Sheets.

b. Submit three smooth 1 1/8 inch diameter (No. 9) epoxy coated dowel bars and sufficient bond-breaker material to coat the bars before sample preparation and testing. Send the samples to the Engineer of Tests. The bars will be coated, then cast in concrete and the bond tested. Submit one additional No. 9 bar for the noncoated comparison test. All sample bars should be a minimum of 24 inches in length.

c. The information and test reports will be reviewed by the Bureau Chief of Construction and Materials. The manufacturer will be advised as to whether or not the product is prequalified.

d. The Bureau of Construction and Materials will maintain a list of prequalified bond-breakers. Products will remain prequalified as long as the formulation and manufacturing processes remain unchanged, and field experience indicates that the material functions appropriately. Changes in formulation or manufacturing processes will require new prequalification testing. Failure of the material to function appropriately in the field will be cause for removal of the product from prequalified status. Products removed from prequalified status will be again considered for prequalification if the manufacturer can provide evidence that the cause of failure has been positively identified, and necessary formulation changes and quality control measures have been implemented to eliminate that cause. Complete prequalification testing will be required for products which have been removed from prequalified status.

1718.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1718.4**.
Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

SECTION 1719

RELEASE COMPOUND FOR ASPHALT MIXES

1719.1 DESCRIPTION

This specification covers release compounds for asphalt mixes.

1719.2 REQUIREMENTS

Provide a concentrated liquid release compound containing no petroleum solvents (diesel fuel, kerosene, etc.) that complies with the following:

- Deleterious Effects: The percentage of coating on the aggregate-binder mixture containing the release compound is equal to that of the mixture without the release agent.
- Release Capabilities: A hot aggregate-binder mixture slides freely in a shallow pan wetted with the release compound.
- Effect on Asphalt Penetration: No more than 7 units difference between a sample in water and one placed in the release compound.

1719.3 TEST METHODS

Test the material in accordance with KTMR-19.

1719.4 PREQALIFICATION

a. Each release compound must be prequalified. Submit a written request to be evaluated for prequalification to the Bureau Chief of Construction and Materials. Provide the following for each brand and type of material to be evaluated:

(1) Name, address, and telephone number of the manufacturer and the preferred contact person.

(2) Name of product and manufacturers dilution recommendation.

(3) Material Safety Data Sheets.

(4) Results of tests from the AASHTO National Transportation Product Evaluation Program (NTPEP). Include the most recent NTPEP test report along with evidence that the product being offered is identical to the one reported in the NTPEP report.

b. A one quart sample will be accepted in lieu of the NTPEP test report until June 1, 2016. Submit the sample in addition to the documentation requested above for prequalification to the Engineer of Tests. The manufacturer will be advised of the results.

c. The Bureau of Construction and Materials will maintain a list of prequalified release compounds. Any prequalified product that does not have a NTPEP test report on file as of January 1, 2017 will be removed from the list of prequalified release compounds. Changes in the formulation, manufacturing process, or failure of the release compound to function appropriately will require a new prequalification.

1719.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1719.4**.

Satisfactory performance in the field.

SECTION 1720

MODULAR EXPANSION DEVICES

1720.1 DESCRIPTION

This specification covers providing a prefabricated modular expansion device on bridges in accordance with these specifications. The device includes the entire manufactured product (multiple sealing elements, steel edge beams and separation beams, joint armoring and attachments, support bars, support boxes and all parts) as well as all attached components. When shown in the Contract Documents, drains at the ends of the devices are subsidiary to the modular expansion devices.

1720.2 REQUIREMENTS

a. Unless shown otherwise in the Contract Documents, provide one of the prequalified brands and models that will accommodate the total design movement shown in the Contract Documents. All modular expansion devices for any single structure must be provided by one supplier.

b. Shape the device to comply closely to the cross slope. Field cutting of the device will not be permitted.

c. Use steel for all major metal components.

d. Use neoprene (Polychloroprene) complying with ASTM D 2628 for the elastomeric sealing units/elements unless modified otherwise by the supplier on the shop drawings. Make the elements one-piece full length of the expansion device, including curbs, and as detailed in the Contract Documents.

e. After installation, there may be no appreciable change in the surface of the modular expansion device when the bridge expands and contracts.

f. Submit shop drawings as specified in **DIVISION 700**.

1720.3 TEST METHODS

Compliance with approved shop drawings for the assembly. Use ASTM D 2628 for the neoprene.

1720.4 PREQUALIFICATION

All modular expansion devices must be prequalified as a unit. Manufacturers wishing to supply modular expansion devices to KDOT projects must send a complete evaluation package including all design and testing information to the KDOT Bureau of Structural and Geotechnical Services. The information will be reviewed and the manufacturer will be notified of the results. Those systems that are satisfactory for use will be placed on a prequalified list maintained by the Bureau of Construction and Materials.

1720.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1720.4**.
Receipt and approval of a Type C certification as specified in **DIVISION 2600**.
Visual inspection for condition and dimensional requirements shown on the shop drawings.

SECTION 1721

FABRIC TROUGH

1721.1 DESCRIPTION

This specification covers a material to be installed as a trough below the finger type and sliding plate type expansion joints (or for other applications as shown in the Contract Documents) to carry drainage off the bridge, and prevent saltwater and debris from running down on other bridge members.

1721.2 REQUIREMENTS

Provide fabric trough material composed of one or two ply tightly woven nylon fabric bonded to, laminated, or covered on both sides with a high density neoprene, ethylene-propylene-diene-monomer (EPDM), or buna-nitrile PVC, that complies with **TABLE 1721-1**.

TABLE 1721-1: REQUIREMENTS FOR FABRIC TROUGH

Property	Requirement	Test Method
Thickness (mm)	3 to 5	
Mass (g/sq m minimum)	3560	
Durometer Hardness (Shore A)	50A to 75A	ASTM D 2240
Low Temperature Brittleness (22 hrs. @ -29ºC, then wrapped around a 75 mm diameter mandrel)	No Cracks	
Tensile Strength, kg/25 mm minimum, both directions	363	ASTM D 412
Elongation, %, maximum	35	ASTM D 412
Tear (Die C), kg/25 mm minimum	55	ASTM D 624
Ozone Resistance (100 hours of exposure of 20% elongated samples @ 38ºC and 100 PPHM ozone.)	No Cracks	ASTM D 1149

Provide material that is resistant to abrasion, sunlight, oils, and saltwater.

1721.3 TEST METHODS

Use the ASTM methods cited above.

1721.4 PREQUALIFICATION

None required.

1721.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type B certification as specified in **DIVISION 2600**, and visual inspection for condition.

SECTION 1722

FIBROUS REINFORCEMENT FOR CONCRETE

1722.1 DESCRIPTION

This specification covers both micro and macro fibers for use as reinforcement in concrete. Micro fibers are used to control plastic shrinkage cracks in concrete while macro fibers control cracking in hardened concrete and are often used as a substitute for traditional crack control steel reinforcing bars or mesh. In addition, macro fibers add toughness, and impact and fatigue resistance to hardened concrete.

1722.2 REQUIREMENTS

a. Micro fibers.

(1) Provide fibers that are 100% virgin polypropylene, fibrillated, rough textured, interconnected fibers containing no reprocessed olefin materials and specifically manufactured as concrete reinforcement.

(2) Provide fibers that are graded with a maximum length of 2 inches and a minimum tensile strength of 32 ksi.

b. Macro fibers.

(1) Provide macro synthetic fibers as defined in ASTM C 1116, Type III, and ASTM D 7508.

(2) Provide fibers having a minimum length of 1.25 inches, a maximum length of 2.0 inches, and an aspect ratio (length divided by equivalent diameter) between 70 and 100, inclusive.

(3) Provide fibers with a minimum tensile strength of 50 ksi.

(4) Provide fibers, which when tested using the procedure described in **subsection 1722.4b**., result in a minimum strength ratio ($R_{e,3}$) of 25%.

1722.3 TEST METHODS – MICRO FIBERS

None specified.

1722.4 TEST METHODS – MACRO FIBERS

a. Determine the tensile strength of macro fibers using ASTM D 7508.

b. Determine equivalent flexural strength ratio ($R_{e,3}$) using ASTM C 1609 with the following modifications:

(1) Utilize 6 x 6 x 20 inch (150 x 150 x 500 mm) beam specimens tested using an 18 inch (450 mm) span.

(2) Test at least three beam specimens using the concrete mixture described below.

(3) Test beam specimens when the concrete compressive strength is between 3,000 and 5,000 psi. Test three 6 x 12 inch cylinders to verify concrete compressive strength of beam specimens at testing. No single cylinder break shall deviate from the other breaks by more than 10%. Provided the average of the three breaks is within the test limits described above, beam testing can proceed.

(4) In addition to the strength requirements, use test concrete satisfying the following:

- 0.35 to 0.50 water cement ratio by weight
- no supplementary cementitious materials
- air-entraining admixtures only
- 50% coarse – 50% fine aggregate by weight
- maximum aggregate size: ¾”
- fine aggregate: naturally occurring (uncrushed) sand - no manufactured sand
- percent air by volume: 6.5±1.5%
- minimum fiber dosage: 4.0 lbs per cubic yard of concrete

c. Testing shall be performed by a laboratory regularly inspected by the Cement and Concrete Reference Laboratory (CCRL) of the National Institute of Standards and Technology, or other approved reference laboratory.

1722.5 PREQUALIFICATION

a. Manufacturers wishing to provide fibrous reinforcement for concrete for KDOT projects must be prequalified.

b. Submit a small sample to the Bureau of Construction and Materials for prequalification. Include the following information:

(1) Name, address and telephone number of the manufacturer and the preferred contact person.

(2) Name of product and manufacturer's recommended dosage rate or rates.

(3) Technical data sheets.

(4) Material Safety Data Sheets.

In addition, submit either of the following:

(5) For micro fibers - Test reports substantiating the requirements of **subsection 1722.2a**.

(6) For macro fibers - Test reports substantiating the requirements of **subsection 1722.2b**. For the C 1609 requirements, include both the mix design of the test concrete, the compressive strength data of the test concrete at the time of beam testing, and the fiber dosage used during testing to satisfy the $R_{e,3}$ requirements of **subsection 1722.2b**.

c. The submittal will be reviewed and the manufacturer will be notified of the results. The Bureau of Construction and Materials will maintain a list of prequalified fibrous reinforcement. For each prequalified macro fiber, a minimum fiber dosage, reported from **subsection 1722.5b.(6)**, will be shown for each product.

1722.6 BASIS OF ACCEPTANCE

Prequalification as required by **subsection 1722.5**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

In addition, when macro fibers are being used as a substitute for 6 X 6 – W4 X W4 welded wire reinforcement in valley gutters and entrance pavement, provide a copy of the approved mix design with the prequalified fiber manufacturer, product name, and dosage clearly identified. Use a fiber dosage that is not less than the product's value shown on the prequalified list.

SECTION 1723

NON-METALLIC OFFSET BLOCKS FOR GUARDRAIL

1723.1 DESCRIPTION

This specification governs non-metallic offset blocks for guardrail that are not covered under the wood post specification in **DIVISION 2300**. Substitution for the wood offset blocks is permitted for line and bullnose guardrail sections as shown on the Contract Documents. Substitution within the end terminal sections is only permitted when specified by the manufacturer of the end terminal.

1723.2 REQUIREMENTS

a. General.

(1) Any manufacturer producing non-metallic offset blocks for guardrail under this specification must be currently prequalified. Procedures for prequalification are outlined in **subsection 1723.4**.

(2) Unless shown otherwise in the Contract Documents, manufacture all offset blocks provided under this specification that comply with the applicable subsections.

b. Material Specifications. Provide offset blocks of the same chemical composition and physical properties as those accepted under the NCHRP 350 crash test. Provide offset blocks that comply with **TABLE 1723-1**.

TABLE 1723-1, REQUIREMENTS FOR NON-METALLIC OFFSET BLOCKS		
Property	**Test Method**	**Requirement**
UV Protection	ASTM G 155	No visible change to the block.
Compressive Strength	See **subsection 1723.3**	To become prequalified ≥ 450 psi. Verification Samples not to exceed ± 20% of prequalification results.
Water Absorption	ASTM D 2842	% Absorption ≤ 20%
Solvent Resistance	KTMR-31	No evidence of softening, blistering, crinkling, dissolving, or change in color or appearance.
Defects and Voids	Visual	Not to exceed ½ inch diameter.

c. Dimensions. Provide offset blocks that comply with the dimensions and details shown in the Contract Documents.

1723.3 TEST METHODS

Test the ultraviolet (UV) protection of the block using ASTM G 155, "Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-metallic Materials." Utilize Cycle #1 for 500 hours following Table X3. Use a sample size of 1 inch by 4 inch by 4 inch.

Perform KTMR-31, "Solvent Resistance of Non-metallic Materials." Obtain a copy of this test by contacting KDOT's Quality Assurance Section in the Materials and Research Center.

Determine the strength of 1 complete block in this manner: Apply the compressive force along the entire length and in the direction that is perpendicular to both the guardrail and post. Support the post track so no force is applied to edges. Blocks are required to have a minimum compressive stress of 450 psi. Calculate the pressure by using the average longitudinal cross section area. Use a properly calibrated compression machine as defined in ASTM E 4.

Determine the water absorption of the block using ASTM D 2842, Procedure B, with the following exceptions:

- Use the actual width and thickness of the specimen instead of the specified 6 inch by 6 inch dimensions.
- Under 9. Conditioning, delete 9.2 and 9.3. Add 9.2 Cool to room temperature and weigh to the nearest 0.1 g. Change 9.4 to 9.3.
- Under 10. 2 Procedure B, maintain a water bath temperature of 77 + 2ºF.

- When calculating the absorption, use this equation:
  %absorption = [((W2i – W3i) – (W2f – W3f))/(W2i – W3i)]X100

1723.4 PREQUALIFICATION

To become prequalified, provide the Bureau of Construction and Materials with a copy of the FHWA letter showing the product has been accepted under the National Cooperative Highway Research Program (NCHRP) Report 350. Blocks must be able to comply with **subsection 1723.3**. Submit 4 offset blocks to the Engineer of Tests.

The Bureau of Construction and Materials will maintain a prequalified list of all complying manufacturers.

1723.5 BASIS OF ACCEPTANCE

The plant must be currently prequalified as specified in **subsection 1723.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Visual inspection for voids as outlined in **subsection 1723.2.b**.

SECTION 1724

SILICONE RUBBER SURFACE CRACK SEALANT

1724.1 DESCRIPTION

This specification covers material for sealing surface cracks previous to epoxy resin crack repair.

1724.2 REQUIREMENTS

a. Provide Type S, Grade NS, Class 50, NT or O, one-part, clear or gray, neutral-cure, silicone rubber sealant that easily extrudes in any weather and cures quickly at room temperature.

b. Provide sealant that complies with **TABLE 1724-1**.

TABLE 1724-1: ONE PART SILICONE SEALANT		
Property	**Test Method**	**Requirement**
Tack-Free Time	ASTM C 679	3 hrs
Working Time	ASTM C 639	20-30 minutes
Peel Strength	ASTM C 794	32 lb/in
Tensile Adhesion Strength	ASTM C 1135	45 psi at 25% extension

c. Clean all tools and other application or mixing equipment frequently using a solvent type that is approved by the crack sealant manufacturer.

1724.3 TEST METHODS

Test the material in accordance with the ASTM standards stated in **subsection 1724.2.**

1724.4 PREQUALIFICATION

a. All silicone rubber sealant intended for use under this specification must be prequalified on the basis of Type, Grade, Class and Use prior to prequalification. Manufacturers desiring to supply material for KDOT jobs must submit a written request to the Bureau Chief of Construction and Materials, with the following information for each type and brand name:

(1) Name, address and telephone number of the manufacturer. Include the name of the preferred contact person.

(2) Brand name of the material.

(3) Type, Grade, Class and Use of the material.

(4) Information regarding recommended usage and application instructions.

(5) Material Safety Data Sheets.

(6) One copy of a certified test report prepared by a laboratory regularly inspected by the Cement and Concrete Reference Laboratory (CCRL) of the National Institute of Standards Technology or other approved reference laboratory, showing test results complying with ASTM C 920. Include evidence that the laboratory is inspected regularly.

b. The information and test reports will be reviewed by the Bureau Chief of Construction and Materials. The manufacturer will be advised as to whether or not the product is prequalified.

c. The Bureau of Construction and Materials will maintain a list of prequalified silicone rubber sealants. Products will remain prequalified as long as the formulation and manufacturing processes remain unchanged, and field experience indicates that the material functions appropriately. Failure of the material to function in the field will be cause for removal of the product from prequalified status. Products removed from prequalified status will be considered for requalification if the manufacturer can provide evidence that the cause of failure has been positively identified, and necessary formulation changes and quality control measures have been implemented to eliminate that cause. Complete prequalification testing may be required for products that have been removed from prequalified status.

1724.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

SECTION 1725

DETECTABLE WARNING SURFACE PANELS FOR CURB RAMPS AND MEDIANS

1725.1 DESCRIPTION

This specification governs fabrication of panels compliant with the Public Rights-of-Way Accessibility Guidelines (PROWAG). The panels are required to comply with all dimensional requirements as stipulated within the PROWAG.

1725.2 REQUIREMENTS

a. General.

(1) Any manufacturer producing panels under this specification must be currently prequalified. Procedures for prequalification are outlined in **subsection 1725.4**.

(2) Unless shown otherwise in the Contract Documents, manufacture all panels provided under this specification to comply with the applicable subsections.

(3) Provide in the appropriate color stipulated in the Contract Documents. Warrant the color for 10 years.

b. Prestressed Concrete Panels.

(1) Provide a non-rusting prestressed support system integrated into the lower portion of the panel. The system is required to impart pressure in excess of 200 psi in both horizontal directions on a fully cured panel.

(2) Dimensions. Provide a 2 X 2 foot panels that comply with the dimensions and details specified by the PROWAG. Larger panels may be used if approved by the Engineer.

(3) Material Specifications. Provide panels that comply with **TABLE 1725-1**.

Table 1725-1: REQUIREMENTS FOR PRESTRESSED CONCRETE PANELS

Property	Test Method	Requirement
Accelerated Weathering	ASTM G 155	No visible change (2915 hrs)
Compressive Strength	ASTM C 39	≥ 8,000 psi
Slip Resistance	ASTM D 2047	≥ 0.80

c. Polymer Concrete Panels.

(1) Provide a polymer concrete panel. For this specification, polymer concrete is defined as having a cementitious material blended with an epoxy material to create a high-strength, tough and durable panel. Fibers may be used.

(2) Dimensions. Provide a 2 X 2 foot panels that comply with the dimensions and details specified by the PROWAG. Larger panels may be used if approved by the Engineer.

(3) Material Specifications. Provide a polymer concrete panel that complies with **TABLE 1725-2**.

Table 1725-2: REQUIREMENTS FOR POLYMER CONCRETE PANELS

Property	Test Method	Requirement
Accelerated Weathering	ASTM G 155	No visible change (2915 hrs)
Compressive Strength	ASTM C 39 or ASTM C 170	≥ 8,000 psi
Slip Resistance	ASTM D 2047 or ASTM C 1028	≥ 0.80

d. Composite Panels.

(1) Provide an anchored cast-in-place design that is replaceable without removing or damaging the surrounding hardened concrete.

(2) Panel. Provide a homogeneous, monolithic, glass-reinforced polymer composite panel that is colorfast and UV stable. Disburse coloring pigments and chemicals to enhance UV stability uniformly throughout the product. Panels using a coating to achieve color fastness or UV stability will not be approved.

If provided, a reinforcing flange or wedge along the perimeter of the panel can be no more than 0.75 inch deep (total depth, including panel thickness) and must be shaped in such a fashion so that it does not prevent panel removal and replacement in hardened concrete. Provide breaks in the perimeter flange to allow for air evacuation from under the panel during installation.

Cast the manufacturer's name into the top surface of the panel.

(3) Dimensions. If possible, provide a single, standard size panel large enough to comply with the length and width requirements in the contract documents. If a single panel will not satisfy the dimensional requirements in the contract documents, arrange the fewest number of standard size panels to minimize total joint length and panel cutting.

Provide a panel whose dome size and in-line spacing is compliant with PROWAG.

(4) Anchor. Provide nylon composite or HDPE, corrosion resistant anchors. Provide a self-threading anchor design that allows for repeated panel removal and re-installations.

Provide a minimum 2.0 inch long spike type anchor whose shape facilitates insertion into stiff, plastic concrete by minimizing concrete displacement while maximizing aggregate/anchor interlock. Other anchor shapes and lengths will be considered as part of the prequalification review on a case-by-case basis provided the panel manufacturer can provide a 3-year history of satisfactory anchor performance, especially in relation to anchor insertion under less than ideal concrete conditions and anchor pullout.

The outer "ring" of anchors can be centered no more than 5 inches from the nearest edge of the panel, measured perpendicular to the edge. The center-to-center spacing between adjacent anchors can be no more than 24 inches in any direction.

(5) Anchor Fastener. Provide minimum #10 size, tamper-proof, countersunk, flathead, stainless steel fasteners that sets flush with the dome or field surface and provides at least 1 inch of embedment into the anchor. As part of the prequalification review of alternate anchors as described in **subsection 1725.2d.(4)**, a shorter fastener embedment or different type of fastener will be considered on a case-by-case basis.

(6) Panel Modification. Provide a panel which, when cut, is engineered to conveniently facilitate the drilling of additional countersunk holes at thickened auxiliary anchor points to accommodate the maximum anchor spacing and edge distance requirements of **subsection 1725.2d.(4)**. If this requirement cannot be met, the panel will be approved for uncut applications only.

(7) Surface Protection. Provide a removable plastic film to protect the panel surface during installation.

(8) Material Specifications. Provide a composite panel that complies with **TABLE 1725-3**.

Table 1725-3: REQUIREMENTS FOR COMPOSITE PANELS

Property	Test Method	Requirement
Water Absorption	ASTM D 570	≤ 0.50%
Accelerated Weathering	ASTM G 155	No visible change (2915 hrs)
Flexural Strength	ASTM D 790, Procedure A	≥ 15,000 psi
Slip Resistance	ASTM C 1028	≥ 0.80 wet or dry
Abrasion Resistance	ASTM C 501	$I_w > 130$
Salt Spray	ASTM B 117	No visible change (120 hrs)
Freeze/Thaw/Heat	ASTM C 1026	No chipping, cracking, or peeling

1725.3 TEST METHODS

Perform all test methods as specified in **subsection 1725.2** for the given product.

1725.4 PREQUALIFICATION

To prequalify concrete panels, send three (3) 6 x 6 inch samples of each color to be prequalified to the Engineer of Tests along with test results from a certified laboratory (CCRL, A2LA or NVLP).

To prequalify composite panels, send a single 1 x 1 foot panel (w/installed anchors) of any color and three (3) 6 x 6 inch sample of each color to be prequalified to the Bureau Chief of Construction and Materials along with test results from an approved laboratory. In addition, provide detailed product information, including all dimensional information, and step-by-step procedures covering original installation and panel removal/re-installation. Consideration of alternate anchors shapes will require additional information as described in **subsection 1725.2d.(4)**. Material or physical changes to panels or anchors requires re-prequalification. Changes in panel size or additions to the number of standard panel sizes does not require re-prequalification as long as the spacing and edge distance requirements of **subsection 1725.2d.(4)** continue to be satisfied.

Panels must be able to comply with the general and product specific requirements of **subsection 1725.2**.

The Bureau of Construction and Materials will maintain a prequalified list of all complying manufacturers. Products will remain on the prequalified list as long as performance in the field is satisfactory.

1725.5 BASIS OF ACCEPTANCE

The manufacturer must be currently prequalified as specified in **subsection 1725.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Visual inspection for cracked or damaged panels.

SECTION 1726

IMPACT ATTENUATORS AND REPLACEMENT MODULES

1726.1 DESCRIPTION

This specification covers impact attenuators and replacement modules.

1726.2 REQUIREMENTS

Provide an impact attenuator and replacement modules as shown in the Contract Documents. Temporary impact attenuators may be previously used.

1726.3 TEST METHODS

None specified.

1726.4 PREQUALIFICATION

All impact attenuators must be prequalified as a unit. Manufacturers wishing to supply impact attenuators to KDOT projects must send a complete evaluation package including the FHWA letter of acceptance and all design and testing information to the KDOT Bureau of Road Design. The information will be reviewed and the manufacturer will be notified of the results. Those systems that are satisfactory for use will be placed on a prequalified list maintained by the Bureau of Construction and Materials.

1726.5 BASIS OF ACCEPTANCE

The complete system or module must be currently prequalified as specified in **subsection 1726.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600.**

Visual inspection of the completed installation.

SECTION 1727

SHOTCRETE CONCRETE

1727.1 DESCRIPTION

This specification covers shotcrete concrete used to repair, reinforce or modify concrete structures.

1727.2 REQUIREMENTS

a. Provide material that complies with the following:

TABLE 1727-1: SHOTCRETE CONCRETE PROPERTIES		
Hardened Properties	**Test Method**	**Requirement**
Slant Shear Bond Strength @ 24 hours	ASTM C 882 Modified*	1200 psi, min.
Drying Shrinkage @ 28 days	ASTM C 157 Modified**	0.08%, max.
Rapid Chloride Permeability @ 28 days	ASTM C 1202*** / AASHTO T 277***	750 coulombs, max.
Volume of Permeable Voids @ 7 days	ASTM C 642***	10%, max.
Freeze-Thaw Resistance @ 300 cycles	ASTM C 666, Procedure A	95% RDM, min.
Flexural Strength @ 24 hours	ASTM C 348	650 psi, min.
Compressive Strength @ 24 hours	ASTM C 109	2500 psi, min.

*No epoxy bonding agent used.
** ICRI Guideline No. 03733, "A Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces", 1"x1"x10" prism, air cured
***Either Rapid Chloride Permeability or Volume of Permeable Voids can be used.

b. If the mix is not in bag or tote form (pre-blended in a manufacturer's controlled environment), then provide a mix design with weight quantities of each component for a cubic yard of finished product. All components are required to be prequalified.

c. Provide material with a corrosion inhibitor.

d. Material may contain fibers.

e. Provide material to satisfy application requirements – vertical, overhead, low-pressure spraying, or hand packed.

1727.3 TEST METHODS

Test as specified in **subsection 1727.2a**.

1727.4 PREQUALIFICATION

a. Manufacturers interested in prequalifying material under **subsection 1727.2a**. must submit the following to the Bureau of Construction and Materials:

(1) A complete description, literature, and set of instructions and recommendations,
(2) A copy of test results performed in accordance with the tests stated in **subsection 1727.2a.**,
(3) Certificate stating results comply with **subsection 1727.2a.**, and
(4) Material Safety Data Sheets (MSDS).

b. The Bureau of Construction and Materials will maintain a list of qualified materials. Products will remain on the list as long as field performance is satisfactory.

1727.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1727.4**.
Receipt and approval of a Type D certification as specified in **DIVISION 2600**.
Visual inspection by the Field Engineer.

SECTION 1728

EXPANDED FOAM FOUNDATION MATERIAL FOR SIGN POSTS

1728.1 DESCRIPTION

This specification covers expanded foam backfill used for setting sign posts. The rigid polyurethane foam is shipped in two parts and mixed on site. Soon after mixing the two components, the product expands in volume and conforms to the shape of the excavation. Reaction and cure times vary with component temperature.

1728.2 REQUIREMENTS

a. Store, handle, and mix according to the manufacturer's instructions.

b. Provide material complying with **TABLE 1728-1**:

TABLE 1728-1: PROPERTIES OF CURED PRODUCT		
Property	**Test Method**	**Requirement**
Shear Strength, min.	ASTM D 732	70 psi
Compressive Strength, min.	ASMT D 1621	165 psi
Density[1], min.	ASTM D 1622	8.5 pcf
Tensile Strength[1], min.	ASTM D 1623, Type A	150 psi

[1]minimum of five test specimens

1728.3 TEST METHODS

Test as specified in **subsection 1728.2b**.

1728.4 PREQUALIFICATION

a. Manufacturers interested in prequalifying material must submit the following to the Bureau of Construction and Materials:

(1) A complete description, literature, and set of instructions and recommendations,

(2) A copy of test results performed as outlined in **subsection 1728.2b**,

(3) Certificate stating results comply with the values outlined in **subsection 1728.2b** and are from tests of material that has essentially the same chemistry and mechanical properties as that submitted for FHWA acceptance,

(4) A copy of the Federal Highway Administration (FHWA) letter accepting the product as foundation material for use with certain sign post systems,

(5) Material Safety Data Sheets (MSDS).

b. The Bureau of Construction and Materials will maintain a list of qualified materials. Products will remain on the list as long as field performance is satisfactory.

1728.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1728.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Receipt and approval of a certification from the manufacturer stating the furnished material has essentially the same chemistry and mechanical properties as that submitted for FHWA acceptance, and complies with the crashworthiness requirements of FHWA and National Cooperative Highway Research Program (NCHRP) Report 350.

Visual inspection by the Field Engineer.

SECTION 1729

ANTI-GRAFFITI COATING

1729.1 DESCRIPTION

This specification covers anti-graffiti coatings, which are coatings applied to substrates to facilitate the removal of graffiti.

1729.2 REQUIREMENTS

a. General.

(1) Anti-graffiti coatings must not react deleteriously with above grade concrete, concrete block, exposed aggregate concrete, brick, stonework, painted steel, or aluminum substrates.

(2) The applied coating must produce a firm, continuous, uniform film that is free of pinholes, cracks, or other film defects and exhibit satisfactory adhesion. The consistency must be such that the coating can be satisfactorily applied by spray, roller, or brush at atmospheric and material temperatures above 50°F without thinning. When applied properly to vertical surfaces, the coating must remain uniform during the required curing period and must not sag, disintegrate, check, peel, or crack.

(3) The VOC content of the coating must comply with the current national rule for industrial maintenance coatings.

(4) When the Contract Documents specify the coating as clear or translucent, the coating must cure clear or translucent, as appropriate.

b. Specific. In addition to the general requirements of **subsection 1729.2a**, the coating must meet the requirements of Type II or Type III.

(1) Type II - Permanent. Type II coatings are chemically resistant coatings that allow removal of the graffiti with solvent or chemical graffiti removers. The use of graffiti removers, solvents, or both must not cause damage or pigment loss.

The color must match Federal Standard 595B, color number 35630 unless otherwise shown in the Contract Documents. When the Contract Documents specify another color, the color must match the color standard supplied by the Engineer. The Contract Documents may specify clear or translucent as a color.

Provide material complying with the requirements listed in **TABLE 1729-1**.

TABLE 1729-1: REQUIREMENTS FOR TYPE II COATINGS

Property	Test Method	Requirement
Graffiti Resistance	ASTM D 6578	Cleanability Level 8, 9, or 10
Recleanability	ASTM D 6578	Min. 10 cycles
Fluid Resistance	ASTM D 1308[a]	No blistering, discoloration, softening or adhesion loss
Set-to-Touch Time	ASTM D 1640[b]	4 hr. maximum
Dry-Through Time	ASTM D 1640[b]	24 hr. maximum

[a] Spot Test using Paint Thinner and Gasoline
[b] 3-mil wet film tested at 77°F.

(2) Type III – Permanent, Water Cleanable. Type III coatings allow for the removal of the graffiti with a high-pressure cold water wash. Coatings must be self-recoatable for the life of the coating.

The color must match Federal Standard 595B, color number 35630, unless otherwise shown in the Contract Documents. When the Contract Documents specify another color, the color must match the color standard supplied by the Engineer. The Contract Documents may specify clear or translucent as a color.

Provide material complying with the requirements listed in **TABLE 1729-2**.

TABLE 1729-2: REQUIREMENTS FOR TYPE III COATINGS		
Property	**Test Method**	**Requirement**
Graffiti Resistance	ASTM D 7089	Cleanability Level 1
Recleanability	ASTM D 7089	Min. 10 cycles
Set-to-Touch Time	ASTM D 1640[a]	4 hr. maximum
Dry-Through Time	ASTM D 1640[a]	24 hr. maximum

[a] 3-mil wet film tested at 77°F.

1729.3 TEST METHODS

Test in accordance with the requirements stated in **subsection 1729.2**.

1729.4 PREQUALIFICATION

a. Each anti-graffiti coating intended for use under this specification must be prequalified before use. Submit a written request for prequalification to the Bureau Chief of Construction and Materials. Provide the following documentation:

(1) Name, address, and telephone number of the manufacturer. Include the name and e-mail address of the preferred contact person.

(2) Brand name of the anti-graffiti coating.

(3) A complete description, literature, and set of instructions for removal of graffiti.

(4) Material Safety Data Sheets.

(5) A copy of test results performed as outlined in **subsection 1729.2b** from a recognized laboratory. Include evidence that the laboratory is regularly inspected. A recognized laboratory is one operated by any State Transportation Agency, the Federal Highway Administration, or any cement and concrete laboratory regularly inspected by the Cement & Concrete Reference Laboratory (CCRL) or the National Institute of Standards and Technology. Test results are to be no more than 24 months out of date.

(6) An infrared spectrum of the anti-graffiti coating which was used in the laboratory tests.

b. Submit a one gallon sample from production to the Engineer of Tests. All coatings will be fingerprinted using infrared spectroscopy for use in screening future verification samples to verify that materials submitted for use are of an identical formulation as originally approved.

c. The information, test reports and test results obtained at the Materials and Research Center on samples submitted, will be reviewed by the Bureau Chief of Construction and Materials. The manufacturer will be advised of the results.

d. The Bureau of Construction and Materials will maintain a list of prequalified products. Products that have been prequalified will remain prequalified as long as the formulation and manufacturing processes remain unchanged, and field experience indicates that the anti-graffiti coating functions appropriately. Changes in formulation or manufacturing processes will require new prequalification testing.

Failure of the material to function appropriately in the field will be cause for removal of the product from prequalified status. Products removed from prequalified status will be considered for requalification if the manufacturer can provide evidence that the cause of failure has been positively identified, and necessary formulation changes and/or quality control measures have been implemented to prevent future failures. Complete prequalification testing may be required for products that have been removed from prequalified status.

1729.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1729.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

SECTION 1730

POLYMER RESINS FOR POLYMER CONCRETE OVERLAY SYSTEMS

1730.1 DESCRIPTION

This specification covers polymer resins for use in Multi-Layer Polymer Concrete Overlay and Slurry Polymer Concrete Overlay for Portland cement concrete bridge decks.

The following types of systems are covered by this specification:

- Type III Epoxy Resin for Multi-Layer Polymer Concrete Overlay,
- Epoxy Resin for Slurry Polymer Concrete Overlay,
- Methyl Methacrylate Resin for Slurry Polymer Concrete Overlay,
- Polyester Resin for Multi-Layer Polymer Concrete Overlay with High Molecular Weight Methacrylate (HMWM) Primer, and
- Polyester Resin for Slurry Polymer Concrete Overlay with HMWM Primer.

1730.2 REQUIREMENTS

a. Epoxy Materials.

(1) Multi-Layer Polymer Concrete Overlay. Provide a system that complies with the requirements of AASHTO M 235 (ASTM C 881), Type III, Grade 1 or 2, with 100 percent solids, and is a thermosetting, moisture-insensitive epoxy resin. With the exceptions in **TABLE 1730-1**:

TABLE 1730-1: TYPE III EPOXY RESIN FOR MULTI-LAYER POLYMER CONCRETE OVERLAY

Property	Test Method	Requirements
Viscosity	ASTM D 2196, Brookfield RVT, Spindle No. 3 at 20 RPM	1000 - 2500 cps
Gel Time	ASTM C 881, para. 11.2.1 modified, 75 ml sample	15-45 minutes
Compressive Strength, 3 hr.	ASTM C 579, Method B*	1000 psi, min.
Compressive Strength, 24 hr.	ASTM C 579, Method B*	5000 psi, min.
Tensile Strength, 7 days	ASTM D 638, Type 1	2000-5000 psi
Elongation (neat), 7 days	ASTM D 638, Type 1	30-80 percent
Chloride Ion Penetration	AASHTO T 277	100 coulombs, max.

*Perform ASTM C 579 with 2X2 inch cubes using 2.75 parts ASTM C778, 20-30 mesh sand to one part of mixed polymer resin binder by volume.

(2) Slurry Polymer Concrete Overlay. Provide a system that complies with **TABLE 1730-2**.

TABLE 1730-2: EPOXY RESIN FOR SLURRY POLYMER CONCRETE OVERLAY

Property	Test Method	Requirements
Viscosity	ASTM D 2196, Brookfield RVT, Spindle No. 3 at 20 RPM	1000 - 2500 cps
Gel Time	ASTM C 881, para. 11.2.1 modified, 75 ml sample	15-45 minutes
Compressive Strength, 3 hr.	ASTM C 579, Method B*	1000 psi, min.
Compressive Strength, 24 hr.	ASTM C 579, Method B*	5000 psi, min.
Tensile Strength, 7 days	ASTM D 638, Type 1	1000-5000 psi
Elongation (neat), 7 days	ASTM D 638, Type 1	30-80 percent
Chloride Ion Penetration	AASHTO T 277	100 coulombs, max.

*Perform ASTM C579 with 2X2 inch cubes using aggregate supplied by the manufacturer.

b. Methyl Methacrylate Materials. Slurry Polymer Concrete Overlay. Provide a system that complies with **TABLE 1730-3**.

TABLE 1730-3: METHYL METHACRYLATE RESIN FOR SLURRY POLYMER CONCRETE OVERLAY		
Property	**Test Method**	**Requirements**
Viscosity	ASTM D 2196, Brookfield RVT, Spindle No. 3 at 20 RPM	1100-1300 cps
Gel Time	ASTM C 881, para. 11.2.1 modified, 75 ml sample	15-45 minutes
Compressive Strength, 3 hr.	ASTM C 579, Method B*	1000 psi, min.
Compressive Strength, 24 hr.	ASTM C 579, Method B*	5000 psi, min.
Tensile Strength, 7 days	ASTM D 638, Type 1	2000-5000 psi
Elongation (neat), 7 days	ASTM D 638, Type 1	100-200 percent
Chloride Ion Penetration	AASHTO T 277	100 coulombs, max.

*Perform ASTM C579 with 2X2 inch cubes using aggregate supplied by the manufacturer.

c. Polyester Materials.

(1) Multi-Layer Polymer Concrete Overlay. Provide a system that complies with **TABLE 1730-4**.

TABLE 1730-4: POLYESTER RESIN FOR MULTI-LAYER POLYMER CONCRETE OVERLAY		
Property	**Test Method**	**Requirements**
Viscosity	ASTM D 2196, Brookfield RVT, Spindle No. 3 at 20 RPM	1000-2000 cps
Gel Time	ASTM C 881, para. 11.2.1 modified, 75 ml sample	10-25 minutes
Compressive Strength, 3 hr.	ASTM C 579, Method B*	1000 psi, min.
Compressive Strength, 24 hr.	ASTM C 579, Method B*	5000 psi, min.
Tensile Strength, 7 days	ASTM D 638, Type 1	2000-5000 psi
Elongation (neat), 7 days	ASTM D 638, Type 1	30-80 percent
Chloride Ion Penetration	AASHTO T 277	100 coulombs, max.

*Perform ASTM C579 with 2X2 inch cubes using aggregate supplied by the manufacturer.

(2) Slurry Polymer Concrete Overlay. Provide a system that complies with**TABLE 1730-5**.

TABLE 1730-5: POLYESTER RESIN FOR SLURRY POLYMER CONCRETE OVERLAY		
Property	**Test Method**	**Requirements**
Viscosity	ASTM D 2196, Brookfield RVT, Spindle No. 3 at 20 RPM	75-200 cps
Gel Time	ASTM C 881, para. 11.2.1 modified, 75 ml sample	15-45 minutes
Compressive Strength, 3 hr.	ASTM C 579, Method B*	1000 psi, min.
Compressive Strength, 24 hr.	ASTM C 579, Method B*	5000 psi, min.
Tensile Strength, 7 days	ASTM D 638, Type 1	2000-5000 psi
Elongation, 7 days	ASTM D 638, Type 1	100-200 percent
Chloride Ion Penetration	AASHTO T 277	100 coulombs, max.

*Perform ASTM C579 with 2X2 inch cubes using aggregate supplied by the manufacturer.

(3) High Molecular Weight Methacrylate (HMWM) Primer. Provide a HMWM primer as part of a system of polyester materials that complies with **TABLE 1730-6**.

TABLE 1730-6: HMWM PRIMER WITH POLYESTER RESINS		
Property	**Test Method**	**Requirements**
Viscosity, max	ASTM D 2196, Brookfield RVT, Spindle No. 3 at 20 RPM	50 cps, minimum
Gel Time	ASTM C 881, para. 11.2.1 modified, 75 ml sample	10-150 minutes
Specific Gravity	ASTM D 2849	0.90 – 1.10
Elongation, 7 days	ASTM D 638, Type 1	100-200 percent
Flash Point	ASTM D 3278	180ºF, minimum

1730.3 TEST METHODS

Test the systems as specified in **subsection 1730.2** with the following modifications:

a. Precondition, cure and test all material at 75±2° F.

b. Perform ASTM C 579 using only plastic inserts.

1730.4 PREQUALIFICATION

a. All systems intended for use under this specification must be prequalified prior to use. Manufacturers desiring to supply material for KDOT jobs must submit a written request to the Bureau Chief of Construction and Materials, with the following information for each system:

(1) Name, address and telephone number of the manufacturer. Include the name of the preferred contact person.

(2) Brand name of the system.

(3) Type of material.

(4) Information regarding recommended usage and application instructions. If HMWM primer is required for the system, include primer information regarding recommended usage and application instructions.

(5) Material Safety Data Sheets.

(6) One copy of a certified test report prepared by a laboratory regularly inspected by the Cement and Concrete Reference Laboratory (CCRL) of the National Institute of Standards Technology or other approved reference laboratory, showing test results complying with **subsection 1730.2**. Include evidence that the laboratory is inspected regularly.

Test results from the AASHTO National Transportation Product Evaluation Program (NTPEP) for the identical system, including primer when applicable, are acceptable in lieu of a test report from an approved reference laboratory.

(7) Include a Fourier Transform Infrared Spectrophotometry (FTIR) spectrum in transmittance mode and a bulk sample of each liquid component tested. All liquid components will be "fingerprinted" using infrared spectroscopy for use in screening future verification samples to verify that materials submitted for use are of an identical formulation as originally approved. All data will be maintained as confidential and used only for QA/QC purposes.

b. In addition to the written request described above, prequalification is also dependent upon two years of satisfactory performance in the field. Proof of performance on non-KDOT projects in Kansas may be submitted to show satisfactory performance history in Kansas.

c. The information, test reports and field performance will be reviewed by the Bureau Chief of Construction and Materials. The manufacturer will be advised as to whether or not the product is prequalified.

d. The Bureau of Construction and Materials will maintain a list of prequalified Polymer Concrete Overlay systems. Systems will remain prequalified as long as the formulation and manufacturing processes remain unchanged, and field experience indicates that the system functions appropriately. Changes in formulation or manufacturing processes will require new prequalification testing. Failure of the system to function appropriately in the field will be cause for removal of the product from prequalified status. Products removed from prequalified status will be considered for requalification if the manufacturer can provide evidence the cause of failure has been positively identified, and necessary formulation changes and quality control measures have been implemented to eliminate the cause. Complete prequalification testing may be required for systems that have been removed from prequalified status.

1730.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1730.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Observation at the project to verify performance.

SECTION 1731

GROUT USED IN POST-TENSIONING

1731.1 DESCRIPTION

This specification covers grouts to be used to protect post-tensioning steel in haunched slab bridges.

1731.2 MATERIALS

a. Provide material that does not contain aluminum or other components which produce hydrogen, carbon dioxide or oxygen gas.

b. Provide material complying with the requirements listed in **TABLE 1731-1.** Conduct all tests with material mixed to produce the minimum time of efflux. Establish the water content to produce the minimum and maximum time of efflux.

TABLE 1731-1: GROUT USED IN POST-TENSIONING

Property	Test Method	Requirement
Total Chloride Ions, max.	ASTM C 1152	0.08% by weight
Hardened Height Change	ASTM C 1090[a]	0.0% to +0.2%
Expansion	ASTM C 940	Max. 2.0% for up to 3 hours
Wet Density	ASTM C 188	Max. and min. obtained test value, lb/ft^3
Compressive Strength	ASTM C 942	Min. 7,000 psi
Initial Set Time, min.	ASTM C 953	3 hours
Initial Set Time, max.	ASTM C 953	12 hours
Time of efflux, immediately after mixing[b]	ASTM C 939	Min. 20 seconds Max. 30 seconds
	ASTM C 939[c]	Min. 9 seconds Max. 20 seconds
Time of efflux, 30 minutes after mixing with remixing for 30 seconds[b]	ASTM C 939	Max. 30 seconds
	ASTM C 939[c]	Max. 30 seconds
Permeability @ 28 days	ASTM C 1202	Max. 2,500 coulombs

[a] Modify ASTM C 1090 to include verification at both 24 hours and 28 days.
[b] Must meet one of the two sets of requirements shown.
[c] Modify the ASTM C 939 test by filling the cone to the top instead of to the standard level.

1731.3 TEST METHODS

Test in accordance with the requirements stated in **subsection 1731.2**.

1731.4 PREQUALIFICATION

a. Each grout intended for use under this specification must be prequalified before use. Submit a written request to be evaluated for prequalification to the Chief of Materials and Research. Provide the following for the material to be evaluated:

(1) Name, address and telephone number of the manufacturer. Include the name of the preferred contact person.

(2) Brand name of the grout.

(3) A complete description, literature, and set of instructions.

(4) Material Safety Data Sheets.

(5) A copy of test results performed as outlined in **subsection 1731.2b** from a recognized laboratory. Include evidence that the laboratory is regularly inspected regularly. A recognized laboratory is one operated by any State Transportation Agency, the Federal Highway Administration, or other cement and concrete laboratory regularly

inspected by the Cement & Concrete Reference Laboratory (CCRL) of the National Institute of Standards and Technology. Test results are to be no more than 24 months out of date.

(6) An infra-red spectrum of the grout which was used in the laboratory tests.

b. Forward a one gallon sample from production of each grout being submitted for prequalification to the Engineer of Tests.

c. The information, test reports and test results obtained at the Materials and Research Center on samples submitted, will be reviewed by the Chief of Materials and Research. The manufacturer will be advised of the results.

d. The Bureau of Materials and Research will maintain a list of prequalified products. Products that have been prequalified will remain prequalified as long as the formulation and manufacturing processes remain unchanged, and field experience indicates that the grout functions appropriately. Changes in formulation or manufacturing processes will require new prequalification testing.

Failure of the material to function appropriately in the field will be cause for removal of the product from prequalified status. Products removed from prequalified status will be considered for requalification if the manufacturer can provide evidence that the cause of failure has been positively identified, and necessary formulation changes and/or quality control measures have been implemented to eliminate that cause. Complete prequalification testing may be required for products that have been removed from prequalified status.

1731.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1731.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

SECTION 1732

GEOFOAM

1732.1 DESCRIPTION

This specification covers the geofoam lightweight Expanded Polystyrene (EPS) fill for use at locations as designated in the Contract Documents. This includes lightweight embankment fill and abutment drainage systems.

1732.2 MATERIALS

a. General. Provide EPS blocks complying with ASTM D 6817 designated EPS 22 or higher with the minimum requirements in **TABLE 1732-1**:

TABLE 1732-1: EPS MINIMUM REQUIREMENTS	
Property	**Requirement**
Density	1.35 lb/cu ft;
Compressive Resistance	7.3 psi at 1% deformation
Flexural Strength	35 psi

Use EPS blocks in standard sizes that are typically from 4 feet wide x 2.5 feet thick x 8 to 16 feet long.

Treat all EPS blocks with a tested and proven EPA registered material complying with ICC ES EG239 for termite treatment with a minimum 3 year field exposure limit.

Provide a minimum of 4 Geogripper Plates per block to restrain the EPS from moving laterally in layer over layer applications. Make the plate of galvanized or stainless steel with two-sided multi-barbed design capable of piercing the EPS. Make each plate capable of holding a lateral load of 60 lbs.

Use Grade 2.5 concrete for the cap that complies with the **SECTION 401**.

b. Abutment Drainage System. Provide EPS blocks complying with ASTM D 6817 designated EPS 12 or higher.

1732.3 TEST METHODS

Test in accordance with ASTM D 6817.

1732.4 PREQUALIFICATION

None required.

1732.5 BASIS OF ACCEPTANCE

a. Receipt and approval of a Type B certification as specified in **DIVISION 2600**.

b. Verification Testing. Perform of random sampling and testing for compressive strength and density in accordance with **TABLE 1732-2**. Failure of the samples to meet the compressive strength or density specification will serve as a basis for rejection of the entire lot.

TABLE 1732-2: TESTING FREQUENCY	
Embankment Volume (cubic yards)	**Number of EPS Blocks Sampled**
< 650	3
650 – 1300	4
> 1300	5

SECTION 1733

GEOMEMBRANE

1733.1 DESCRIPTION

This specification covers the requirements for geomembrane installed as an impermeable barrier.

1733.2 MATERIALS

Provide either a polypropylene geomembrane or a polyethylene geomembrane that has the minimum, minimum average roll values (MARV) shown in **TABLE 1733-1**.

TABLE 1733-1: GEOMEMBRANE MINIMUM AVERAGE ROLL VALUES		
Type of Geomembrane: Property	**Test Method**	**Requirement**
Polypropylene:		
Thickness		30 mils
Puncture Resistance	ASTM D 4833	40 lbs.
Tensile Strength	ASTM D 638	78 lbs./in.
Polyethylene:		
Thickness		30 mils
Tensile Yield Strength	ASTM D 638	78 lbs./in.
Puncture Resistance	FTMS 101C, Method 2065	45 lbs.
Tear Resistance	ASTM D 1004	24 lbs.

Provide cushioning material (sand) that complies with the requirements of FA-A or FA-B, **DIVISION 1100**.

1733.3 TEST METHODS

Test in accordance with the requirements stated in **subsection 1733.2**.

1733.4 PREQUALIFICATION

None required.

1733.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600.**

SECTION 1801

INORGANIC ZINC PRIMER FOR STRUCTURAL STEEL

1801.1 DESCRIPTION

This specification covers inorganic zinc primer for use on structural steel.

1801.2 REQUIREMENTS

a. General.

(1) The coating is either a single component or multi-component type that cures without the use of a separate curing solution. It must be well ground, free of caking, skins, gelation and excessive settling with a shelf life for each component of no less than 12 months. Formulate the paint with a tint that provides distinct color contrast with the blast cleaned metal surfaces and the finish coat. The VOC content of the coating must comply with the EPA Federal Register 40 CFR, Part 59, Subpart D, Table 1for industrial maintenance coatings.

(2) The manufacturer is responsible for the formulation. Once established, the formulation may not be changed without prior notification to and approval of the KDOT.

b. Pigment. Use a finely divided zinc powder as the pigment. Zinc dust must comply with ASTM D 520, Type II and contain no toxic heavy metals.

c. Vehicle Component. Use a liquid component consisting of partially hydrolyzed silicate with appropriate extenders and solvents.

d. Mixed Paint.

(1) Zinc in the dried film, % by weight .... 75 minimum

(2) Cyclic Corrosion/UV Exposure Test, 15 cycles (one cycle = 2 weeks; one week of UV exposure and one week in the Cyclic Corrosion Tester.)

(a) Scribe Corrosion .... 7 minimum

(b) Unscribed Area .... 9 minimum

e. Packaging. Package the inorganic zinc primer such that when mixed according to the manufacturers instructions, a complete container of each component is utilized.

1801.3 TEST METHODS

a. Zinc in the Dried Film.

(1) Single Component Primer

Pigment .... ASTM D 2371

Total Solids of the Whole Paint, Non-Volatile Zinc Oxide .... ASTM D 2369

Calculations:

ZnO x 0.8034 = Total Zinc

(% Pigment x Total Zinc)/Total Solids = Zinc in Dried Film

(2) Multi-Component Primer

Total Solids of Liquid Portion, Non-Volatile Zinc Oxide .... ASTM D 2369

The manufacturer will provide percent pigment by the mix ratio.

Calculations:

ZnO x 0.8034 = Total Zinc

(100 - %Pigment)(Non-volatile) + %Pigment = Total Solids

(%Pigment x Total Zinc)/Total Solids = Zinc in Dried Film

b. Cyclic Corrosion/UV Exposure .... ASTM D 5894 and KTMR-30

(1) Scribe Corrosion .... ASTM D 1654

(2) Unscribed Area .... ASTM D 1654

1801.4 PREQUALIFICATION

a. Prequalification of the inorganic zinc primer is required. Manufacturers desiring prequalification should submit a 1 pint sample of each component to the Engineer of Tests. Manufacturers will be notified when testing is completed. The Bureau of Construction and Materials will maintain a list of prequalified materials.

b. Testing and evaluation by KDOT may be waived if complete testing has been performed on the identical product by AASHTO National Transportation Product Evaluation Program (NTPEP) or another state DOT. Forward an official copy of the test report along with evidence that the product referenced is identical to that submitted for prequalification, to the Engineer of Tests for evaluation.

c. All liquid components will be fingerprinted using infrared spectroscopy for use in screening future verification samples to ensure that materials submitted for use are of an identical formulation as originally approved.

1801.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1801.4**.
Receipt and approval of a Type C certification as specified in **DIVISION 2600**.
Visual observation of performance on the project.

SECTION 1802

ORGANIC ZINC PRIMER FOR STRUCTURAL STEEL

1802.1 DESCRIPTION

This specification covers organic zinc primer for use on structural steel.

1802.2 REQUIREMENTS

a. General.

(1) The coating is either a single component or multi-component type that cures without the use of a separate curing solution. It must be well ground, free of caking, skins, gelation and excessive settling with a shelf life for each component of no less than 12 months. Formulate the paint with a tint that provides distinct color contrast with the blast cleaned metal surfaces and the finish coat. The VOC content of the coating must comply with the EPA Federal Register 40 CFR, Part 59, Subpart D, Table 1for industrial maintenance coatings.

(2) The manufacturer is responsible for the formulation. Once established, the formulation may not be changed without prior notification to and approval of the KDOT.

b. Pigment. Use a finely divided zinc powder as the pigment. Pigments must contain no toxic heavy metals.

c. Mixed Paint.

(1) Zinc in the dried film, % by weight .... 77 minimum

(2) Cyclic Corrosion/UV Exposure Test, 15 cycles (one cycle = 2 weeks; one week of UV exposure and one week in the Cyclic Corrosion Tester.)

(a) Scribe Corrosion 7minimum

(b) Unscribed Area 9minimum

d. Packaging. Package the organic zinc primer such that when mixed according to the manufacturer's instructions, a complete container of each component is utilized.

1802.3 TEST METHODS

a. Zinc in the Dried Film.

(1) Single Component Primer

Pigment .... ASTM D 2371

Total Solids of the Whole Paint, Non-Volatile Zinc Oxide .... ASTM D 2369

Calculations:

ZnO x 0.8034 = Total Zinc

(% Pigment x Total Zinc)/Total Solids = Zinc in Dried Film

(2) Multi-Component Primer

Total Solids of Liquid Portion, Non-Volatile Zinc Oxide .... ASTM D 2369

The manufacturer will provide percent pigment by the mix ratio.

Calculations:

ZnO x 0.8034 = Total Zinc

(100 - % Pigment)(Non-volatile) + % Pigment = Total Solids

(% Pigment x Total Zinc)/Total Solids = Zinc in Dried Film

b. Cyclic Corrosion/UV Exposure. .... ASTM D 5894 and KTMR-30

(1) Scribe Corrosion .... ASTM D 1654

(2) Unscribed Area .... ASTM D 1654

1802.4 PREQUALIFICATION

a. Prequalification of the organic zinc primer is required. Manufacturers desiring prequalification should submit a 1 pint sample of each component to the Engineer of Tests. Manufacturers will be notified when testing is completed. A list of prequalified materials will be maintained by the Bureau of Construction and Materials.

b. Testing and evaluation by KDOT may be waived if complete testing has been performed on the identical product by AASHTO National Transportation Product Evaluation Program (NTPEP) or another state DOT. Forward an official copy of the test report along with evidence that the product referenced is identical to that submitted for prequalification, to the Engineer of Tests for evaluation.

c. All liquid components will be "fingerprinted" using infrared spectroscopy for use in screening future verification samples to ensure that materials submitted for use are of an identical formulation as originally approved.

1802.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1802.4.**
Receipt and approval of a Type C certification as specified in **DIVISION 2600**.
Visual observation of performance on the project.

SECTION 1803

ORGANIC ZINC RICH PAINT FOR REPAIRING DAMAGED SPELTER COATING

1803.1 DESCRIPTION

This specification covers organic zinc rich paint for use in repairing damaged spelter coating.

1803.2 REQUIREMENTS

Provide one-component organic zinc rich paint manufactured as a coating for steel and having a minimum of 85% zinc by weight in the dried film.

1803.3 TEST METHODS

None required.

1803.4 PREQUALIFICATION

None required.

1803.5 BASIS OF ACCEPTANCE

The basis of acceptance is visual inspection of the container label for compliance with these requirements.

SECTION 1804

RESERVED

SECTION 1805

RESERVED

SECTION 1806

WATER-BORNE ACRYLIC FINISH COAT

1806.1 DESCRIPTION

This specification covers water-borne acrylic finish coat intended for use with organic and inorganic zinc primers and epoxy mastic primer on structural steel.

1806.2 REQUIREMENTS

a. General.

(1) The coating is a single component, water-borne acrylic formulated to display compatibility with and adhesion to the cured organic and inorganic zinc primers, acrylics and epoxy mastic primers. It is used as a protective color finish coat. The pigment must be finely ground, and the mixed paint must not be caked, gelled, skinned nor exhibit hard settling in the container. The coating cures to a tough, semi-gloss, abrasion resistant surface. The shelf life of this paint is no less than 24 months. The VOC content of the coating must comply with the EPA Federal Register 40 CFR, Part 59, Subpart D, Table 1for industrial maintenance coatings.

(2) The manufacturer is responsible for the formulation. Once established, the formulation may not be changed without prior notification to and approval of the KDOT.

b. Pigment. Use titanium dioxide and color retentive tinting pigments and selected extender pigments.

c. Paint.

(1) Total Solids, % by weight .... 45 minimum

(2) Cyclic Corrosion/UV Exposure Test, 15 cycles (one cycle = 2 weeks; one week of UV exposure and one week in the Cyclic Corrosion Tester.)

(a) Scribe Corrosion .... 7 minimum

(b) Unscribed Area .... 9 minimum

1806.3 TEST METHODS

a. Total Solids .... ASTM D 1644, except that the procedure is modified to a dry time of 72 hours at 100°F rather than 3 hours at 221ºF.

b. Cyclic Corrosion /UV Exposure .... ASTM D 5894 and KTMR-30

(1) Scribe Corrosion .... ASTM D 1654.

(2) Unscribed Area .... ASTM D 1654.

1806.4 PREQUALIFICATION

a. Prequalification of the water-borne acrylic finish coat is required. Manufacturers desiring prequalification should submit a 1 pint sample to the Engineer of Tests. Manufacturers will be notified of results when testing is completed. A list of prequalified materials will be maintained by the Bureau of Construction and Materials.

b. Testing and evaluation by KDOT may be waived if complete testing has been performed on the identical product by AASHTO National Transportation Product Evaluation Program (NTPEP) or another state DOT. Forward an official copy of the test report along with evidence that the product referenced is identical to that submitted for prequalification, to the Engineer of Tests for evaluation.

c. All liquid components will be fingerprinted using infrared spectroscopy for use in screening future verification samples to verify that materials submitted for use are of an identical formulation as originally approved.

1806.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1806.4**.
Receipt and approval of a Type C certification as specified in **DIVISION 2600.**
Visual observation of performance on the project.

SECTION 1807

MOISTURE-CURE URETHANE SYSTEM

1807.1 DESCRIPTION

This specification covers a moisture-cure urethane micaceous iron oxide paint system for use on structural steel. The system may also be used for overcoating applications.

1807.2 REQUIREMENTS

a. General.

(1) Each coating must be supplied as a single component material. All coatings must be well ground, free of caking, skins, gelation, and excessive settling with a shelf life of not less than 12 months. Pigmentation must contain no toxic heavy metals. The VOC content of the coatings must comply with the EPA Federal Register 40 CFR, Part 59, Subpart D, Table 1 for industrial maintenance coatings.

(2) All coatings must be able to be applied at relative humidity as high as 98% and temperatures as low as 20ºF. There is no restriction on dewpoint temperature differential if the surface is visibly dry and free from condensate. Verify the surface to be free of any frozen water products when the application temperature is below 32ºF.

(3) The manufacturer is responsible for the formulation. Once established, do not change the formulation without prior notification to and approval of the KDOT.

b. Coating system for use on full removal and repaint projects or new construction projects. This system consists of a zinc-rich, moisture-cure polyurethane primer stripe coat applied to all edges, corners, bolts, rivets, and weld seams; a zinc-rich, moisture-cure polyurethane full primer coat; and a micaceous iron oxide-filled, moisture-cure aliphatic polyurethane topcoat. The topcoat color will be specified on the Contract Documents. All micaceous iron oxide products must comply to ASTM D 5532, Type 1 and have a certificate of compliance.

(1) Stripe Primer and Full Primer:
- Total solids, % by weight .... 87 minimum
- Zinc in the dried film, % by weight .... 83 minimum

(2) Topcoat:
- Total solids, % by weight .... 77 minimum
- Pigment, Micaceous Iron Oxide .... 3 lb/gal minimum

(3) Paint System, Cyclic Corrosion/UV Exposure Test, 15 cycles (one cycle = 2 weeks; one week of UV exposure and one week in the Cyclic Corrosion Tester.):
- Scribe Corrosion .... 7 minimum
- Unscribed Area .... 8 minimum

c. Coating system for use on overcoating projects. This system consists of a zinc-rich/micaceous iron oxide-filled, moisture-cure polyurethane spot primer; a micaceous iron oxide-filled, moisture-cure polyurethane intermediate coat; and a micaceous iron oxide-filled, moisture-cure aliphatic polyurethane topcoat. The topcoat color will be specified in the Contract Documents. Comply all micaceous iron oxide products to ASTM D 5532, Type 1 and provide a certificate of compliance.

(1) Spot Primer:
- Total solids, % by weight .... 86 minimum
- Pigment, Zinc dust & Micaceous Iron Oxide .... 3.5 lb/gal minimum

(2) Intermediate Coat:
- Total solids, % by weight .... 82 minimum
- Pigment, Micaceous Iron Oxide .... 6 lb/gal minimum
- Color .... Tint to distinguish from primer and topcoat

(3) Topcoat:
- Total solids, % by weight .... 77 minimum
- Pigment, Micaceous Iron Oxide .... 3 lb/gal minimum

(4) Paint System, Cyclic Corrosion/UV Exposure Test, 15 cycles (one cycle = 2 weeks; one week of UV exposure and one week in the Cyclic Corrosion Tester.):
- Scribe Corrosion .... 7 - 10
- Unscribed Area .... 8 - 10

1807.3 TEST METHODS

a. Total Solids .... ASTM D 1644, except heat the sample for 72 hours at 100ºF.

b. Cyclic Corrosion/UV Exposure .... ASTM D 5894 and KTMR-30
- Scribe Corrosion .... ASTM D 1654
- Unscribed Area .... ASTM D 1654

c. Zinc in the Dried Film.
- Pigment .... ASTM D 2371
- Total Solids of the Whole Paint, Non-Volatile .... ASTM D 2369

Calculations:
ZnO x 0.8034 = Total Zinc
(% Pigment x Total Zinc)/Total Solids = Zinc in Dried Film

1807.4 PREQUALIFICATION

a. Prequalification of the moisture-cure urethane system is required. Manufacturers desiring prequalification should submit a 1 pint sample of each component to the Engineer of Tests. Manufacturers will be notified of results when testing is complete. The Bureau of Construction and Materials will maintain a list of prequalified materials.

b. All applicable liquid components will be fingerprinted using infrared spectroscopy for use in screening future verification samples to verify that materials submitted for use are of an identical formulation as originally approved.

1807.5 BASIS OF ACCEPTANCE

Prequalification as required by **subsection1807.4**.
Receipt and approval of a Type C certification as specified in **DIVISION 2600**.
Visual observation of performance on the project.

SECTION 1808

CALCIUM SULFONATE ALKYD SYSTEM

1808.1 DESCRIPTION

This specification covers a calcium sulfonate alkyd paint system for use on structural steel including weathering steel. The system may also be used for encapsulation or overcoating.

1808.2 REQUIREMENTS

a. General.

(1) The coating system consists of 3 materials: rust penetrating sealer, spot primer, and topcoat. The sealer is for use on pack rusted steel associated with and around rockers, riveted flanges and joints. The spot primer is for use where the existing coating has been removed. The topcoat is for use over existing paint, penetrating sealer, and spot primer. The coating can be used over a variety of existing paints including but not limited to lead based paint, inorganic/organic zinc, epoxy, vinyl, and alkyd. Supply each coating as a single component material. All coatings must be well ground, free of caking, skins, gelation, and excessive settling with a shelf life of not less than 12 months. Provide pigmentation that contains no toxic heavy metals. Comply with the current national rule for industrial maintenance coatings concerning VOC content.

(2) The manufacturer is responsible for the formulation. Once established, no change in the formulation is permitted without prior notification to and approval of the KDOT.

b. Vehicle: Use a modified overbased calcium sulfonate alkyd resin.

c. Rust Penetrating Sealer:
- Total solids, % by weight .... 40 minimum

d. Spot Primer:
- Total solids, % by weight .... 70 minimum

e. Topcoat:
- Total solids, % by weight .... 70 minimum

f. Paint System,
- Cyclic Corrosion/UV Exposure Test, 15 cycles (one cycle = 2 weeks; one week of UV exposure and one week in the Cyclic Corrosion Tester.):
  - Scribe Corrosion .... 7 minimum
  - Unscribed Area .... 8 minimum

1808.3 TEST METHODS

a. Total Solids .... ASTM D 1644, except heat the sample for 72 hours at 100ºF.

b. Cyclic Corrosion/UV Exposure .... ASTM D 5894 and KTMR-30
- Scribe Corrosion .... ASTM D 1654
- Unscribed Area .... ASTM D 1654

1808.4 PREQUALIFICATION

a. Prequalification of the calcium sulfonate paint system is required. Manufacturers desiring prequalification should submit a 1-gallon sample to the Engineer of Tests. Manufacturers will be notified of results when testing is complete. The Bureau of Construction and Materials will maintain a list of prequalified materials.

b. Testing and evaluation by KDOT may be waived if complete testing has been performed on the identical product by AASHTO National Transportation Product Evaluation Program (NTPEP) or another state DOT. Forward an official copy of the test report along with evidence that the product referenced is identical to that submitted for prequalification, to the Engineer of Tests for evaluation.

c. All applicable liquid components will be fingerprinted using infrared spectroscopy for use in screening future verification samples to verify that materials submitted for use are of an identical formulation as originally approved.

1808.5 BASIS OF ACCEPTANCE

Prequalification as required by **subsection 1808.4**.
Receipt and approval of a Type C certification as specified in **DIVISION 2600.**
Visual observation of performance on the project.

SECTION 1901

USES OF PIPE

1901.1 GENERAL

TABLE 1901-l displays the authorized applications and specification references for all types of pipe utilized by KDOT. This table summarizes general applications for pipe. The Contract Documents should be consulted for specified uses. When a type of pipe is not specified in the Contract Documents, then any type of pipe permitted for the type of construction may be used.

TABLE 1901-1 - USES OF PIPE

Type of Pipe	AASHTO, ASTM or Specification Class	Type of Construction							Spec.
		Cross Road	Side road & Entrance	Storm Sewer	Under-drain (type)	Under-drain Outlet (type)	Sanitary Sewer	Erosion	
Reinforced Concrete (Arch)	A-II, A-III or A-IV	X	X	X					1902
Reinforced Concrete (Round)	II, III, IV or V	X	X	X					1902
Reinforced Concrete (Horizontal Elliptical)	HE-II, HE-III or HE-IV	X	X	X					1902
Cast Iron Soil							X		1903
Cast Iron or Ductile Iron Pressure	As shown on the Contract Documents						X		1903
Corrugated Steel (Circular or Arch)[3]		X[2]	X[2]	X[2]	F[1]	G[1]		X	1904 & 1905
Corrugated Steel (Bituminous Coated Arch)		X[2]	X[2]	X[2]				X	1906
Corrugated Steel (Bituminous Coated Circular)		X[2]	X[2]	X[2]				X	1906
Corrugated Aluminum (Circular or Arch)		X	X	X	F[1]	G[1]		X	1904 & 1905
Corrugated Aluminum (Bituminous Coated Arch)		X	X	X				X	1906
Corrugated Aluminum (Bituminous Coated Circular)		X	X	X				X	1906
Corrugated Steel (Bituminous Coated Circular Fully Paved)		X[2]	X[2]	X[2]					1906
Corrugated Aluminum (Bituminous Coated Circular Fully Paved)		X	X	X					1906
Corrugated Polyethylene Tubing					L[1]	E[1]			1907
Polyethylene (PE)[4]		X[2]	X	X[2]					1908
Polyvinyl Chloride (PVC)[5]		X[2]	X	X[2]	H[1]	K[1]	X		1909

[1]The letter signifies the underdrain type designation as shown in **DIVISION 800**.
[2]Consult the KDOT pipe policy for locations and applications where the use of CSP, PE or PVC is prohibited. Contact the Bureau of Construction and Materials for additional information.
[3]Includes zinc coated (galvanized) and aluminum alloy (aluminized) coated pipe and pipe-arches provided under **SECTION 1904**. Consult the KDOT pipe policy for locations and applications where the use of galvanized CSP and aluminized CSP is prohibited.
[4]Maximum size (nominal) = 60 inches.
[5]Maximum size (nominal) = 36 inches.

SECTION 1902

QUALITY CONTROL PROGRAM FOR PRECAST CONCRETE PRODUCTS

1902.1 DESCRIPTION

This specification covers precast concrete pipe, end sections, inlets, manholes, boxes, and related concrete accessories. This specification does not apply to prestressed concrete beams or slabs, retaining wall panels, or temporary barriers.

1902.2 REQUIREMENTS

a. Materials.

(1) Use cement from a prequalified source that complies with **DIVISION 2000**. Make cement certifications available at the precast production site.

(2) Fly ash may be substituted for Types II or I/II portland cement at rates up to 25 percent (35% for concrete pipe). Use fly ash from a source prequalified under **SECTION 2004**. Obtain the Engineer's approval before substituting fly ash for Type III Cement.

Mix designs containing fly ash must be approved for each plant by using Kansas Test Method KTMR-29, "Wetting and Drying Test of Steam Cured Reinforced Concrete Pipe with Fly Ash." If the mixture complies with the requirement, the producer and the KDOT plant inspectors will be notified in writing. Preliminary approval will be given for mixtures at 150 days based on satisfactory test performance of KTMR-29. Contact the Bureau of Construction and Materials for information, and to make arrangements for testing.

Alternatively, provide the results of ASTM C 1567 mortar expansion tests, using the mix design's materials at their designated percentages. Provide a mix with a maximum expansion of 0.10% at 16 days after casting.

If any of the sources of Cement, Fly Ash, or Aggregate are changed in the future, repeat the testing or reporting procedures for the new mix design, as described in this subsection.

Make all test results, certifications, and approval letters available for review at the production site.

(3) Aggregates. Use aggregates that comply with "Aggregates for Concrete Not Placed on Grade" as shown in **DIVISION 1100** of the Standard Specifications except that the gradation requirements do not apply. Also, update aggregate producer's certifications at 6-month intervals and when aggregate source changes are made. Make these certifications available at the precast production site.

(4) Use admixtures that comply with **DIVISION 1400**. Make certifications for admixtures available at the precast production site.

(5) Use steel reinforcement as specified in AASHTO M 170, AASHTO M 206 or AASHTO M 207, as applicable. Make certifications for steel reinforcement available at the precast production site. All steel components utilized in the products, reinforcing and structural must comply with **DIVISION 1600**.

b. Pipe. Supply pipe, either elliptical, arch or round, as designated in the Contract Documents and complying with either AASHTO M 170 for round pipe, AASHTO M 206 for arch pipe or AASHTO M 207 for elliptical pipe with the following additions or deletions:

(1) Classes of Pipe. Provide only Class II or stronger round pipe, Class HE-II or stronger elliptical pipe, or Class A-II or stronger arch pipe.

(2) Sizes of pipe. The minimum diameters of round pipe and the minimum waterway areas of elliptical pipe and arch pipe will be shown in the Contract Documents. Pipe having larger diameters or waterway areas may be considered provided the Engineer approves any substitutions. The nominal waterway areas for various sizes of arch pipe are as shown in AASHTO M 206 and for various sizes of elliptical pipe are as shown in AASHTO M 207.

(3) Lift Holes. One lift hole, not to exceed 4 inches in diameter, may be provided in each section of pipe. After placement, fill lift holes with a suitable concrete mortar, unless directed otherwise by the Engineer.

c. End Sections

(1) Fabricate beveled end sections from pipe complying with this specification for Class II, Class A-II or Class HE-II pipe, as applicable. Bevel to comply with the dimensions shown on the Contract Documents.

(2) Fabricate flared end sections complying with the concrete compressive strength, the absorption, the steel area and the workmanship requirements of this specification for Class II, Class A-II or Class HE-II pipe, as applicable.

(3) Two lift holes, not exceeding 4 inches in diameter, will be permitted in each section. After placement, fill lift holes with a suitable concrete mortar, unless directed otherwise by the Engineer.

d. Manholes, Inlets, and Boxes for Storm Water Drainage. Fabricate manholes, inlets, and boxes for storm water drainage complying with the KDOT approved shop drawings, including reinforcement, absorption, and concrete strength.

e. Manholes, Inlets, and Boxes for Sanitary Sewer Drainage. Fabricate manholes, inlets, and boxes for sanitary sewer drainage complying with the KDOT approved shop drawings and ASTM C 478.

1902.3 TEST METHODS

a. The following current test methods and property requirements, AASHTO or the ASTM equivalent are to be applied to procedures referenced in this specification.

(1) AASHTO T-22, "Compressive Strength of Cylindrical Concrete Specimens." Apply the single operator precision statement for field conditions from ASTM C-39.

(2) AASHTO T-23, "Making and Curing Concrete Test Specimens in the Field."

(3) AASHTO T-24, "Obtaining and Testing Drilled Cores and Sawed Beams of Concrete."

(4) AASHTO T-119, "Slump of Hydraulic Cement Concrete."

(5) AASHTO T-121, "Weight per Cubic Foot, Yield and Air Content (Gravimetric) of Concrete."

(6) AASHTO R-39, "Making and Curing Concrete Test Specimens in the Laboratory."

(7) AASHTO T-196, "Air Content of Freshly Mixed Concrete by the Volumetric Method."

(8) AASHTO T-152, "Air Content of Freshly Mixed Concrete by the Pressure Method." Not applicable, without special calibration, in the following conditions:

- Slump $\leq$ 2 inches.
- A mid-range or high-range water-reducer is used.
- An air-entraining agent other than a vinsol resin is used.
- Non-plastic concrete such as commonly used in the manufacture of pipe and concrete masonry units.

(9) AASHTO T-231, "Capping Cylindrical Concrete Specimens." For unbonded neoprene caps, ASTM C-1231, "Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders."

(10) ASTM C-497, "Concrete Pipe, Manhole Sections, or Tile." (Suggested minimum amplitude of 5 mils.)

(11) ASTM C 1567, "Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)."

(12) Kansas Test Method KTMR-29, "Wetting and Drying Test of Steam Cured Reinforced Concrete Pipe with Fly Ash."

b. Cylinders are to be 4∅ X 8-inch, however 6∅ X 12-inch cylinders will also be approved.

c. Compressive strength testing of a minimum of three 28-day laboratory cured cylinders is required for each mix design of a producer. The five lot moving average will apply to each mix design.

d. Cure optional shipping strength cylinders under the same conditions as the product they represent. Test a minimum of 2 cylinders for shipping strength at the same age. Attain a minimum of 80 percent of the specified 28-day compressive strength for the product on each cylinder before shipping. These products are still subject to the requirements of this section and final approval at the project site. Note in the monthly report which products are shipped after 28 days of age, therefore not requiring shipping strength data.

When shipping strength cylinders are utilized, a minimum of 1 set is to be produced at the same time period and from the same concrete batch as the 28-day compressive strength cylinders. Additional shipping strength cylinders may be produced at other times from different concrete batches and tested if desired. Submit all shipping strength data to KDOT and provide availability to the inspector at the production site.

e. Whether internal or external to the producing facility, the individuals conducting quality control sampling and testing for all producers are to be certified by ACI, or a KDOT approved equivalent, in the appropriate method(s) of sampling and testing, or the laboratory must be AASHTO accredited. Provide copies of the certifications to KDOT. Notify KDOT within 2 months of any changes in certification status or QC testing personnel.

f. KDOT reserves the right to require the producing facility hire a laboratory to perform verification sampling and testing for KDOT, with all associated costs paid for by the producing facility. All laboratories performing verification sampling and testing must be accredited by AASHTO for all the accreditation available test methods shown in **subsection 1902.3**. In addition, all laboratories performing verification sampling and testing must be approved by KDOT, and must report all test results directly to KDOT.

1902.4 PRODUCER PREQUALIFICATION

a. Becoming Prequalified.

(1) Notify KDOT of desire to prequalify. Produce 5 lots of concrete that would be used on KDOT products. Provide 28-day compressive strength test data for all 5 lots. Allow KDOT to sample and test 1 of the 5 lots. This sample will be a split sample, with KDOT and Producer testing essentially the same product. The maximum variation between the average of the Producer's 5 lots and KDOT's test results is 10%.

(2) Demonstrate that all highway and bridge construction industry related products manufactured at each facility are produced under a Quality Control Program. Present a Quality Control Plan to the Bureau Chief of Construction and Materials for evaluation and disposition. The plan must provide the following information as the minimum requirements:

- Name and location of the producer's facility.
- Name, telephone number, level of authority (organizational chart), and qualifications of the persons and alternates directing quality control at the facility. One of these individuals must be present during production at the facility.
- The name and location of the laboratory, whether internal or external to the facility, conducting the quality control testing for the producer. A listing of any accreditation of the laboratory as well as the frequency of NIST traceable equipment calibrations is required.
- Except as described in **subsection 1902.4a(4)**, a lot is defined as the production from each mix design during the 7 consecutive day period beginning Sunday and ending Saturday of each week. Test 1 lot from each mix design used at the facility during this 7-day period. Lot size is 7 consecutive days regardless of the size or type of product or whether the mix is used only once during that 7-day period or each of the 7 days.
- List the QC tests to be performed, including which tests are used for shipping strength. Define the method for obtaining random samples for each test and the number of samples to be tested per lot.
- The frequency of submitting quality control summary reports. This is not to be less than 1 report per month.

(3) The program will be reviewed, and if found acceptable, the producer's facility will be placed on a list of prequalified precast product sources maintained by the Bureau of Construction and Materials.

(4) Upon approval by the Engineer, Producers that demonstrate a continually low monthly production rate, or do not continually provide products to KDOT may base their lots on a per unit basis, not to exceed 1 month. Producers of manholes, inlets, boxes and other project specific products that choose this option must notify the Bureau of Construction and Materials when producing KDOT products. KDOT may also choose to decrease the frequency of verification sampling, testing and production monitoring for any Producer.

b. Maintaining Prequalified Status.

(1) Monitor on a lot by lot basis for each mix design or product the 5 lot moving average of compressive strength, $\overline{X}_t$; the n - 1 weighted standard deviation of the 5 test values used to determine the moving average, $\boldsymbol{S_t}$; the quality index, $\boldsymbol{Q_L}$; and the associated percent within limits (PWL) as referenced in the Terminology and Definitions.

Notify KDOT of changes in mix designs, concrete materials sources, mixing equipment, or sources of concrete. Changes that significantly affect the control charts may constitute a new mix design and therefore require a new five lot moving average. Produce 5 successive lots complying with the minimum strength requirements for each new mix design.

Selection of the production lot or test number, t is important since it determines the 5 test moving average. Since t is an integer, it is suggested that for the first lot, set t = 1, increment by 1 for each successive lot.

A producer, at their option, may impose a more stringent quality control requirement than the five lot moving average. Inform KDOT as to the frequency of quality control testing, the PWL, the production quantity represented by the test or tests, other types of control monitoring such as attributes, variables, tracking and traceability methods, etc. The Producer and KDOT must mutually agree upon this program.

The frequency of sampling and testing may be decreased with the approval of KDOT if proficiency in maintaining the quality control of the products is demonstrated to the satisfaction of KDOT.

(2) Clearly mark the lot when any single cylinder test value for that lot has a final strength of less than 85 percent of the specified minimum 28-day compressive strength. Clearly mark this material to prevent it from being included in a KDOT project and store it separately from the approved material.

(3) Comply with a 90 percent within limits (PWL) requirement relative to the minimum specified 28-day compressive strength for the 5 lot moving average. The Lower Spec Limit (LSL) for each product is that product's required 28-day compressive strength. Notify KDOT immediately whenever the 5 lot moving average falls below 90 PWL, and comply with the following. Produce 5 successive lots complying with the minimum strength requirements as agreed upon by KDOT and the Producer, and provide documentation that corrective action has been taken and that compliance has been reestablished.

(4) Maintain optional control charts of $\overline{X}_t$, $\boldsymbol{S_t}$; and PWL vs. test number t.

(5) Display plant name, initials, or logo, date manufactured, AASHTO class when applicable, and size on all inventories. Clearly mark all products not intended for KDOT use. Maintain traceability of all products shipped to KDOT projects.

(6) The producer's facility will be randomly visited to inspect the placement of the steel and other necessary requirements for the project.

(7) Provide KDOT with the current week's production schedule at the beginning of each week. Verification samples will be taken at a minimum of once every 5 lots for each product. This may include, but is not restricted to, any combination of cylinders, core samples, and, for pipe, 3-edge bearing tests. The same statistical parameters ($\overline{X}_t$,$\boldsymbol{S_t}$; and PWL) will be developed from the verification test data of the cylinders. Under normal conditions, no more than 10 pieces of pipe per year will be tested to ultimate strength when the 3-edge bearing test is used for verification testing.

(8) A minimum of 5 of the KDOT's verification test results will be compared with the associated producer's quality control tests through the F and t statistical test to determine if they represent the same population. Continual deviations will be rectified with the Producer.

(9) Any unacceptable practices witnessed by KDOT personnel at the producer's facility may result in loss of Prequalified Status if not corrected or eliminated after notification.

c. Terminology and Definitions. Refer to 5.2.1 in Part V for terminology and definitions concerning QC/QA and Statistical Analysis.

d. Monthly Report Requirements

(1) Include the following information in the quality control summary reports.

- Clear and consistent identification of each mix design and test samples. Use only 1 producer defined lower specification limit for each mix design.
- The date the sample, product, or cylinders were produced and the dates tested for both shipping strength and 28-day compressive strengths of laboratory cured cylinders. Include documentation when products are not shipped before 28 days, therefore waving the shipping strength requirements.
- The load at failure, compressive strength, applicable correction factor, and corrected strength, for each individual sample tested as per **subsection 1902.3c**.
- The statistical analysis of this data as described in **subsection 1902.4b(1)** and the optional control charts.

(2) Do not send QC Reports for products that are not normally used in the highway and bridge construction industry.

(3) Reports that are more than 2 months late will cause a loss of Prequalified Status for a 6-month period. Further delinquent reports may cause permanent loss of Prequalified Status.

(4) Make available the actual test data and reports, including shipping strength data, to the inspector at the production site. Test reports are to bear the names and signatures of the certified technicians or representative of the laboratory conducting the sampling and testing. For precast facilities that are performing their own QC testing, actual data records are to be initialed by the certified technicians conducting the testing. Make available for inspection the shipping records for KDOT projects.

1902.5 BASIS OF ACCEPTANCE

Delete the basis of acceptance in AASHTO M 170, AASHTO M 206 and AASHTO M 207, and replace with the following:

a. Prequalification as required by **subsection 1902.4.**

b. Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

c. All products governed by this special provision are subject to final visual inspection for shipping damage, fit and other visual defects, and disposition when delivered to the project site.

d. Receipt and approval of a written statement from the producer certifying that iron and steel used in the production of all product delivered to the job site complies with all provisions of the Buy America Act. See **subsection 106.1c.** for a definition of "Buy America" materials.

SECTION 1903

CAST IRON AND DUCTILE IRON PIPE

1903.1 DESCRIPTION

This specification governs pipe, fittings, and accessory items produced from malleable, gray, or ductile (nodular) cast iron and intended for various piping system applications, including drainage systems.

1903.2 REQUIREMENTS

a. General. Provide pipe, fittings, and accessory item castings that comply with the design, dimensions, alloy designation and thermal treatment, requirement for supplemental corrosion protection, and specific fabrication requirements as specified in the Contract Documents. Provide compliant components of pipe systems that are open to atmospheric pressure complying with **subsection 1903.2b**. Provide compliant closed systems that can be pressurized with the specification(s) selected from ASTM A 377 that is (are) appropriate for the intended application. The selected specification(s) is (are) denoted in the Contract Documents.

b. Material Specifications. Provide compliant components of open systems complying with ASTM A 48 when produced from gray cast iron or ASTM A 536 when produced from ductile cast iron. Accessory items may also be produced from ferritic malleable cast iron in compliance with ASTM A 47. Provide compliant pipe, fittings, and accessory items for these piping systems with ASTM A 74. The mechanical property requirements of ASTM A 74 determine the class or grade of cast iron required.

1903.3 TEST METHODS

Conduct all tests required by the applicable ASTM or other specification of **subsection 1903.2b** according to the procedures specified in that standard.

1903.4 PREQUALIFICATION

Not applicable.

1903.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified **DIVISION 2600**.

Inspection by field personnel of all products and components for compliance with dimensional and supplemental corrosion protection coating requirements when corrosion protection is specified, quality of workmanship, delivery condition, approval of the required associated documentation, and any other requirements as may be specified in the Contract Documents.

SECTION 1904

CORRUGATED METAL PIPE AND END SECTIONS

1904.1 DESCRIPTION

This specification governs corrugated steel pipe, arches, corrugated aluminum alloy pipe, arches, and the associated end sections and accessory items for use in drainage systems and other applications.

1904.2 REQUIREMENTS

a. General. Provide pipe, arches, end sections, and accessory items that comply with the design, dimensions, alloy designation and thermal treatment, requirement for supplemental corrosion protection, and specific fabrication requirements as specified or in the Contract Documents. The components of pipe systems are to comply with **subsection 1904.2b**. The selected specification(s) is (are) denoted in the Contract Documents.

b. Material Specifications.

(1) Comply all corrugated steel (galvanized and aluminized) pipe, pipe-arches, and accessory items with AASHTO M 36. Comply all steel sheet utilized to fabricate the pipe and pipe-arches with AASHTO M 218 when zinc coated, or AASHTO M 274 when aluminum alloy coated. The type of pipe, and type and class of coating will be specified in the Contract Documents. Provide only continuous helical (lock or welded) seams. Do not interconnect components with differing coating types within a piping system.

(2) Comply all corrugated aluminum alloy pipe, pipe-arches, and accessory items with AASHTO M 196. The type of pipe will be specified in the Contract Documents. Provide only continuous helical lock seams. Do not interconnect metal aluminum alloy pipe with metal steel pipe or accessory items except as permitted through M 196.

(3) Repairs to the high frequency resistance welded (HFRW) seam in steel continuous welded helical corrugated metal pipe (CMP) are to be adherent to the following guidelines:

(a) For pipes with a nominal diameter of 24 inches or greater, the maximum allowable total length of manual weld repair for the helical weld seam in a section of steel CMP is ½-inch of weld per 1-inch of nominal pipe diameter per 20 feet (or fraction thereof) of pipe section length.

(b) For pipes with a nominal diameter of less than 24 inches, the maximum allowable total length of the manual weld repair referenced in (a) is 12 inches.

(c) For pipes with a nominal diameter of 24 inches or greater, the maximum allowable length of a single weld repair for the helical weld seam in a section of steel CMP is 1/4 -inch of weld per 1-inch of nominal pipe diameter, not to exceed 18 inches.

(d) For pipes with a nominal diameter of less than 24 inches, the maximum allowable length of the single weld repair referenced in (c) is 6 inches.

(e) Do not space repair welds closer than 1 helix length of welded seam. One helix length is the distance traversed by a point on the weld seam during 1 revolution of the pipe.

(f) Repair welds are not permitted within the re-roll areas at the ends of a steel CMP section.

(g) No visible discontinuities, e.g., hot or cold cracks, porosity, entrapped slag, voids, etc., are permitted within the total weld length, repair and coil splice welds included, of the finished section of steel CMP.

(h) The preferred weld repair method is, but not restricted to, gas metal arc welding (GMAW). Any method that utilizes a ferrous based filler metal compatible with the parent coil steel and provides an acceptable repair weld is adequate. Weld repair without the use of filler metal, such as by Gas Tungsten Arc Welding (GTAW), is also acceptable when practical.

(i) Minimize the number of plant coil splices within a section of steel CMP. This is subject to the judgment of the KDOT inspector and based on the steel CMP section size. In no instance is the number of coil splices to exceed 3 per steel CMP section.

(4) Produce end sections from the same metal and provide with the same coating as the pipe to which they are to be attached. Comply with the design and dimension requirements as stated in **subsection 1904.2a**. However, the thermal treatment, denoted by the temper designation for aluminum alloys, must not reduce the ductility of the metal to the degree that forming tears or cracks occur during production of the end section. A section of CMP that is an integral component of the end section is subject to **subsection 1904.2b**.

1904.3 TEST METHODS

Conduct all tests required by the applicable AASHTO, ASTM or other specification of **subsection 1904.2b** according to the procedures specified in that standard.

1904.4 PREQUALIFICATION

Not applicable.

1904.5 BASIS OF ACCEPTANCE

a. Receipt and approval of a Type A certification as specified in **DIVISION 2600** for all corrugated metal pipe (CMP) and the associated end sections and accessory items provided through this specification.

b. Inspection, and testing when applicable, by field personnel of CMP and end sections and accessory items for compliance with corrosion protection coating thickness requirements when applicable, mechanical or welded seam quality, and dimensional requirements.

c. The final disposition of CMP and end sections and accessory items will be completed at the final destination as the result of inspection for the quality of workmanship, the delivery condition, and receipt and approval of the associated required documentation. Corrugated metal pipe and end sections and accessory items may also require inspection during the production process at the fabrication facility.

SECTION 1905

STRUCTURAL PLATE FOR PIPE, PIPE ARCHES, AND ARCHES

1905.1 DESCRIPTION

This specification governs the steel and aluminum alloy structural plate and accessory items utilized in the construction of pipe, pipe arches, and arches.

1905.2 REQUIREMENTS

a. General. Provide pipe, pipe arches, arches, and accessory items that comply with the design, dimensions, alloy designation and thermal treatment, requirement for supplemental corrosion protection, and specific fabrication requirements as specified in the Contract Documents. Comply with AASHTO LRFD Bridge Design Specifications and AASHTO LRFD Bridge Construction Specifications.

Properly form the components required to construct these units to facilitate and expedite their assembly. When the end of an assembly is required by the Contract Documents to comply with the finished fill slope angle; precut the end components so the end of the assembled unit complies with this indicated angle.

b. Material Specifications.

(1) Provide compliant components and accessory items produced from steel metal for pipe, pipe arches, and arches with AASHTO M 167.

(2) Provide compliant components and accessory items produced from aluminum alloy metal for pipe, pipe arches, and arches with AASHTO M 219.

(3) Do not interconnect steel metal components and accessory items with aluminum alloy metal components and accessory items except as permitted through the specifications previously referenced.

1905.3 TEST METHODS

Conduct all tests required by the applicable AASHTO, ASTM or other specification of **subsection 1905.2b** according to the procedures specified in that standard.

1905.4 PREQUALIFICATION

Not applicable.

1905.5 BASIS OF ACCEPTANCE

a. Receipt and approval of a Type A certification as specified in **DIVISION 2600** for all steel and aluminum alloy components and accessory items utilized in the construction of pipe, pipe arches, and arches.

b. Inspection, and testing when applicable, by field personnel of the components and accessory items for compliance with corrosion protection coating thickness requirements when applicable, placement of fastener holes, uniformity of corrugations, dimensional requirements, and any other specification requirements considered pertinent to the construction of the final product.

c. The final disposition of all steel and aluminum alloy components and accessory items utilized in the construction of pipe, pipe arches, and arches will be completed at the final destination as the result of inspection for the quality of workmanship, the delivery condition, and receipt and approval of the associated required documentation. Inspection during the production process of components and accessory items at the manufacturing or fabrication facility may also be required.

SECTION 1906

ASPHALT COATED CORRUGATED METAL PIPE, PIPE ARCHES, COUPLING BANDS AND STRUCTURAL PLATE

1906.1 DESCRIPTION

This specification covers asphalt coated corrugated metal pipe, pipe arches, coupling bands and structural plate. The following four types of treatments are included:

Type A. Fully Asphalt Coated
Type B. Half Asphalt Coated with Paved Invert
Type C. Fully Asphalt Coated with Paved Invert
Type D. Fully Asphalt Coated and 100%t Paved or Lined

1906.2 REQUIREMENTS

a. Provide “Type A” coated pipe unless otherwise specified in the Contract Documents.

b. Supply asphalt coated corrugated metal pipe, pipe arches, coupling bands and structural plate complying with AASHTO M 190 with the following revisions or additions:

(1) Asphalt coat only corrugated metal pipe, pipe arches, coupling bands and structural plate that comply with the applicable **SECTIONS 1904** and **1905**.

(2) Do not apply the Imperviousness Test in AASHTO M 190.

c. As an alternate, coat corrugated structural plate in accordance with AASHTO M 243.

1906.3 TEST METHODS

Test in accordance with the methods shown in AASHTO M 190 and/or M 243.

1906.4 PREQUALIFICATION

None Required

1906.5 BASIS OF ACCEPTANCE

Asphalt coated corrugated metal pipe, pipe arches, coupling bands and structural plates are accepted based on receipt and approval of a Type D certification as specified in **DIVISION 2600** and visual inspection for conditions and dimensional requirements.

SECTION 1907

PLASTIC PIPE FOR UNDERDRAINS, OUTLETS AND DRAIN TILE

1907.1 DESCRIPTION

This specification covers polyvinyl chloride (PVC) pipe for use in underdrain, pavement edge drain, and outlet installations. Polyethylene (PE) is also permitted for edge drains.

1907.2 REQUIREMENTS

a. Underdrain Pipe. Provide perforated polyethylene or polyvinyl chloride underdrain pipe and fittings in the diameter shown in the Contract Documents that complies with ASTM F 891 for polyvinyl chloride, except the minimum pipe stiffness required is 100 psi, at 5% deflection, for PVC pipe.

b. Outlet Pipe. Provide a smooth interior walled pipe in the diameter shown in the Contract Documents that complies with ASTM F 891 for polyvinyl chloride, except the minimum pipe stiffness required is 100 psi, at 5% deflection, for PVC pipe.

c. Drain Tile. Provide perforated polyethylene drain tile and fittings in the diameter shown in the Contract Documents that complies with AASHTO M 252 or M 294 for perforated polyethylene pipe.

1907.3 TEST METHODS

Test pipe supplied for this specification according to the procedures referenced and outlined in AASHTO M 252, AASHTO M 294, and ASTM F 891.

1907.4 PREQUALIFICATION

None Required.

1907.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600.**
Visual inspection for conditions and dimensional requirements.

SECTION 1908

POLYETHYLENE (PE) PIPE

1908.1 DESCRIPTION

This specification covers polyethylene pipe for storm sewers and culverts.

1908.2 REQUIREMENTS

a. Polyethylene Pipe. Provide polyethylene (PE) pipe for storm sewers and culverts that complies with one of the following:

(1) AASHTO M 294 (Corrugated Pipe) with the following additions or exceptions:
- Only Type S is acceptable.
- Rotational Molded Pipe will not be accepted.

(2) ASTM F 894 (Ribbed, Profile) with the following additions or exceptions:
- AASHTO LRFD Bridge Design Specifications, SECTION 12, 50 year life requirements.
- Minimum Cell Class per ASTM D 3350 of 334433C or 335434C.
- Minimum section properties as noted in SECTION 12.

(3) ASTM F 714 (Smooth Wall) with the following additions or exceptions:
- A DR of 21 or less will be required.
- AASHTO LRFD Bridge Design Specification, SECTION 12, 50 year life requirements.
- Minimum Cell Class per ASTM D 3350 of 335434C.

(4) Soil tight joints are required (AASHTO LRFD Bridge Construction Specifications, SECTION 26).
- Maximum opening is 1 inch.
- For openings over 1/8-inch, exceed the channel length by four times the length of the opening. Channel length is the length of the path that the soil must infiltrate.
- The D_{85} soil size to size of opening ratio must be 0.3 for medium to fine sand and 0.2 for uniform sands. D_{85} is the sieve size that 85% of the backfill material is smaller than.

b. Joints. To obtain soil tight joints, manufacture the pipe joints to comply with the following:
- Maximum opening is 1 inch.
- For openings over ⅛-inch, exceed the channel length by 4 times the size of the opening. Channel length is the length of the path that the soil must infiltrate.

c. End Sections. Provide culvert end sections that comply with the sizes and dimensions in the Contract Documents. Fabricate end sections from materials that comply with these specifications. Corrugated metal or concrete end sections are also acceptable. Connect dissimilar materials using a soil-tight connection approved by the Engineer.

d. Deflection. Maximum deflection (reduction of the barrel base inside diameter) is 5%. Measurement will be made using a mandrel or other method as approved by the Engineer not less than 30 days following the installation. Deflections in excess of 5% may require the pipe to be removed and reinstalled, or replaced if permanently deformed or damaged in any way.

1908.3 TEST METHODS

Test materials in accordance with the AASHTO and ASTM standards cited in **subsection 1908.2**.

1908.4 PREQUALIFICATION

Follow the instructions on the AASHTO National Transportation Product Evaluation Program's (NTPEP) website to participate in the audit program for polyethylene (PE) pipe plants.

Forward an official copy of the initial (and latest) NTPEP audit report to the Bureau Chief of Construction and Materials for evaluation. Include copies of the most recent six months of quality control test results.

In order to maintain prequalified status, send a copy of the annual NTPEP certificate of compliance as soon as it is received. Plants that have been removed from the NTPEP website listing will be removed from prequalified status.

Plants that fail to provide the annual certificate of compliance or are no longer in compliance with the audit requirements may be removed from prequalified status.

1908.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1908.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Visual inspection for condition and dimensional requirements.

Successful testing with a mandrel as outlined in **subsection 817.3b**.

SECTION 1909

POLYVINYL CHLORIDE (PVC) PIPE

1909.1 DESCRIPTION

This specification covers polyvinyl chloride pipe (PVC) for storm sewers and culverts.

1909.2 REQUIREMENTS

a. Polyvinyl Chloride Pipe. Provide polyvinyl chloride (PVC) for storm sewers and culverts that comply with one of the following:

(1) AASHTO M 304 (Profile Wall) with the following additions or exceptions:

- Seamless construction will be required; spiral wound pipe will not be allowed.
- ASTM D 1784, use only Cell Classification of 12454C.

(2) AASHTO M 278 (Smooth wall), or ASTM F 679 (Large Diameter Sewer Pipe).

- ASTM D 1784, use only Cell Classification of 12454.

b. Joints. To obtain soil tight joints, manufacture the pipe joints to comply with the following:

- Maximum opening is 1 inch.
- For openings over ⅛-inch, exceed the channel length by 4 times the size of the opening. Channel length is the length of the path that the soil must infiltrate.

c. End Sections. Provide only corrugated metal or precast concrete end sections that comply with the sizes and dimensions in the Contract Documents, and applicable **SECTION 1902** or **1904**. Connect the dissimilar materials using a soil tight connection approved by the Engineer.

1909.3 TEST METHODS

Test materials in accordance with the AASHTO and ASTM standards cited in **subsection 1909.2**.

1909.4 PREQUALIFICATION

Follow the instructions on the AASHTO National Transportation Product Evaluation Program's (NTPEP) website to participate in the audit program for polyvinyl chloride (PVC) pipe plants.

Forward an official copy of the initial (and latest) NTPEP audit report to the Bureau Chief of Construction and Materials for evaluation. Include copies of the most recent six months of quality control test results.

In order to maintain prequalified status, send a copy of the annual NTPEP certificate of compliance as soon as it is received. Plants that have been removed from the NTPEP website listing will be removed from prequalified status.

Plants that fail to provide the annual certificate of compliance or are no longer in compliance with the audit requirements may be removed from prequalified status.

1909.5 BASIS OF ACCEPTANCE

Prequalification as specified in **subsection 1909.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

Visual inspection for condition and dimensional requirements.

Successful testing with a mandrel as outlined in **subsection 817.3b**.

SECTION 2001

PORTLAND CEMENT AND BLENDED HYDRAULIC CEMENT

2001.1 DESCRIPTION

This specification governs the requirements for portland and blended hydraulic cement utilized in the production of concrete.

2001.2 REQUIREMENTS

a. General. Cement types are to be designated according to the classifications of AASHTO M 85 for portland and AASHTO M 240 for blended cement.

Utilize Type I, IP(x), IS(x), IT(Ax)(By), II(MH), or III cement as allowed in **SECTION 401**. The "x" and "y" in the previous sentence equals the targeted percentage of pozzolan or slag cement in the product expressed as a whole number by mass of final blended product. Likewise, "A" and "B" are either "S" for slag cement or "P" for pozzolan with "A" being the larger material by mass and "B" the smaller.

A cement type and source must be prequalified before it can be utilized in KDOT projects.

Cements of differing types and or sources cannot be intermixed within any singular component of a structure.

A contractor must have moisture protective facilities to store the cement required for 3 active construction days. The Engineer's representative may waive this requirement if it is determined that a well-regulated supply from the cement producer can be maintained. Any cement that has been contaminated by moisture or reclaimed by any method is not acceptable.

Previously approved cement bulk stored at the source plant or terminal for over 6 months or in bulk or packaged and stored at a contractor or distributor facility for over 3 months after the initial test date is subject to re-sampling, testing, and the requirements of this subsection.

Cement stored at facilities, other than those described in the foregoing, before the initiation of construction or delivered to such facilities during construction of KDOT projects is to be sampled and tested and is subject to the requirements of this Section. This requirement may be waived if certifications documenting that the cement is a prequalified type from a prequalified source are provided to the Engineer's representative.

b. Portland Cement. Provide Type I, Type II(MH), and Type III portland cement that comply with all applicable requirements (including the optional chemical and physical requirements, annexes, and appendices) of AASHTO M 85, except as modified by the following:

(1) The time of setting may be determined by use of the Gillmore needles method (AASHTO T 154), or the Vicat needle method (AASHTO T 131). Identify which method is being used on the report. KDOT will test using the Gillmore method.

(2) Optimized SO_3 – Provide supporting expansion data whenever SO_3 results exceed the requirements stated in AASHTO M 85, Table 1.

(3) If processing additions are used, report the percentage, composition, and the source of the additions in writing to KDOT.

(4) Heat of hydration requirements as stated in AASHTO M 85, Table 4 will not be enforced.

c. Blended Hydraulic Cement. Supply blended hydraulic cements Type IP(x), Type IS(x), and Type IT(Ax)(By) that comply with AASHTO M 240 except as modified by the following:

(1) Provide a written statement specifying the proportions and materials being blended to produce the blended hydraulic cement, and that the amount of pozzolan or slag cement in the finished cement will not vary more than ± 5.0% by weight of the finished cement from lot to lot or within a lot.

(2) Report the amount retained on the No. 325 sieve, and the fineness by the air permeability method in accordance with the procedures specified in ASTM C 204 at the time of shipment.

(3) Mortar expansion of the finished cement must be within the limits included in Table 2 of AASHTO M240 or the job specific mixture requirements in **subsection 2001.2d.(1)(d).**

(4) The equivalent alkalis, as defined in Table 2 of AASHTO M 85, may not exceed 1.5% in any application. For prequalification, or to increase the equivalent alkalis above current production levels, submit results from ASTM C 441 testing showing mortar expansion within the limits in Table 2 of AASHTO M 240 for the maximum

equivalent alkalis level intended for production. Submit a sample to the Engineer of Tests for verification testing. Monthly quality control test reports will be monitored to verify the equivalent alkalis level of regular production remains below this maximum level. If production at a higher level is desired, complete requalification which establishes a new maximum limit will be required.

d. Field Blended Cements.

(1) Cements for use in concrete that are blended in the field by substituting any pozzolan or slag cement for portland cement whether in the mixer or otherwise, must comply with the following:

(a) Provide a written statement specifying the proportions and materials being blended to produce the total cementitious content, and that the amount of pozzolan or slag cement will not vary more than ± 1.0% by weight of the total cement from batch to batch.

(b) Use portland cement or blended hydraulic cement from sources prequalified under this specification.

(c) Use pozzolan or slag cement from approved or prequalified sources.

(d) Test and provide project mix design results complying with **SECTION 401**.

(e) Concrete made with these mixtures is subject to strength and other requirements detailed in other parts of the specifications.

(2) Silica fume, which is specified elsewhere, is excluded from the requirements in **subsection 2001.2d.(1)**.

(3) Refer to **SECTION 401** for more specific information regarding the substitution of any pozzolan or slag cement for portland cement as a field blended cement.

2001.3 TEST METHODS

Conduct all tests required by the applicable AASHTO, ASTM or other specifications of **subsection 2001.2** according to the procedures specified in that standard. Field sample cement in accordance with the procedures of Part V, KT-29. Obtain all other cement samples in accordance with the requirements and procedures of ASTM C 183.

2001.4 PREQUALIFICATION

a. Becoming Prequalified.

(1) Submit the following to the Engineer of Tests:

(a) A copy of the quality control plan for the source. The plan should include information on what cement types are produced, where and how sampling is done, frequency, and what standards (AASHTO, ASTM, etc.) are applied.

(b) A 2-gallon sample of each cement type produced by the source and permitted through this Section that is representative of the product intended for use on KDOT projects.

(c) Certified quality control test results of cement, by type, that was produced by the source during the 6 months immediately before the prequalification request. Provide the high, low and average values or statistical analysis for each month.

(d) Documentation of the source nominal cement production levels, by quantity of each type produced, for the 6 months preceding the prequalification request.

(e) Documentation of routine Cement and Concrete Reference Laboratory (CCRL) inspection of the source laboratory performing the cement quality control testing. Include the results of the most recent evaluation.

(f) The names of the individuals responsible for the quality control for cement production at the source.

(2) Submit monthly quality control reports for all prequalified cement Types within 2 weeks after completion of testing. Include supporting expansion data whenever SO_3 results exceed the requirements stated in AASHTO M 85, Table 1. Also include a summary of the amount, composition, and source of all processing additions used for each type of cement manufactured during the month. If none were used, report that fact also.

(3) Prequalification of a cement source, by type, will be based on cement produced when the source is utilizing specific materials, equipment and processes. Any change in materials, materials sources, equipment or processes voids the source prequalification, and a new prequalification will be required.

b. Maintaining Prequalified Status. After a cement source has acquired prequalified status, the source will be permitted to provide cement, by prequalified type, for use on KDOT projects provided the following conditions are complied with:

(1) The quality-monitoring program meets the minimum sampling and testing frequencies established in ASTM C 183. This frequency may be altered somewhat with the approval of the Bureau Chief, Construction and Materials.

(2) Submit monthly quality control reports for all prequalified cement types within 2 weeks after completion of the testing. Include a summary of the amount, composition and source of all process additions used under ASTM C 465 for each type of cement manufactured during the month. If none were used, report that fact also.

(3) Utilize an approved laboratory to conduct quality control tests. The laboratory will be considered approved if it is properly equipped, has the capabilities to perform the tests required through this subsection and is routinely inspected through the CCRL program. Continued approval of the control laboratory and the source, by cement type, will depend on satisfactory comparison of its test results with the results obtained by the Materials and Research Center on random verification samples of cement produced by the source.

(4) The source has not changed materials, material sources, equipment, or processes since prequalification.

2001.5 BASIS OF ACCEPTANCE

a. Prequalification as specified in **subsection 2001.4**.

b. A proper certification must accompany each shipment of cement. Provide a copy of the bill of lading which includes the following certification statement and the signature of a responsible source representative to the Field Engineer responsible for the project.

Certification Statement

The material herein has been sampled and tested as prescribed by KDOT and complies with the applicable specification requirements for Type __ cement in accordance with the requirements of AASHTO_______.

Date________________ Signed_______________________________

If a processing addition is used in the manufacture of the cement, include the following as a part of the certification statement:

A processing addition, consisting of __% of ______________ and complying with the requirements of AASHTO M 85, has been used in the manufacture of this cement.

c. Identify the bills of lading with a project number, and denote the cement source, the type, and the quantity in the shipment. Retain this copy at the project or Contractor or distributor facility for the Engineer's representative’s records.

d. In the case of more than one project being supplied by a contractor or distributor facility, the facility must provide the Engineer's representative either a copy of the bill of lading, or a signed listing of the bills of lading representing the cement, by type and source, incorporated into each project.

Note: Verification samples will be obtained by KDOT personnel at the project site. Test results that do not comply with the specifications of this subsection may be considered sufficient cause to rescind approval to furnish cement, by type, on a certification basis.

SECTION 2002

HYDRATED LIME

2002.1 DESCRIPTION

This specification covers hydrated lime suitable for use in mortar, portland cement concrete and the treatment of soil, soil-aggregate and asphalt mixtures.

2002.2 REQUIREMENTS

a. General. Ship and store lime in moisture proof containers. Lime that has become partially set or caked will be rejected.

b. Hydrated Lime for Mortar and Concrete. Provide Type N, normal finishing hydrated lime that complies with ASTM C 206.

c. Hydrated Lime for Treating Soil, Soil-Aggregate and Asphalt Mixtures.

(1) Hydrated lime for this purpose is any hydrated lime product consisting of hydrated lime and insoluble inert material and complying to the following:

- Available Lime Index as Calcium Hydroxide, %, min 90

(2) Hydrated lime for treating soil, soil-aggregate and cold in-place recycle asphalt pavement may be manufactured at the jobsite by slaking pebble quicklime. Use equipment specifically manufactured for this purpose and approved by the Field Engineer. Provide a certification stating the purity of the load with each load of quicklime.

Verification sampling of the pebble quicklime is required on the basis of 1 sample per 10 loads. Identify the sample as raw material for lime slaking, and submit a one quart sample with the certification for the load sampled to the MRC for comparison to the laboratory test.

(3) Carbide lime may also be used for treating soil and soil-aggregate. Carbide lime is hydrated lime created as a by-product of acetylene gas manufacturing. It is a relatively pure form of hydrated lime and retains approximately 50% moisture indefinitely after the manufacturing process. Its consistency at delivery is that of a flowable to semi-flowable paste which can be spread evenly over the subgrade. Provide hauling equipment that can be sufficiently sealed to prevent loss of the material during transportation.

During loading of the material, thoroughly mix the upper crust with the lower portions to provide a consistent product. The solids portion of the carbide lime material must comply with all chemical and physical requirements of **subsection 2002.2c** above, except as noted below.

Determine the percent solids of the material by using a rapid method (e.g. microwave), approved by the Engineer. Represent the quantity of material by randomly selecting 1 test per 5 loads for pay, and for determining the rate of application. Provide a copy of each test report to the Engineer along with copies of the weigh tickets represented. If the material demonstrates consistent percent solids content, a reduced testing frequency may be requested according to Part V. Periodic unannounced check tests for moisture content will be conducted by the Engineer.

Verification sampling of carbide lime is required on the basis of 1 sample per 10 loads. Place a one quart sample in a sealed, airtight container and forward it to the MRC for analysis.

The source of carbide lime used on a project must be tested and approved prior to use. The Engineer will take a representative sample of the material and forward it to the MRC for analysis. The source may be approved without testing if the material is currently being used on another KDOT project and has already been tested and approved.

If the available lime index falls below 90% during source qualification or verification testing, the first occurrence will be reported as non-comply (NCPL), and the Project Engineer will be notified. The DME may allow continued use of the source, and adjust the application and pay rates based on the test results, or may require the Contractor to use lime in another form or from another source. All subsequent verification samples from the same source that fail the available lime index will be reported as pass, attention advised (PAAA).

(4) Gypsum may be added, no more than 1% by weight, to assist in the pumpability of the lime slurry. If gypsum is used, it shall be incorporated into the process prior to slaking. Any addition of gypsum will be considered subsidiary to the Contract Documents.

2002.3 TEST METHODS

Sample and test according to the following methods:

- Chemical Analysis .... ASTM C 25
- Sampling, other than field .... ASTM C 50
- Sampling, Field KT-29
- Physical Tests .... ASTM C 110

2002.4 PREQUALIFICATION

None required, except for source qualification of carbide lime as outlined above. No prequalified lists are maintained for any hydrated lime products.

2002.5 BASIS OF ACCEPTANCE

a. Hydrated Lime.

(1) Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

b. Pebble Quicklime (for slaking).

(1) Receipt and approval of the certified lime purity for each load of quicklime.
(2) Visual inspection of the final product in the field.

c. Carbide Lime (for use as hydrated lime).

(1) Approval of the source as outlined in **subsection 2002.2c(3)**.
(2) Receipt and approval of a Type C certification as specified in **DIVISION 2600**.
(3) Visual inspection of the material in the field.
(4) Adjustments for moisture and available lime index as outlined in **subsection 2002.2c(3)**.

SECTION 2003

PEBBLE QUICKLIME

2003.1 DESCRIPTION

This specification covers pebble quicklime suitable for treatment of soil and soil-aggregate mixtures for purposes of stabilization. Pebble quicklime is a calcined material, the major part of which is calcium oxide or calcium oxide in natural association with a lesser amount of magnesium oxide capable of slaking with water. This specification applies specifically to lime made from calcium type limestone.

2003.2 REQUIREMENTS

Provide material that complies with the requirements of AASHTO M 216. When pebble quicklime is used as lime slurry, gypsum may be added (no more than 1% by weight) to assist in pumping the material. If Gypsum is used, incorporate into the process prior to slaking. Any addition of gypsum is considered subsidiary to the Contract Documents.

2003.3 TEST METHODS

Test according to the applicable provisions of ASTM C 25 and ASTM C 110.

2003.4 PREQUALIFICATION

Not Required.

2003.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

Satisfactory performance in the field.

SECTION 2004

FLY ASH FOR USE IN CONCRETE

2004.1 DESCRIPTION

This specification covers fly ash that may be used as a partial replacement for portland cement and blended hydraulic cement in concrete, when allowed by other parts of the Contract Documents.

2004.2 REQUIREMENTS

a. Fly ash sources must be prequalified.

b. Provide material that complies with the chemical and physical requirements of ASTM C 618, Class C or Class F, except the loss on ignition may not exceed 3.0%. The supplementary optional physical requirements apply, except that with the "Effectiveness in Controlling Alkali-Silica Reaction," the expansion of the test mixture as a percentage of the low-alkali cement control at 14 days may not exceed 120%. Conduct this testing with 15% fly ash and a Type I/II cement with an alkali content between 0.40% and 0.44%.

c. The quality-monitoring program must comply with the minimum sampling and testing frequencies established in ASTM C 311. This frequency may be altered slightly with the approval of the Bureau Chief of Construction and Materials, provided the monitoring intent of ASTM C 311 is met or exceeded.

d. There are other requirements that must be met for the fly ash/cement mixture in addition to those cited above for qualification of the fly ash alone. Additional testing will be required for specific applications. Consult the Contract Documents before proposing the use of fly ash in concrete.

2004.3 TEST METHODS

Sample and test fly ash according to ASTM C 311. Field sample according to Part V, KT-29.

2004.4 PREQUALIFICATION

a. Becoming Prequalified.

(1) Submit the following to the Engineer of Tests:

(a) A copy of the quality control plan for the source. The plan should include information on where and how sampling is performed, frequency, and what standards (ASTM, etc.) are used.

(b) A 2-gallon sample of fly ash representative of material intended for use on KDOT projects.

(c) Certified test results of fly ash produced by the power plant during the 6 months immediately before the prequalification request. Show the high, low and average values or statistical analysis for each month.

(d) Written information regarding the sources of coal utilized in the production of fly ash for the preceding 6 months, and that anticipated for the future.

(e) Written evidence of the latest Cement and Concrete Reference Laboratory (CCRL) inspection of the laboratory performing the fly ash testing.

(2) The Engineer of Tests will test the submitted sample and review the information submitted by the source, for compliance with the Contract Documents. The Bureau Chief of Construction and Materials will notify the source of the results in writing. Power plants complying with all requirements will be placed on a list of prequalified fly ash sources maintained by the Bureau of Construction and Materials.

(3) Prequalification of the source of fly ash will be based on material produced when the power plant is using specific materials, equipment and processes. Any change in materials, materials sources, equipment or processes voids the source prequalification, and a new prequalification will be required.

b. Maintaining Prequalified Status. After a fly ash source has gained prequalified status, the source will be permitted to furnish fly ash for use on KDOT projects provided the following conditions are met.

(1) Submit quality monitoring test reports monthly for all monitoring samples.

(2) Use an approved laboratory to conduct quality control tests. The laboratory will be considered approved if it is properly equipped, has the capabilities to perform the tests required by the Contract Documents and is regularly inspected by the CCRL program. Continued approval of the control laboratory and the source will depend on satisfactory comparison of its test results with the results obtained by the Materials and Research Center.

(3) The source has not changed materials, material sources, equipment or processes since prequalification.

2004.5 BASIS OF ACCEPTANCE

a. Prequalification as specified in **subsection 2004.4**.

b. A proper certification must accompany each shipment of fly ash. Provide to the Field Engineer 2 copies of the bill of lading which includes the following certification statement and the signature of a responsible company representative.

Certification Statement

The material herein has been sampled and tested as prescribed by KDOT and complies with the applicable specification requirements for Class ___ fly ash.

Date________________ Signed_______________________________

Identify the bills of lading with a project number, and denote the fly ash source, the type and the quantity in the shipment. Retain these copies at the project or ready mix plant for the Field Engineer's records.

In the case of more than one project being supplied by a ready mix plant, the plant must provide the Field Engineer with a copy of the bill of lading, or a signed listing of the bills of lading representing the fly ash incorporated in each project.

Note: Verification samples will be obtained by KDOT personnel at the project site. Test results which do not comply with the Contract Documents may be considered sufficient cause to rescind approval to furnish fly ash on a certification basis.

SECTION 2005

FLY ASH FOR STABILIZATION, MODIFICATION AND COLD RECYCLE ASPHALT MATERIAL

2005.1 DESCRIPTION

This specification covers fly ash which is suitable for treatment of sub-grade stabilization and modification, and cold recycle asphalt material. Using fly ash to improve strength is the primary benefit for cold recycle asphalt material and sub-grade stabilization. Changing the moisture sensitivity of sub-grade is the primary benefit of modification, however; soil strength improvements are also expected. Fly ash is a finely divided residue that results from the combustion of ground or powdered coal.

2005.2 REQUIREMENTS

a. General. Comply with the physical requirements of ASTM D 5239, paragraph 6.4, and the chemical requirements of ASTM C 618, Table 1, for Class C fly ash. Sample and test production a minimum of once per month for quality control.

b. Fly Ash for Stabilization and Cold Recycle. Do not use fly ash as a substitute for lime. Meet or exceed a compressive strength of 500 psi at 7 days.

c. Fly Ash for Modification. Meet or exceed a compressive strength of 100 psi at 7 days.

d. Storage and Handling. Store and handle fly ash in closed waterproof containers before distribution on the roadway or fill. Other methods of storage and handling are subject to the approval of the Engineer. Partially caked or set fly ash is unacceptable for use.

2005.3 TEST METHODS

Sample the fly ash using KT-29. Test the chemical composition of fly ash in accordance with ASTM C 311. Test physical properties of fly ash by ASTM D 5239, paragraph 6.4.

2005.4 PREQUALIFICATION

New sources, sources that have not been used on a KDOT project within the last 12 months, and sources which have allowed the required monthly reporting of quality control test results to lapse, must be prequalified. Submit certified analyses of the quality control tests completed during the 90 day period immediately prior to the prequalification request. Certified analyses are defined as representative materials tested by a laboratory regularly inspected and certified by the Cement and Concrete Reference Laboratory (CCRL).

Forward the certified analyses and a 2-quart sample to the Engineer of Tests. The sample will be tested in accordance with this specification, and compared to the certified analysis of the quality control test.

If the material satisfies all requirements, the source will be placed on a prequalified list. Monthly results of the producers quality control testing are required to be forwarded to the Bureau of Construction and Materials to maintain status on the prequalified list. Active sources will remain on the prequalified list so long as verification samples and monthly test results comply with all requirements and indicate acceptable quality control.

2005.5 BASIS OF ACCEPTANCE

Prequalification as required by **subsection 2005.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

SECTION 2006

SILICA FUME

2006.1 DESCRIPTION

This specification covers silica fume, or microsilica, that may be used as a partial replacement for portland cement and blended hydraulic cement in concrete, when allowed by other parts of the Contract Documents. Silica fume is a by-product resulting from the reduction of high purity quartz with coal in electric arc furnaces in the manufacture of silicon and ferrosilicon alloys.

2006.2 REQUIREMENTS

Provide material which complies with ASTM C 1240.

2006.3 TEST METHODS

As specified in ASTM C 1240.

2006.4 PREQUALIFICATION

a. Sources of silica fume must be prequalified. Submit certified analyses of the quality control tests completed during the 6-month period immediately before the prequalification request. Certified analyses are defined as the range of test results of the properties specified above on representative materials tested by a laboratory which is regularly inspected and certified by the Cement and Concrete Reference Laboratory (CCRL). Include mill certifications for the raw material.

b. Forward the certified analysis to the Bureau Chief of Construction and Materials. If the material satisfies all requirements, the source will be placed on a prequalified list.

c. Verification samples will be taken by each District, at the rate of one per year, for each silica fume producer supplying material to that District's projects.

d. Semi-annual results of the producer’s quality control testing, as defined above, are required to be forwarded to the Bureau of Construction and Materials to maintain status on the prequalified list. Sources will remain on the prequalified list, so long as verification samples and semi-annual test results complies with all requirements, and indicate acceptable quality control.

2006.5 BASIS OF ACCEPTANCE

a. Prequalification as specified in **subsection 2006.4**.

b. Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

SECTION 2007

SLAG CEMENT FOR USE IN CONCRETE AND MORTARS

2007.1 DESCRIPTION

This specification covers slag cement for use in concrete and mortars.

2007.2 REQUIREMENTS

Provide material that complies with the requirements of ASTM C 989, "Slag Cement for Use in Concrete and Mortars."

2007.3 TEST METHODS

As specified in ASTM C 989.

2007.4 PREQUALIFICATION

a. Manufacturers desiring to provide material under this specification are to submit the following to the Engineer of Tests:

(1) A 2-gallon prequalification sample of each product they wish to prequalify.

(2) Complete instructions on the use of the material and a Material Safety Data Sheet (MSDS).

(3) Copies of quality control test reports for the 6 months before to the date of submittal to substantiate a history of satisfactory quality control. Also, provide evidence that the quality control laboratory is regularly inspected by the Cement and Concrete Reference Laboratory (CCRL).

b. If the prequalification samples comply with the requirements of **subsection 2007.2**, and the other submittals are satisfactory, the name of the product will be placed on a list of prequalified products maintained by the Bureau of Construction and Materials.

c. A prequalified plant will retain its prequalified status as long as test results of random samples obtained by KDOT and quality control samples obtained by the producer indicate that the plant is exercising acceptable quality control.

d. A terminal established by a prequalified plant will be considered prequalified to supply slag cement under this specification.

2007.5 BASIS OF ACCEPTANCE

Prequalification as required by **subsection 2007.4**.

Receipt and approval of a Type C certification as specified in **DIVISION 2600.**

2008 – BLENDED SUPPLEMENTARY CEMENTITIOUS MATERIALS FOR USE IN CONCRETE

SECTION 2008

BLENDED SUPPLEMENTARY CEMENTITIOUS MATERIALS FOR USE IN CONCRETE

2008.1 DESCRIPTION

This specification covers blended supplementary cementitious materials (SCMs) that may be used as a partial replacement for portland cement in concrete, when allowed by other parts of the Contract Documents.

2008.2 REQUIREMENTS

a. All individual SCMs to be blended must be prequalified according to **DIVISION 2000**.

b. Provide material that complies with the chemical and physical requirements of ASTM C 1697, except the loss on ignition may not exceed 3.0%. The supplementary optional physical requirements apply, except that with the "Effectiveness in Controlling Alkali-Silica Reaction," the expansion of the test mixture as a percentage of the low-alkali cement control at 14 days may not exceed 120%. Conduct this testing with 15% blended supplementary material and a Type I/II cement with an alkali content between 0.52% and 0.60%. Do not vary the amount of pozzolan or slag cement in the finished blended supplementary cementitious material from the target value by more than 2.5% for silica fume and not more than 5% for other supplementary cementitious materials.

c. The quality-monitoring program must comply with the minimum sampling and testing frequencies established in **DIVISION 2000** for the individual materials being blended. If the required sampling and testing frequencies of two or more SCMs vary, the sampling and testing plan of the SCM with the higher frequency will govern. This frequency may be altered with the approval of the Bureau Chief of Construction and Materials, provided the monitoring intent of each material is met or exceeded.

d. There are other requirements that must be met for the blended supplementary cementitious materials /cement mixture in addition to those cited above for qualification of the blended supplementary cementitious materials alone. Additional testing will be required for specific applications. Consult the Contract Documents before proposing the use of blended supplementary cementitious materials in concrete.

2008.3 TEST METHODS

Sample and test blended supplementary cementitious materials according to **DIVISION 2000**. Field sample according to Part V, KT-29.

2008.4 PREQUALIFICATION

a. Becoming Prequalified. Each supplemental cementitious material to be blended must be prequalified for use by KDOT on an individual basis prior to approval of the blended SCMs. Refer to **DIVISION 2000** for prequalification requirements for each individual type of material. Each blended SCM must also be prequalified as follows:

(1) Submit the following to the Engineer of Tests:

(a) A copy of the quality control plan for the source. The plan should include information on where and how sampling is performed, frequency, and what standards (ASTM, etc.) are used.

(b) A 2-gallon sample of blended product representative of material intended for use on KDOT projects.

(c) Certified test results of SCM produced by the material source during the 6 months immediately before the prequalification request. Show the high, low and average values or statistical analysis for each month.

(e) Written evidence of the latest Cement and Concrete Reference Laboratory (CCRL) inspection of the laboratory performing the SCM testing.

(2) The Engineer of Tests will test the submitted sample and review the information submitted by the source, for compliance with the Contract Documents. The Bureau Chief of Construction and Materials will notify the source

of the results in writing. Sources complying with all requirements will be placed on a list of prequalified blended supplemental cementitious materials sources maintained by the Bureau of Construction and Materials.

(3) Prequalification of the source of product will be based on material produced when the material producer is using specific materials, equipment and processes. Any change in materials, materials sources, equipment or processes voids the source prequalification, and a new prequalification will be required.

b. Maintaining Prequalified Status. After a source has gained prequalified status, the source will be permitted to furnish the product for use on KDOT projects provided the following conditions are met.

(1) Submit quality monitoring test reports monthly for all monitoring samples.

(2) Use an approved laboratory to conduct quality control tests. The laboratory will be considered approved if it is properly equipped, has the capabilities to perform the tests required by the Contract Documents and is regularly inspected by the CCRL program. Continued approval of the control laboratory and the source will depend on satisfactory comparison of its test results with the results obtained by the Materials and Research Center.

(3) The source has not changed materials, material sources, equipment or processes since prequalification.

2008.5 BASIS OF ACCEPTANCE

a. Prequalification as specified in **subsection 2008.4**.

b. A proper certification must accompany each shipment of blended product. Provide to the Field Engineer 2 copies of the bill of lading which includes the following certification statement and the signature of a responsible company representative.

Certification Statement

The material herein has been sampled and tested as prescribed by KDOT and complies with the applicable specification requirements for Blended Supplementary Cementitious materials with the following designation: ____________.

Date________________ Signed_______________________________

Identify the bills of lading with a project number, and denote the product source, the type and the quantity in the shipment. Retain these copies at the project or ready mix plant for the Field Engineer's records.

In the case of more than one project being supplied by a ready mix plant, the plant must provide the Field Engineer with a copy of the bill of lading, or a signed listing of the bills of lading representing the blended product incorporated in each project.

Note: Verification samples will be obtained by KDOT personnel at the project site. Test results which do not comply with the Contract Documents may be considered sufficient cause to rescind approval to furnish blended supplementary cementitious material on a certification basis.

SECTION 2101

TOPSOIL

2101.1 DESCRIPTION

This specification covers the material requirements for topsoil.

2101.2 REQUIREMENTS

Topsoil is the top six inches of field or pasture loam and has a good supply of humus along with a high degree of fertility. Good topsoil has a loose crumbly structure.

- Topsoil handled too wet or soggy are not acceptable.
- Soils from ditch bottoms, drained ponds or eroded areas are not acceptable.
- Soils supporting growth of noxious weeds, as defined by The Kansas Seed Law, or undesirable weeds, are not acceptable.

2101.3 TEST METHODS

None Specified.

2101.4 PREQUALIFICATION

None Specified.

2101.5 BASIS OF ACCEPTANCE

Visual inspection by the Engineer for compliance with this specification.

SECTION 2102

PLANTS

2102.1 DESCRIPTION

Material requirements for Plants.

2102.2 REQUIREMENTS

a. General.

(1) Referenced Specifications and Standards:

(a) DataScape Guide to Commercial Nomenclature, latest edition, American Nurseryman Publishing Co.

(b) American Standard for Nursery Stock, latest edition, American National Standards Institute, Inc.: ANSI Z60.1

(2) Quality and Size. Provide plants that comply with all applicable portions of ANSI Z60.1. Only plants free of noxious weeds, insect infestations, mechanical injury, diseases, or defects are acceptable for use under this specification. Plant growth is to be vigorous, symmetrical and typical for the species.

Provide the minimum acceptable size specified in the Contract Documents, measured before pruning and with branches in normal position. Larger plants may be substituted, at no change in the Contract unit price, if approved by the Engineer.

(3) Container Plants. Container grown nursery plants may be substituted for balled and burlapped plants if approved by the Engineer.

(4) Inspection of Plants. Plants must comply with any permits, certifications or inspections required by State, Federal or other authorities. Inspection by the Engineer of all plants may be done at any time before final planting. Immediately remove rejected plants from the project site.

Identify the plant's genus, species, cultivar and common name with a tag attached to each plant or attached randomly in groups of smaller plants.

Plants held in storage will be rejected if they show signs of shriveled and dry tops or roots, or if the plant has new growth that developed while in storage. Move deciduous plants from the nursery field before leaf buds have opened. Deciduous plants moved after leaf buds have opened will be rejected, unless written approval is provided by the Engineer.

b. Balled and Burlapped Plants (B & B). Balls must be firm, natural and completely wrapped with jute, flax or hemp burlap. Do not wrap using plastic or polyethylene fabric wrapping. Secure the burlap with rope, twine or wire to hold the ball in a firm, rigid condition. Balls that are crushed, deformed or broken will be rejected. Only nursery stock that has been harvested during the current planting season is acceptable.

The Engineer may accept plants with root balls smaller than specified if the plants were grown in "root control, in-ground containers." Remove the fabric bag for root controlled plants and secure the earth ball with burlap before planting.

c. Container Plants. Provide only plants grown in the container for a minimum of 4 months. When the plant is removed from the container for planting, the soil mixture must remain intact with the root system reaching the sides of the container. Do not use plants with a heavy, twisted root mass circling the bottom of the container.

d. Bare Root Plants. Provide nursery grown plants with well branched root systems which are characteristic of the species presented. Saturate the root system with an anti-transpirant gel or treat with acrylates and protect from moisture loss with a suitable covering.

e. Transplanting Established Materials. All established trees, shrubs, and other plants on a project that are to be transplanted are indicated in the Contract Documents. The method of moving will be shown, such as B & B. Use the ball and burlap method when transplanting out of season or when the plants are leafed out. B & B is always used when transplanting evergreen plants.

During the planting season, small plants and trees, 2 inch caliper or less, may be transplanted “bare-root.” Exceptions to “bare root” planting are shown in the Contract Documents. When transplanting “bare root,” dig the plant with a root spread ⅓ greater than that required for nursery grown plants of the same type, kind and size.

f. Native or Collected Plants. When collected plants are to be supplied, notify the Engineer not less than 5 days before beginning to dig. Dig only inspected and approved plants. The “bare root” requirements of **subsection 2102.2 e**. will apply.

g. Anti-Desiccant (Anti-Transpirant). Treat all evergreens or plants in partial or total leaf with an anti-desiccant at the nursery before digging or in the case of potted plants, before delivery. A certification of treatment by the nursery or the treating agency is to accompany the treated plants. Treat all deciduous plants that break dormancy after delivery but before planting. Apply the polyvinyl chloride complex liquid by dipping or spraying according to the manufacturer’s recommendation.

2102.3 TEST METHODS

None Specified.

2102.4 PREQUALIFICATION

None Required.

2102.5 BASIS OF ACCEPTANCE

a. Initial Acceptance. Visual inspection and measurement of plants by the Engineer and compliance with all applicable provisions of this Section. Additionally, provide the Engineer with the certificate of treatment for plants treated with an anti-desiccant.

b. Final Acceptance. Compliance with the “plant establishment” provisions of **DIVISION 900.**

SECTION 2103

SEEDS

2103.1 DESCRIPTION

This specification covers the material requirements for seeds.

2103.2 REQUIREMENTS

a. General. Provide seeds which comply with the seed and noxious weed laws of the State of Kansas and applicable Kansas Department of Agriculture Rules and Regulations except as specifically noted in this Section**.**

Do not provide Sericea Lespedeza and Multiflora Rose with any seed.

b. Seed Quality and Definitions. Conduct all seed analyses in accordance with rules and regulations as prescribed by the Association of Official Seed Analysts (AOSA) and Kansas Seed Law. The Kansas Seed Law specifies the kind and amount of weed seed permitted; the requirement for a current analysis report; and labeling of all seed to show its purity, germination, date of last germination test, and weed seed content.

Cleaning and conditioning of seed must result in a product that meets or exceeds minimum standards. The product must also be clean enough to plant using existing drilling equipment without further processing.

(1) Kansas Seed Law. The germination test is valid for 9 months after the end of the month the test was made, so long as the seed remains in Kansas.

(2) Federal Seed Law. For seed shipped across state lines, the germination test is valid for 5 months after the end of the month the test was made.

(3) Interpretation of Current Analysis Report. For seed purchased during the valid period of the germination test, the analysis report may be considered current for the full seeding period in effect at the time of purchase. (If seed is purchased March 1, and the valid date expires March 31, the analysis report may be considered current if the seed is planted by April 30, which is the end of the spring seeding period. If the seed is to be planted during a later seeding season, a new germination test is required.) This interpretation may be amended by the Engineer for those projects in which KDOT delayed seeding to a later seeding season. In these situations the seed need not be retested only for the next season.

c. Pure Live Seed (PLS) Requirements and Determination. Compute percent pure live seed (%PLS) by adding percent germination to percent firm or hard seed. Divide the sum by 100. Multiply this product by the percent purity.

$$\%\,PLS = \frac{(\%\,Germ. + \%\,Firm\ or\ Hard\ Seed) \times \%Purity}{100}$$

Minimum PLS requirements are shown in **TABLES 2103-1** and **2103-2.** The Engineer may grant permission to use seeds that fail to comply with the required PLS provided the following conditions are met.

(1) The Contractor can provide suitable evidence to the Engineer that seeds comply with **TABLE 2103-1** or **2103-2** are not readily available.

(2) The Contractor is willing to increase the quantity of seeds, at no additional cost to KDOT, to provide the minimum quantity of PLS required.

d. Origin of Seed. Where named or numbered strains are not available, use of seed from native stands is permitted if the seed is harvested within range of its planting location not to exceed:

(1) 300 miles south, 150 miles north or west and 1500 feet in higher elevation.

(2) Native seed sources must be identified as to state and county where seed was harvested in order to certify location and elevation.

e. Buffalo Grass Seed (Buchloe dactyloides). Buffalo grass seed may be an improved strain, hybrid or named variety as specified on the Contract Documents. Stain with a dye. Treat all buffalo grass seed to enhance germination.

f. Bulk Seed Determination. Determine the amount of bulk seed needed for each bid item based on PLS requirements and the following formula:

$$\text{Total Bulk Mass} = \frac{\text{Bid Item PLS Plan Quantity}}{\text{\% PLS}}$$

2103.3 TEST METHODS

As prescribed by the AOSA and The Kansas Seed Law.

2103.4 PREQUALIFICATION

None Required. Seed supplier must follow all registration and licensing requirements stated in The Kansas Seed Law.

2103.5 BASIS OF ACCEPTANCE

The Engineer will accept each seed shipment to a project work site based on the following:

a. Receipt of a copy of the seed supplier's "Kansas Seed Law Business Registration" certificate.

b. Receipt and approval of a certification from the seed supplier stating the compliance of the supplied seed with this specification and The Kansas Seed Law.

c. Verification that each seed container is labeled as required by The Kansas Seed Law.

d. Verification of compliance with the minimum required % PLS as stated in **TABLE 2103-1** and **2103-2.**

TABLE 2103-1: GRASS SEED

Bid Item	Minimum % PLS
Bluegrass, Kentucky	64.0
Bluestem, Big (Kaw)	35.0
Bluestem, Little (Aldous)	28.0
Bluestem, Sand (Garden)	35.0
Bromegrass, Smooth	72.0
Buffalograss (Sharp's Improved)	72.0
Canarygrass,(Reed)	63.0
Dropseed, Sand	57.0
Fescue, Tall, (K-31), (Rebel II)	80.0
Foxtail, Creeping (Garrison)	60.0
Grama, Blue (Lovington)	21.0
Grama, Sideoats (El Reno)	35.0
Indiangrass (Osage)	42.0
Lovegrass, Sand (Bend)	58.0
Millet, Foxtail	77.0
Ryegrass, Perennial	83.0
Sacaton, Alkali (Salado)	57.0
Sandreed, Big	15.0
Sandreed, Prairie	28.0
Sudangrass	76.0
Switchgrass (Blackwell)(Kanlow)	81.0
Timothy	76.0
Wheatgrass, Intermediate	72.0
Wheatgrass, Streambank (Sodar)	63.0

TABLE 2103-1: GRASS SEED	
Bid Item	**Minimum % PLS**
Wheatgrass, Western (Barton)	60.0
Wheat x Wheatgrass Hybrid (Regreen)(TM)	85.0
Wild-rye, Canada	**
Ryegrass, Common	83.0
Ryegrass, Italian	83.0

** No Industry Standard

TABLE 2103-2: WILDFLOWER SEED		
Common Name	**Bid Item**	**Minimum % PLS**
Golden yarrow	Achillea filipendulina	**
Yarrow	Achillea millefolium	68.0
Red yarrow	Achillea millefolium f. rubra	**
Lead-plant	Amorpha canescens*	**
False-indigo	Amorpha fruticosa*	**
Swamp milkweed	Asclepias incarnata	**
Common milkweed	Asclepias syriaca	**
Butterfly milkweed	Asclepias tuberosa	**
Drummond's aster	Aster drummondii	**
Fendler's aster	Aster fendleri	**
New England aster	Aster novae-angliae	**
Aromatic aster	Aster oblongifolius	**
Azure aster	Aster oolentangiensis	**
Single-stemmed bog aster	Aster paludosus subsp. hemisphericus	**
	Aster patens var. patentissimus	**
Willowleaf aster	Aster praealtus var. praealtus	**
Silky aster	Aster sericeus	**
Blue false-indigo	Baptisia australis var. minor*	**
Plains wild-indigo	Baptisia bracteata var. glabrescens	**
Purple poppy-mallow	Callirhoe involucrata	**
Showy partridge-pea	Cassia chamaecrista*	**
Indian paintbrush	Castilleja coccinea	**
Citron paintbrush	Castilleja purpurea var. citrina	**
Downy paintbrush	Castilleja sessiliflora	**
Cornflower	Centaurea cyanus	80.0
Ox-eye daisy	Chrysanthemum leucanthemum	78.0
Chicory	Cichorium intybus	83.0
Bigflower coreopsis	Coreopsis grandiflora	**
Lance-leaved coreopsis	Coreopsis lanceolata	71.0
Plains coreopsis	Coreopsis tinctoria	83.0
Rough-leaf dogwood	Cornus drummondii	**
Gray dogwood	Cornus foemina	**
Crownvetch	Coronilla varia*	**
Cosmos	Cosmos bipinnatus	76.0
Golden prairie-clover	Dalea aurea*	**
White prairie-clover	Dalea candida*	**
Nine-anther prairie-clover	Dalea enneandra*	**
Round-head prairie-clover	Dalea multiflora*	**
Kaneb purple prairie-clover	Dalea purpurea 'Kaneb'*	58.0
Silky prairie-clover	Dalea villosa*	**
Illinois bundleflower	Desmanthus illinoensis*	**
Shooting star	Dodecatheon meadia	**

TABLE 2103-2: WILDFLOWER SEED		
Common Name	**Bid Item**	**Minimum % PLS**
Purple coneflower	Echinacea angustifolia	**
Pale coneflower	Echinacea pallida	**
Englemann's daisy	Engelmannia pinnatifida	**
Button snakeroot	Eryngium yuccifolium	**
Tall joe-pye weed	Eupatorium altissimum	**
Joe-pye weed	Eupatorium maculatum var. bruneri	**
Boneset	Eupatorium perfoliatum	**
Sweet joe-pye weed	Eupatorium purpureum	**
Indian blanket flower	Gaillardia pulchella	63.0
Prairie gentian	Gentiana puberulenta	**
Snakeweed	Gutierrezia sarothrae	**
Maximilian sunflower	Helianthus maximilianii	**
Dame's rocket	Hesperis matronalis	83.0
Bush morning-glory	Ipomoea leptophylla	**
Perennial Sweetpea	Lathyrus latifolius*	**
Round-head lespedeza	Lespedeza capitata*	**
Rough gayfeather	Liatris aspera	**
Dotted gayfeather	Liatris punctata	**
Eureka thickspike gayfeather	Liatris pycnostachya 'Eureka'	**
Cardinal flower	Lobelia cardinalis	**
Indian-tobacco	Lobelia inflata	**
Blue cardinal flower	Lobelia siphilitica	**
Palespike lobelia	Lobelia spicata	**
Bird's foot trefoil	Lotus corniculatus*	80.0
Tahoka daisy	Machaeranthera tanacetifolia	**
Black-foot daisy	Melampodium leucanthum	**
Wild bergamot	Monarda fistulosa var. fistulosa	**
Missouri eveningprimrose	Oenothera macrocarpa	73.0
White eveningprimrose	Oenothera speciosa	58.0
White beardtongue	Penstemon albidus	**
Buckley's penstemon	Penstemon buckleyi	**
Cobaea penstemon	Penstemon cobaea	**
Large beardtongue	Penstemon grandiflorus	**
Tube penstemon	Penstemon tubaeflorus	**
Blue phlox	Phlox divaricata subsp. laphamii	**
Prairie phlox	Phlox pilosa subsp. fulgida	**
Prairie phlox	Phlox pilosa subsp. pilosa	**
White milkwort	Polygala alba	**
Blood polygala	Polygala sanguinea	**
Sand cherry	Prunus pumila var. besseyi	**
Upright prairieconeflower	Ratibida columnifera	76.0
Mexican hat prairieconeflower	Ratibida columnifera f. pulcherrima	76.0
Grayhead prairieconeflower	Ratibida pinnata	76.0
Sunglow prairieconeflower	Ratibida pinnata 'Sunglow'	**
Black-eyed susan	Rudbeckia hirta	78.0
Brown-eyed susan	Rudbeckia triloba var. triloba	**
Nekan blue sage	Salvia azurea 'Nekan'	**
Lance-leaved sage	Salvia reflexa	**
Catclaw sensitive brier	Schrankia nuttallii	**
Compass plant	Silphium laciniatum	**
Cup plant	Silphium perfoliatum	**

TABLE 2103-2: WILDFLOWER SEED		
Common Name	**Bid Item**	**Minimum % PLS**
Prairie goldenrod	Solidago missouriensis var. fasciculata	**
Rigid goldenrod	Solidago rigida var. rigida	**
Red false-mallow	Sphaeralcea coccinea	**
Prince's plume	Stanleya pinnata var. pinnata	**
Rockpink flameflower	Talinum calycinum	**
Prairie flameflower	Talinum parviflorum	**
Bracted spiderwort	Tradescantia bracteata	**
Prairie spiderwort	Tradescantia occidentalis	**
Ohio spiderwort	Tradescantia ohiensis	**
Shortstem spiderwort	Tradescantia tharpii	**
White clover	Trifolium repens*	**
Venus'looking glass	Triodanis perfoliata	**
Moth mullein	Verbascum blattaria	**
Dakota vervain	Verbena bipinnatifida	**
Rose vervain	Verbena canadensis	**
Hoary vervain	Verbena stricta	**
Arkansas ironweed	Vernonia arkansana	**
Western ironweed	Vernonia baldwinii subsp. interior	**
Western ironweed	Vernonia fasciculata subsp. fasciculate	**
Rocky Mountain zinnia	Zinnia grandiflora	**

*Inoculate legume seeds with their specific nitrogen fixing bacteria listed in **TABLE 2103-3** and in accordance with **SECTION 2106.**
** No Industry Standard

TABLE 2103-3: NITROGEN FIXING BACTERIA			
Genus	**Inoculant**	**Genus**	**Inoculant**
Amorpha	Amorpha Spec 1	Desmanthus	Desmanthus Spec 1
Baptisia	Baptisia Spec 1	Lathyrus	Type C
Cassia	Type EL	Lespedeza	Type EL
Dalea	UMR6815		

SECTION 2104

SODS

2104.1 DESCRIPTION

This specification covers the material requirements for various types of sod.

2104.2 REQUIREMENTS

a. General. Cut the sod uniformly and according to the industry standard for the kind of sod being supplied. Torn, broken, or dry sod is not acceptable. The sod must be strong enough to hold together when rolled and unrolled 3 times; reinforcement netting may be added to sod.

Sods containing noxious weeds or quantities of foreign grass will not be accepted. Do not furnish sod containing orchard grass, crabgrass, wiregrass (barnyard Bermuda), giant foxtail, bindweed or yellow nut sedge.

b. Kentucky Bluegrass Sod. Cut sod strips approximately 1 inch thick, 24 inches wide, and 54 inches long, or in similar dimensions that will produce 1 sq yd. Other dimensions may be approved by the DME.

c. Bermuda Grass or Zoysia Grass Sod, Plugs or Strips. Cut this sod approximately 3 inches thick and 12 to 14inches wide. Further division into plugs is to be done at the planting site.

d. Turf Type Tall Fescue Sod. Cut the sod strips 1¼ in. thick (±¼ in.), approximately 18 inches wide and 72 inches long, or in similar dimensions that will produce 1 sq yd. Sod content equal to approximately 60% of one or more hybrid varieties of turf type tall fescue and 40% Kentucky bluegrass is required.

e. Perennial Wildflower Sod. Cut wildflower sod in pads 20 inches wide and 36 inches long, or some similar measurements that will produce 5 square feet and weighing approximately 15 lbs. Provide sod pads composed of densely packed, 3 inches tall perennial wild flower plants with well developed root systems. Provide plants mature enough to bloom within 6 to 8 weeks after planting. Sod containing a minimum of 11 varieties of hardy perennial plants, including: Black-Eyed Susan, Purple Coneflower, Dame's Rocket, Gaillardia, Johnny Jump-Up, Shasta Daisy, Rockcress, and Wallflower is required. Do not allow any grasses in the sod. Use a net-like fabric to allow handling of the sod pads.

f. Buffalograss Sod. Cut the sod strips 1 ¼ inches thick, 18 inches wide and 72 inches long, or in similar dimensions that will produce 1square yard. Provide sod containing a minimum of 95% buffalograss.

2104.3 TEST METHODS

None Specified.

2104.4 PREQUALIFICATION

None Required.

2104.5 BASIS OF ACCEPTANCE

Visual inspection by the Engineer.

SECTION 2105

SOIL COMPOST

2105.1 DESCRIPTION

This specification covers the material requirements of soil compost for use in planting trees, shrubs and other plant materials.

2105.2 REQUIREMENTS

Provide compost suitable for general gardening, soil incorporation and plant backfill.

The Kansas Department of Health and Environment, Bureau of Waste Management, Topeka, Kansas maintains a current list of Kansas Permitted Composting Facilities. Provide compost from a Kansas Permitted Composting Facility that complies with **TABLE 2105-1**.

TABLE 2105-1: SOIL COMPOST REQUIREMENTS

Parameters	Range
#1 PH	6.0 - 7.5
#2 Soluble Salts	5 ds (mmhos/cm) or below
#3 Nutrient Content (dry weight basis)	N .8% or above, P 1% or above
#4 Bulk Density	28 to 35 lbs/cu ft (450 to 560 kg/m³)
#5 Moisture Content	30 - 40%
#6 Organic Matter Content	>35% of dry weight
#7 Particle Size	pass through a ½ inch or smaller screen
#8 Stability (Maturity)	#6 or #7 (Solvita Compost Maturity Test)

Cover compost after processing at the composting site, during transport and at the project site.

Conduct the tests a maximum of 4 weeks before the compost is delivered to the project.

Provide testing results for Parameters #1 through #7 from testing conducted by Servi-Tech, Inc., Dodge City, Kansas. The Environmental Scientist will consider other testing facilities, at the Contractor's request.

Conduct the testing for Parameter #8 using a Solvita Compost Maturity Test kit. The Solvita Compost Maturity Test kit may be obtained from Woods End Research Laboratory, Inc.

Submit the results of tests conducted on the compost for Parameters #1 through #8 and a sample of the compost (one 5 pound sealed plastic bag) to the Bureau of Right of Way, Environmental Services Section before the compost is incorporated into the project.

The Environmental Scientist will visually inspect the compost sample to determine the absence of man-made materials, such as glass and plastic.

2105.3 TEST METHODS

None Specified.

2105.4 PREQUALIFICATION

None Required.

2105.5 BASIS OF ACCEPTANCE

Approval of the required tests results by the KDOT Environmental Scientist and visual inspection of the container label to verify compliance with this Section.

SECTION 2106

NITROGEN FIXING BACTERIA

2106.1 DESCRIPTION

This specification covers the requirements for nitrogen fixing bacteria.

2106.2 REQUIREMENTS

a. General. Inoculation media containing live nitrogen fixing bacteria of the correct "culture" is be supplied with all legume seeds. Each kind of legume seed has a "culture" of bacteria that is adapted to it. Plant the leguminous seeds as soon as possible after inoculation.

b. Packaging. Supply nitrogen fixing bacteria in containers of a size sufficient to treat the amount of seed to be planted. Treat the seed according to the directions on the container. Use only dated media and only within the date period listed.

2106.3 TEST METHODS

None Specified.

2106.4 PREQUALIFICATION

None Required.

2106.5 BASIS OF ACCEPTANCE

Visual inspection of the container label to verify that the bacteria is of the proper culture, supplied in the proper quantity and properly dated.

SECTION 2107

AGRICULTURAL LIMESTONE

2107.1 DESCRIPTION

This specification covers material requirements for agricultural limestone.

2107.2 REQUIREMENTS

Use ground limestone, ground dolomite or a mixture of the two having an effective calcium carbonate (E.C.C.) value of at least 50%. The E.C.C. value is calculated as follows:

E.C.C = (AB) X Calcium Carbonate Equivalent
A = (%passing a No. 8 sieve - %passing a No. 60 sieve) x 0.50
B = %passing No.60 sieve

Calcium Carbonate Equivalent is calculated from the Neutralization Value as determined according to the Official Methods of Analysis of the Association of Official Analytical Chemists.

2107.3 METHODS OF TEST

None Specified.

2107.4 PREQUALIFICATION

Registration of each manufacturing/distribution facility with the Kansas Department of Agriculture.

2107.5 BASIS OF ACCEPTANCE

Provide a copy of the agricultural limestone distributor's registration with the State Department of Agriculture as required by the Kansas Agricultural Liming Materials Act. Bulk shipments must be accompanied by a certified delivery slip showing the minimum percentage of Effective Calcium Carbonate as defined by the Kansas Agricultural Liming Materials Act.

SECTION 2108

FERTILIZERS

2108.1 DESCRIPTION

This specification covers the material requirements for fertilizers.

2108.2 REQUIREMENTS

a. Fertilizers used on KDOT projects must comply with the applicable sections of the "Kansas Commercial Fertilizer Law" as administered by the Kansas State Board of Agriculture.

b. Fertilizer Grade. The grade for each commercial fertilizer will be shown in the Contract Documents. The fertilizer grade shown in the Contract Documents shall be read as follows:

- the first number represents the percentage of nitrogen required (expressed as available N),
- the second number represents the percentage of phosphorous required (expressed as the percent of available P_2O_5),
- the third number represents the percentage of potassium required (expressed as the percent of available K_2O).

A mixed fertilizer such as 12-24-12 would contain 12% N, 24% P_2O_5 and 12% K_2O.

A tolerance of -0.5% will be permitted for each of the designated ingredients in commercial fertilizers.

c. Sources of Fertilizer. Use one of the following types of commercial fertilizers on KDOT work:

(1) Package fertilizers in granulated or tablet form, manufactured by firms registered by the Kansas State Board of Agriculture annually on July 1st.

Fertilizer tablets are commercially prepared, tightly compressed material used when planting trees and plants. They are formulated to be long-lasting (2 year minimum) with a slow-release analysis of 20-10-5 derived from urea-formaldehyde, calcium phosphates, potassium sulfate, calcium sulfate, ferrous sulfate and comply with the following minimum guaranteed analysis.

Total Nitrogen (N)*	20.0%
7% Water Soluble Organic Nitrogen	
13% Water Insoluble Nitrogen	
Available Phosphoric Acid (P_2O_5)	10.0%
Soluble Potash (K_2O)	5.0%
Calcium (Ca)	2.6%
Sulfur (S)	1.6%
Iron (Fe)	0.35%

*17% slowly available nitrogen from urea-formaldehyde

(2) Bulk fertilizers blended by custom blenders licensed by the Kansas State Board of Agriculture annually on January 1st. Liquid fertilizers are considered to be bulk fertilizers.

2108.3 TEST METHODS

None specified.

2108.4 PREQUALIFICATION

Comply with registration and licensing requirements of the Kansas State Board of Agriculture as specified in **subsection 2108.2c.(2)**.

2108.5 BASIS OF ACCEPTANCE

a. Package Fertilizers.

(1) Receipt of the current certificate of registration issued by the Kansas State Board of Agriculture for annual registration of the product.

(2) The grade of commercial package fertilizers will be determined and accepted on the basis of the label analysis, which must appear on each package. Show on the label analysis the following information as required by the applicable provisions of the "Kansas Commercial Fertilizer Law":

(a) the name and address of the person registering the commercial fertilizer;
(b) the brand and grade of the commercial fertilizer;
(c) the net mass in the package or container;
(d) the registered guaranteed analysis. The guaranteed analysis includes the minimum percentages of plant foods in the following order and form:

Nitrogen, minimum ___ percent
Available phosphoric acid, minimum___ percent
Soluble potash, minimum___ percent,
except as follows:

- unacidulated mineral phosphatic materials and basic slag show the guaranteed analysis in the following order and form:
  Total phosphoric acid, minimum___ percent
  Available phosphoric acid, minimum___ percent
  Fineness of grind:___ percent through mesh screen, and
- bone, tankage, and other natural organic phosphate materials shall show the guaranteed analysis in the following form:
  Total phosphoric acid, minimum___ percent;

(e) Commercial fertilizers containing any ingredient which is injurious to plants must be labeled to show:

- the name and percentage of each such active ingredient;
- adequate directions for use, and
- adequate warnings against misuse;

(f) the minimum percentage of any and all other plant food elements or compounds contributing to the value of the commercial fertilizer, and
(g) any other information as may be prescribed by rules and regulations.

(3) Small quantities of package fertilizers may be accepted on brand name. Only high quality fertilizer of a recognized brand, and of the proper grade and type for the intended use, will be accepted in this manner.

b. Bulk.

(1) Receipt of a copy of custom blender's current license issued by the Kansas State Board of Agriculture.

(2) Receipt of a certified label or a certified delivery slip covering each shipment, and showing the information required in **subsection 2108.05(a)(2)**.

c. Verification Tests. Verification tests may be conducted by KDOT on samples obtained at frequencies and locations designated by the Engineer to determine the reliability of bag label analysis and custom blender certified labels or a certified delivery slip.

If a product of any supplier is found to consistently deviate from the bag level analysis or the custom blenders certified analysis, the acceptance of that product will be discontinued. Copies of the failing test reports will be furnished to the Kansas State Board of Agriculture for appropriate action under the "Kansas Commercial Fertilizer Law".

SECTION 2109

PEAT MOSS

2109.1 DESCRIPTION

This specification covers the materials requirements for peat moss.

2109.2 REQUIREMENTS

The peat moss is to be dark in color, finely divided or granular, with a pH value between 5.0 and 7.0, and substantially free of mineral and woody matter. Provide peat moss that is free of weed seeds, nematodes, soil borne diseases, and concentrations of any substances in sufficient amount to be harmful to plant growth.

2109.3 TEST METHODS

None Specified.

2109.4 PREQUALIFICATION

None Required.

2109.5 BASIS OF ACCEPTANCE

Visual inspection by the Engineer for compliance with **subsection 2109.2.**

SECTION 2110

MULCH

2110.1 DESCRIPTION

This specification covers material suitable for use as mulch.

2110.2 REQUIREMENTS

a. General Mulch Materials. Prairie hay is the preferred mulch material. Use prairie hay containing primarily Bluestem grasses, switchgrass, indiangrass and other desirable perennial grasses, normally found in Bluestem pastures. Additional materials acceptable for mulching include sudan grass hay or excelsior mulch.

Provide written evidence to the Engineer if none of the preferred/additional mulching materials are available. The Engineer may permit the use of wheat straw, oat straw, sawdust, shredded wood, peat moss or pulverized corn cobs.

Do not provide mulching material containing Sericea Lespedeza, Multiflora Rose or any noxious weed identified by the Kansas Department of Agriculture.

b. Excelsior Mulch.

(1) General. Excelsior mulch is composed of fibers cut from green wood. The cut is to be made to provide maximum fiber strength, but at an angle to the natural grain of the wood so the fiber will splinter as weathering progresses. Provide excelsior mulch free of seeds or other viable plant material that are not desirable in the mulch. Deliver excelsior mulch to the project in bales.

(2) Dimensions. The approximate dimensions of the majority of the fibers are as follows:

Length ....4 to 6 inch
Thickness ....0.020 to 0.040 inch
Width ....0.030 to 0.050 inch

(3) Smolder Resistance. The excelsior mulch material is not to flame or smolder for a distance of more than 12 inches from point of ignition. See **subsection 2110.3** for test method.

(4) Toxicity. Vegetation growth and/or seed germination are not to be inhibited by any toxicity in the mulch. Excelsior mulch material is to be non-toxic to the personnel engaged in handling and installation.

c. Shredded or Chipped Wood Mulch. Provide shredded or chipped hardwood, cypress or cedar wood mulch for use around trees, shrubs and other plants as designated in the Contract Documents. Chipped wood mulch is to be substantially free of mineral, organic or vegetative matter other than wood. The mulch is to have no more than one calendar year between the time of cutting and shredding or chipping and the time of application to the current project. Do not use this chipped wood mulch around small perennials and vines.

d. Composted Mulch. Use only composted wood mulch around small perennials and vines.

e. Wood Cellulose Fiber. Provide wood cellulose fiber composed of a blend of virgin wood and paper fibers that contains no growth or germination inhibiting factors and complies with **TABLE 2110-1**:

TABLE 2110-1: WOOD CELLULOSE FIBER

Property	Requirement
Wood	70%
paper	30%
Moisture Content	9-15%
Organic matter	80% minimum
pH	6.5 average
water holding capacity	1.6 gal/lb
Guar Tackifier	2% minimum

f. Hydro-Mulch. Provide a bonded fiber matrix (BFM) product made from non-toxic, biodegradable, thermally processed, virgin, wood fibers that contains no growth or germination inhibiting factors and complies with **TABLE 2110-2**:

TABLE 2110-2: HYDRO-MULCH	
Property	**Requirement**
Virgin wood fibers	90% minimum
Organic matter	99% minimum
Hydrocolloid-based binder	10% minimum
"Dry" Moisture Content	9 - 15%
pH	5.5 – 7.5
Water holding capacity	13 times own weight
Dye agent color	Green or Yellow

2110.3 METHOD OF TESTS

Test for smolder resistance of excelsior mulch as follows: Obtain a representative sample of the excelsior large enough to form a mat approximately 30 x 30 x 1 ½ inches. Leach the sample with seven one-hour immersions in separate portions of water maintained at 80°F during the leaching period. Drain for about 15 minutes after each immersion. After the last immersion and draining period, spread the sample out on a flat surface to form a mat approx. 30 x 30 x 1 ½ inches and air dried for 72 hours at room temperature. At the completion of the air drying period, place a lit cigarette on the surface of the mat. Measure and record the distance that a flame or smolder spreads from the cigarette.

2110.4 PREQUALIFICATION

None Required.

2110.5 BASIS OF ACCEPTANCE

a. Excelsior mulch is accepted on the basis of satisfactory test results from the Materials and Research Center. Perform tests on samples supplied from the project delivered material.

b. The Engineer will accept straw or hay bales based on the following:

- North American Weed Management Association (NAWMA) Standards.
- Receipt of a statement that this material "meets the North American Weed Free Forage Standards" on a Transit certificate with the vehicle tag number, the type and number of bales being transported or a Forage tag on each bale.

Contact the Kansas Department of Agriculture to request inspection or for certifications. For a Certified Weed-Free Forage/Mulch Growers Listing contact the Kansas Department of Agricultures.

c. The wood cellulose fiber will be accepted based on visual inspection of the container label to verify compliance with this specification. Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

d. All other mulch materials are accepted based on a visual inspection by the Engineer.

SECTION 2111

MULCH TACKING SLURRY

2111.1 DESCRIPTION

This specification covers the materials to be used as tacking slurry applied to mulch.

2111.2 REQUIREMENTS

a. Tacking Material. Provide tacking material that complies with the following:

- A blend of fibers of recycled slick paper, produced from printers' slick paper containing wood cellulose, and kaolin clay.
- Free of synthetic or plastic materials or other foreign material
- Biodegradable
- Disperses in water and forms a homogeneous slurry, and remains in suspension when agitated by the hydraulic slurry equipment.
- When sprayed uniformly over the mulch, forms an absorbent cover allowing percolation of water to the underlying soil.
- Packaged in moisture resistant bags with the net weight (mass) of the packaged material plainly shown on each bag.
- Non-water soluble fibers.

Complies with the following minimum requirements for wood cellulose mulch:

Applied Color	Green
Organic Matter, percent by weight	Min. 80
Tacking Agents, percent by weight	>4
Moisture Content, percent by weight	12 ± 3
Water Holding Capacity	>1200 (grams of H_2O per 100 grams of fiber
pH Range	5.5 ± 3

b. Tacking Agent. Add a Guar Gum based tacking agent to the tacking material in the hydraulic slurry at a rate and manner recommended by the manufacturer. The tacking agent must be biodegradable and comply with the following:

Density	30 grams per cc
Hazardous Components	None
Percent Volatile	0 at 70°F
Appearance	Cream Colored Powder
Water Miscibility	Thickener
Odor	Mild

c. Water. Use water for mulch tacking slurry that complies with the **DIVISION 2400**.

d. Toxicity. Do not use tacking materials and/or tacking agents that are toxic to vegetation, hazardous to the germination of seed or may be injurious to personnel handling and applying the materials.

2111.3 TEST METHODS

None Specified.

2111.4 PREQUALIFICATION

None Required.

2111.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600.**

SECTION 2112

WEED CONTROL FABRIC

2112.1 DESCRIPTION

This specification covers the material requirements for weed control fabric.

2112.2 REQUIREMENTS

Weed control fabric can be an opaque woven or non-woven material, manufactured specifically for use as a weed barrier. Use fabric that can maintain its integrity for a minimum of 2 years in direct sunlight and has the following minimum physical properties:

Weight	96 g/sq. yd.
Grab tensile strength	100 lbf.
Puncture strength	60 lbf.
Tear strength	45 lbf.

2112.3 TEST METHODS

Grab tensile strength	ASTM D 4632
Puncture strength	ASTM D 4786
Tear strength	ASTM D 4533

2112.4 PREQUALIFICATION

None Required.

2112.5 BASIS OF ACCEPTANCE

Visual inspection of the label to verify compliance with this Section.

SECTION 2113

EROSION CONTROL MATERIALS

2113.1 DESCRIPTION

This specification covers erosion control products manufactured from wood, straw or coconut fiber mat, synthetic mat, paper mat, jute mesh or other material that is placed on slopes or ditches for short-term or long-term protection of seeded areas.

2113.2 REQUIREMENTS

a. Provide prequalified erosion control materials of the class and type specified in the Contract Documents.

b. Erosion control products are categorized in **TABLE 2113-1 and 2113-2**:

TABLE 2113-1: CLASS 1. "SLOPE PROTECTION		
Type	**Uses**	**Soil Type**
Type C	Slopes > 3:1	Clay soils
Type D	Slopes > 3:1	Sandy soils

TABLE 2113-2: CLASS 2 FLEXIBLE CHANNEL LINER		
Type	**Duration**	**Shear Stress t_d**
Type E	Short-term (≤ 5 years)	up to 2 lbs/sq ft
Type F	Short-term (≤ 5 years)	up to 4 lbs/sq ft
Type G	Long-term (> 5 years)	up to 6 lbs/sq ft
Type H*	Long-term (> 5 years)	up to 8 lbs/sq ft

*Use Only 100% synthetic products

c. Anchors. Provide and use anchors as recommended by the erosion control product manufacturer. In the absence of any recommendations by the manufacturer, provide material in **TABLE 2113-3**:

TABLE 2113-3: WIRE, STAPLE AND ANCHORS	
Property	**minimum size**
Slope Protection	
Wire Diameter	11 gauge
Leg Length (Heavy Soil)	6 inch
Leg Length (Light Soil)	8 inch
Crown Width	1 inch
Flexible Channel Liner - Wire Staple Anchors	
Wire Diameter	8 gauge
Leg Length (Heavy Soil)	10 inch
Leg Length (Light Soil)	14 inch
Crown Width	2 inch
Flexible Channel Liner - Metal Stake Pin Anchors	
Pin Diameter	3/16 inch
Pin Length (Heavy Soil)	10 inch
Pin Length (Light Soil)	14 inch
Steel Washer Diameter	1½ inch, nominal
Flexible Channel Liner - Hardwood Stake Anchors	
Light Soil	1 x 3 x 12 inch
Heavy Soil	1 x 3 x 18 inch

2113.3 TEST METHODS

Erosion Control products will be tested and evaluated by the Texas Department of Transportation and the Texas Transportation Institute following procedures outlined in the Texas DOT Erosion Control Report. Anchors are evaluated on the basis of their performance in the field.

2113.4 PREQUALIFICATION

Prequalification procedures may be obtained by writing to the Texas Department of Transportation, Director of Construction and Maintenance, 125 East 11th Street, Austin, TX 78701-2483. A list of prequalified materials based on the annual Texas DOT Erosion Control Report and field performance within Kansas will be maintained by the KDOT Bureau of Construction and Materials. The KDOT prequalified list establishes the acceptable materials to be incorporated into KDOT projects. Products will remain on the KDOT list provided field performance is satisfactory or the manufacturer requests the removal of their own product.

2113.5 BASIS OF ACCEPTANCE

a. Erosion Control Materials.

(1) Prequalification as required by **subsection 2113.4**.

(2) Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

(3) Field observation before or during material installation.

b. Anchors. Field observation before or during installation.

SECTION 2114

TEMPORARY SEDIMENT BARRIERS

2114.1 DESCRIPTION

This specification is applicable to materials used as ditch checks or barriers designed to reduce water velocity and temporarily contain sediment.

2114.2 REQUIREMENTS

a. Geotextile Fabric for Temporary Silt Fence. Provide material that complies with AASHTO M 288 for unsupported silt fence, with 4 ft. maximum post spacing. Actual post spacing is as shown in the Contract Documents.

b. Posts. Provide wood, steel, or synthetic posts of sufficient strength to resist damage during installation and to support the applied loads. Length is to be as shown in the Contract Documents. Hardwood posts having dimensions of at least 1 3/16 x 1 3/16 inch, No. 2 Southern Pine at least 2 ⅝ x 2 ⅝ inch or steel posts of U, T, L, or C shape, weighing 0.95 lbs per foot minimum are satisfactory.

c. Prefabricated Silt Fence. Prefabricated silt fence systems that comply with geotextile fabric and posts in **subsection 2114.2a.** and **2114.2b**.

d. **Biodegradable Logs.** Provide commercially available biodegradable logs manufactured from straw, excelsior wood fiber, coconut fiber, jute or other biodegradable material bound with an open mesh fabric of jute or light-weight plastic.

Do not use biodegradable logs manufactured from straw for ditch checks or inlet sediment barriers.

e. Synthetic Sediment Barriers. Provide synthetic sediment barrier materials such as Geo-Ridge Permeable Berm™, Triangular Silt Dike™ or equivalent. The Stormwater Compliance Engineer will consider an equivalent of the brand names specified. Provide the Engineer with a complete description, literature, test reports, etc. on the proposed equivalent prior to installation.

f. Filter Sock. Provide burlap or synthetic mesh bags, coarse aggregate, wood chips, compost or other permeable filler material to slow and filter stormwater runoff. Use only coarse aggregate filler for curb inlet protection.

2114.3 TEST METHODS

a. Silt Fence. As specified in AASHTO M 288.

b. Biodegradable Logs, Synthetic Sediment Barriers, and Filter Sock. None Required.

2114.4 PREQUALIFICATION

None Required.

2114.5 BASIS OF ACCEPTANCE

a. Geotextile for silt fence. Receipt and approval of a Type D certification as specified in **DIVISION 2600**, and visual inspection at the point of usage.

b. Posts. Visual inspection for condition and dimensional requirements at the point of usage.

c. Biodegradable Logs. Dimensional and other requirements shown in the Contract Documents, and visual inspection of the installed material.

d. Synthetic Sediment Barriers. Brand name and visual inspection of the installed material.

e. Filter Sock. Visual inspection and compliance with requirements in the Contract Documents.

SECTION 2201

RETROREFLECTIVE SHEETING

2201.1 DESCRIPTION

This specification covers Type I and all Types of High Intensity retroreflective sheeting. This includes both non-exposed glass bead lens and microprismatic sheeting.

2201.2 REQUIREMENTS

a. General. Provide retroreflective sheeting that complies with ASTM D 4956. The type to be provided will be shown in the Contract Documents. Types and classes are as defined in ASTM D 4956.

b. Conformable Retroreflective Sheeting. Provide High Intensity retroreflective sheeting that has a conformable aluminum foil backing with an aggressive pressure sensitive adhesive. This material is designed for application to moderately rough or porous metal, wood or masonry surfaces. Provide material that complies with ASTM D 4956 with the following exceptions and additions:

(1) Conformable aluminum backing thickness – 0.005 inches to 0.010 inches.

(2) Follow all manufacturers' recommendations for application procedures and temperatures.

2201.3 MANUFACTURER WARRANTY

The following warranty conditions apply only to the retroreflective sheeting manufacturer. Provide a product warranty for a minimum period of 10 years on all Types of High Intensity retroreflective sheeting for placement on permanent signing. Failure to comply with this warranty may be cause for removal from the prequalified list.

The High Intensity retroreflective sheeting warranty must comply with the following requirements and obligations:

- Certification: Submit with each lot or shipment, a certification which states that the material supplied is subject to and complies with the requirements. Include in the certification, the manufacturer's office, address, phone number and the contact for potential claims under the provisions of this warranty. Provide documentation as to which signs were fabricated from each lot.
- Field Performance: Field Performance applies to retroreflective sheeting applied to sign blank materials or overlaid on existing signs. The field performance obligation period begins with the date of erection. The sheeting is considered unsatisfactory if it has deteriorated due to natural causes to the extent that the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions or shows any of the following defects:
    - Cracking discernible with the unaided eye from a driver's position at a distance of 50 feet or greater from the sign:
    - Scaling, pitting, orange peel, delamination, edge lifting or curling;
    - Peeling in excess of 3/8 inch;
    - Shrinkage in excess of 3/16 inch total per yard of sheeting width;
    - Fading or loss of color to the extent that retroreflective sheeting color fails to comply with **subsection 2201.2a.**, or;
    - Loss of retroreflectivity reducing the coefficient of retroreflection as measured by a retroreflectometer to less than the minimum specified in Table 12 of **ASTM D 4956** at 0.2° observation and -4° entrance angles. Make all measurements after cleaning the sign.

Defective Material Replacement: When traffic signs with High Intensity sheeting fail to comply with the field performance requirements, re-sheet or replace the signs at no cost to KDOT for materials and labor. Employ a contractor qualified by KDOT to perform signing work. Install highway signs, as shown in the Contract Documents and the MUTCD and provide proper traffic control.

Replace all defective material within 60 days after written notification by KDOT. Signs not corrected within 60 days, will be removed and replaced by KDOT. Signs removed by KDOT will be placed in storage for inspections by the manufacturer, and the manufacturer will be billed for all costs of replacement of the sheeting.

When more than 25% of the signs within a lot fail to comply with the requirements, replace all signs made from that lot.

2201.4 PREQUALIFICATION

Manufacturers desiring to provide material under this specification are to submit prequalification samples of each type, class and color covered by this specification which they wish to prequalify. Each sample consists of 3 pieces 24 inches square.

Forward the prequalification samples to the Engineer of Tests. Samples will be tested for compliance with all requirements of this specification. Each Manufacturer will be notified of the test results.

If the prequalification samples of retroreflective sheeting comply with this specification, the product will be placed on a list of prequalified products maintained by the Bureau of Construction and Materials. No retroreflective sheeting will be used on KDOT projects unless it has been prequalified. Testing and evaluation by KDOT may be waived if complete testing has been performed on the identical product by AASHTO National Transportation Product Evaluation Program (NTPEP) within the last five years. Forward an official copy of the test report along with evidence that the product referenced is identical to that submitted for prequalification, to the Engineer of Tests for evaluation.

2201.5 TEST METHODS

All tests will be conducted in accordance with ASTM D 4956 with the exception of artificial weathering. Artificial weathering will be conducted according to ASTM G 155, Cycle 1, with the following additions and exceptions:

- At the end of each 20 hour cycle, the panels will be placed in a cold cabinet at approximately 0°F for one hour. After removal from the cold cabinet, panels will be returned to the weatherometer to await the start of the next cycle.

2201.6 BASIS OF ACCEPTANCE

a. Permanent Sheeting.

(1) Prequalification as required by **subsection 2201.4**.

(2) Satisfactory results of tests conducted at MRC. Each lot of sheeting will be sampled at destination by a representative of KDOT and will be subjected to a visual examination and tested for physical properties as necessary to verify that the sheeting complies with this specification.

(3) Receipt of the warranty certification as specified in **subsection 2201.3** by the Project Engineer.

b. Temporary Sheeting. Retroreflective sheeting used to manufacture temporary traffic control signs will be accepted on the basis of a certification prepared by the contractor stating that the retroreflective sheeting used to manufacture the signs was prequalified under this specification, and visual inspection by the Engineer for condition and other requirements.

SECTION 2202

IMAGE SYSTEMS FOR RETROFLECTIVE SHEETING

2202.1 DESCRIPTION

This specification covers Process Inks, Electronic Cuttable Films, and Digital Print for use on retroreflective sheeting.

2202.2 REQUIREMENTS

a. General. Provide transparent or opaque process inks with reducers and thinners as required for proper application. Provide durable, transparent or opaque, colored electronic cuttable films with a pressure sensitive adhesive and a removable liner. Provide digital print on Type XI retroreflective sheeting. Provide materials that are suitable for processing legends, borders, and background colors on retroreflective sheeting. Provide process inks or electronic cuttable films in 2 types as follows:

Type I - For use with Type I retroreflective sheeting.
Type High Intensity - For use with all types of High Intensity retroreflective sheeting.

b. Color. Provide transparent inks, films, and digital print that are yellow, red, orange, green, blue, or brown. Opaque ink, film, or digital print is black. Provide colors that comply with the chromaticity limits in **ASTM D 4956**.

c. Performance. Provide process inks, electronic cuttable films, and digital print that, when applied according to the manufacturer's recommendations, comply with the following:

(1) They are compatible with the retroreflective sheeting.

(2) They have good adhesion to the sheeting and do not cause blistering, puckering, shrinkage, expansion or other deterioration of the sheeting.

(3) After artificial weathering, they have a "good" or better colorfastness, and show no evidence of cracking, edge lifting, curling or other surface deterioration.

(4) Process inks dry hard within 16 hours.

2202.3 TEST METHODS

All tests will be conducted in accordance with ASTM D 4956 with the exception of artificial weathering. Artificial weathering will be conducted according to ASTM G 155, Cycle 1, with the following additions and exceptions:

- At the end of each 20-hour cycle, place the panels in a cold cabinet at approximately 0ºF for 1 hour. After removal from the cold cabinet, return the panels to the weatherometer to await the start of the next cycle.

2202.4 PREQUALIFICATION

Manufacturers desiring to provide material under this specification are to submit prequalification samples of each type and color covered by this specification that they wish to prequalify. Each sample of process ink consists of 1 quart of transparent and opaque inks and any necessary reducer or thinner required for proper application. Each sample of electronic cuttable film and digital print consists of 2 pieces 24 inches square.

Supply a sufficient quantity of the correct type of retroreflective sheeting for ink or film applications. Directions for proper application to retroreflective sheeting must accompany all samples of ink or film.

Forward the prequalification samples to the Engineer of Tests. Samples will be tested for compliance with all requirements of this specification. Each manufacturer will be notified of the test results.

If the prequalification samples of ink, film, or digital print comply with this specification, the product will be placed on a list of prequalified products maintained by the Bureau of Materials and Research. No ink, film, or digital print will be used on KDOT projects unless it has been prequalified. Manufacturers will be required to requalify at intervals determined by the Engineer of Tests.

Testing and evaluation by KDOT may be waived if complete testing has been performed on the identical product by AASHTO National Transportation Product Evaluation Program (NTPEP) within the last five years. Forward an official copy of the test report along with evidence that the product referenced is identical to that submitted for prequalification, to the Engineer of Tests for evaluation.

2202.5 BASIS OF ACCEPTANCE

Prequalification as required by **subsection 2202.3**.
Receipt and approval of a Type C certification as specified in **DIVISION 2600**.
Visual observation of performance.

SECTION 2203

ROLL-UP SIGNS

2203.1 DESCRIPTION

This specification covers white, fluorescent orange, and fluorescent pink retroreflective sheeting used for temporary roll-up warning signs.

2203.2 REQUIREMENTS

a. Provide retroreflective sheeting that complies with ASTM D 4956, Type VI, Class 5.

b. Mounting Stands. The type and configuration of stands for mounting and displaying roll-up signs are not specified here, and are at the Contractor's option. However, all stands used must meet the crashworthy criteria for Category 2 devices contained in the testing and acceptance guidelines of the National Cooperative Highway Research Program (NCHRP) Report 350. Retain a copy of the NCHRP Report 350 crashworthy test data and the FHWA acceptance letter to be provided to the Engineer if requested. In addition, the mounted sign and stand must be able to resist normal wind loading without falling over, and be able to maintain a minimum mounting height of 12 inches above the edge of the pavement.

2203.3 TEST METHODS

All tests will be conducted in accordance with ASTM D 4956 with the exception of artificial weathering. Artificial weathering will be conducted according to ASTM G 155, Cycle 1, with the following additions and exceptions:

- At the end of each 20-hour cycle, the panels will be placed in a cold cabinet at approximately 0ºF for 1 hour. After removal from the cold cabinet, panels will be returned to the weatherometer to await the start of the next cycle.

2203.4 PREQUALIFICATION

Only the retroreflective sheeting used to manufacture the signs will be prequalified. Sheeting manufacturers interested in prequalifying material under this specification must submit 3 pieces 24 inches square to the Engineer of Tests. Samples will be tested for compliance with all requirements of this specification. Each manufacturer will be notified of the test results.

If the prequalification samples of retroreflective sheeting comply with this specification, the product will be placed on a list of prequalified products maintained by the Bureau of Construction and Materials. No retroreflective sheeting will be used on KDOT projects unless it has been prequalified. Manufacturers will be required to requalify at intervals determined by the Engineer of Tests.

Testing and evaluation by KDOT may be waived if complete testing has been performed on the identical product by AASHTO National Transportation Product Evaluation Program (NTPEP) within the last five years. Forward an official copy of the test report along with evidence that the product referenced is identical to that submitted for prequalification, to the Engineer of Tests for evaluation.

2203.5 BASIS OF ACCEPTANCE

Prequalification as required by **subsection 2203.4** above.

Receipt and approval of a certification prepared by the manufacturer stating that the sheeting used to manufacture the roll-up signs is essentially the same as that submitted for prequalification.

Visual inspection on delivery.

SECTION 2204

CENTER MOUNT REFLECTORS

2204.1 DESCRIPTION

This specification covers plastic center mount reflectors.

2204.2 REQUIREMENTS

a. General. Provide reflectors that are plastic reflector discs with a mounting hole in the center, and a nominal diameter of 3 inches. Provide the reflectors in 3 colors; white, amber and red. Provide amber and red reflectors that comply with the limits set by the Highway Yellow and Red Color Tolerance Charts of the U. S. Department of Transportation.

b. Construction and Materials.

(1) Plastic Reflector Unit. Provide reflectors that consist of 2 circular pieces of plastic, hermetically sealed together at the edges and at the center mounting hole. Provide units with an air space between the two sealed pieces and permanently sealed against dust, water and vapor.

(a) Front (Lens). Provide reflectors whose front piece of plastic consists of a clear and transparent acrylic plastic of the color shown in the Contract Documents. Provide reflectors whose outer surface of the front piece is smooth and highly polished, free from cracks, checks, projections or indentations. This surface may contain a mounting hole and trademark identification. Legibly mold the manufacturer's name and identification into the face near the edge. Form the inner surface into numerous small reflector elements to affect "cubecorner" retroreflection.

(b) Back. Provide a plastic back that is either transparent or opaque, but sealed to the front to form an airtight seal in order to protect the reflector elements.

(2) Housing and Mounting. Provide reflectors with a center mounting hole with a grommet that uses either of two designs. A Type I grommet is formed as part of the backing and projects through the reflector and beyond the lens by about 1/32 in. The backing, including the grommet, is hermetically sealed to the lens. A Type II grommet is formed from nonferrous metal and applied after the reflector is assembled and sealed. Provide either type of grommet with an inside diameter of 0.19 – 0.24 inches, inclusive.

c. Performance. Provide reflectors with the following minimum Reflective Intensity per reflector at a divergence angle of 0.2º:

TABLE 2204-1: MINIMUM REFLECTIVE INTENSITY

Angle of Incidence	Reflective Intensity (cd/ft-c)		
	White	Amber	Red
-4º	90	54	25
20º	45	27	12

2204.3 TEST METHODS

Center mount reflectors will be sampled by a representative of KDOT and submitted to the Engineer of Tests. A sample consists of 18 reflectors per each 5000 reflectors for each color. For each additional 5000, or fraction thereof, add 4 reflectors to the sample size. Lightly wash the reflectors with a mild detergent and dry with a clean cloth before testing as follows:

a. Coefficient of Luminous Intensity per Reflector. Determine the reflective intensity of center mount reflectors according to ASTM E 809. Measure each reflector individually at a divergence angle of 0.2º and incidence angles of -4º and 20º. Average readings taken at every 45º rotation.

b. Heat Test. After measuring the reflective intensity per reflector, place a minimum of 9 reflectors face up in a horizontal position on the central rack of a forced draft oven maintained between 148º and 150°F for 4 hours.

Remove the reflectors from the oven and place them face up on a table to cool. Allow the reflectors to return to room temperature, wipe the reflectors with a clean chamois and measure the reflective intensity of each reflector as described in **subsection 2204.3a**. The reflective intensity of each reflector must not be less than the minimum values shown in **subsection 2204.2c**.

c. Leakage Test. After measuring the reflective intensity per reflector, immerse a minimum of 9 reflectors face down in water in a vacuum desiccator under a coarse bronze or stainless steel screen to keep them beneath the water. Cover the desiccator and slowly reduce the air pressure in the desiccator until a vacuum of 20 inches of mercury is obtained. Hold this reduced pressure for 5 minutes and then allow air to slowly enter the desiccator until the pressure is equal to atmospheric pressure. Allow the reflectors to remain under water for an additional 5 minutes. Remove the reflectors from the water and wipe off the excess water with a clean cloth. Measure the reflective intensity of each reflector as described in **subsection 2204.3a**. Any reflectors that have filled with any water will be marked as failures and the reflective intensity will not be measured. The reflective intensity of each reflector must not be less than the minimum values shown in **subsection 2204.2c**.

d. Resampling. When only 1 reflector per sample fails **subsection 2204.3a.**, **b.** or **c.**, the entire sample will be accepted for use on KDOT projects. A failure of 2 reflectors per sample will require resampling and testing. A failure of 3 or more will cause the entire sample to be rejected without resampling.

2204.4 PREQUALIFICATION

None required.

2204.5 BASIS OF ACCEPTANCE

Each lot or batch will be sampled by a representative of KDOT and tested as necessary to verify compliance with the specification.

Satisfactory performance in the field.

SECTION 2205

FLEXIBLE DELINEATOR POSTS AND ANCHORING DEVICES

2205.1 DESCRIPTION

This specification covers flexible delineator posts and anchoring devices.

2205.2 REQUIREMENTS

a. General.

(1) Provide delineator posts consisting of a flexible, durable, UV resistant and non-discoloring material that meet all the requirements of the MUTCD. Provide posts to which retroreflective sheeting can be applied, and are capable of recovering from 5 cold weather impacts between 27 and 37°F and 5 hot weather impacts between 80 and 90°F. Upon installation, the delineator must be resistant to overturning, twisting, or displacement from wind and vehicle forces. For 2-piece systems, the post must be compatible with an anchor that holds the post in place by a locking mechanism, or with a bolting arrangement.

(2) When shown in the Contract Documents, apply High Intensity retroreflective sheeting that complies with **SECTION 2201**. Apply white or yellow retroreflective sheeting to 1 or 2 sides as stated in the Contract Documents. The total length and color of the post are shown in the Contract Documents.

(3) Delineators are required to meet the crashworthy criteria for category I devices contained in the testing and acceptance guidelines of the National Cooperative Highway Research Program (NCHRP) Report 350.

2205.3 TEST METHODS

a. Tensile Strength and Elongation. Test flexible delineator posts and anchoring devices is accordance with the procedures referenced in ASTM D 638 and ASTM G 154.

b. Impact Resistance Test. Test flexible delineators for impact resistance as prescribed by the AASHTO National Transportation Product Evaluation Program (NTPEP) test procedures for flexible delineator posts and plastic barrels.

The manufacturer must submit Impact Resistance data for tests that have been performed on the identical product by the AASHTO NTPEP test location that includes both hot and cold weather conditions. Forward an official copy of the test report along with evidence that the product referenced is identical to that submitted for prequalification, to the Engineer of Tests for evaluation.

c. Crashworthy Test. Test delineators as prescribed by the NCHRP Report 350 for category 1 devices. Federal Highway Administration (FHWA) guidance indicates that category 1 devices may be accepted based on a self-certification by the manufacturer. This certification may be a one-page affidavit signed by the manufacturer, with documentation supporting the certification (crash tests and/or engineering analysis) kept on file by the certifying organization. Forward an official copy of the certification with evidence that the product referenced is identical to that submitted for prequalification, to the Engineer of Tests for evaluation.

2205.4 PREQUALIFICATION

The flexible delineator post, complete with appropriate anchor, will be prequalified as a system or unit by KDOT. Manufacturers interested in prequalifying items under this specification must submit 2 complete units (posts with appropriate anchors), the Impact Resistance test data, and the Crashworthy Certification to the Engineer of Tests. The sample will be tested for compliance with all requirements of this specification and the producer will be notified in writing of the test results. A list of qualified materials will be maintained by the Bureau of Construction and Materials.

2205.5 BASIS OF ACCEPTANCE

Prequalification as required by **subsection 2205.4**.

Receipt and approval of a Type C certification in accordance with **DIVISION 2600**.

SECTION 2206

RAISED PAVEMENT MARKERS

2206.1 DESCRIPTION

This specification covers Flexible Raised Pavement Markers and Rigid Raised Pavement Markers (Type I or Type II) for lane marking and delineation on both portland cement concrete and asphalt surfaces.

2206.2 REQUIREMENTS

a. General. Provide temporary raised pavement markers (RPMs) as shown in the Contract Documents. The markers shall be readily visible at night, from a minimum of 300 feet, when viewed with high beam automobile headlamps. Prior to use, markers must be approved by the Engineer.

Provide flexible RPMs which consist of a flexible body with retroreflective sheeting on both sides facing traffic. The markers shall be between 4 and 6 inches wide, be at least 2 inches tall and have a flat base for mounting to the road. The width of the marker will face traffic in each direction. Each marker shall use adhesive to secure the marker to the road surface and, when hit, will not cause damage to an automobile. Attach a cover to the marker to protect the retroreflective material during surfacing operations. Remove the cover after the operations to expose the retroreflective surface.

Provide rigid (Type I) RMPs that are traversable by motor vehicles and constructed of traffic bearing high impact plastic with 1 or 2 retroreflective faces, as shown in the Contract Documents. The markers shall be 2.5 to 4 inches wide and at least 0.4 inches high. The width of the marker will face traffic in each direction. Each marker shall use an adhesive to secure marker to the road surface and, when hit, the marker will not cause damage to an automobile. The adhesive used shall not stain the pavement and will allow the markers to be easily removed without damage to the roadway surface.

Provide rigid (Type II) RPMs constructed of traffic bearing high impact plastic with retroreflective surfaces on the 2 sides facing traffic. The marker shall be at least 2.5 inches high, 12 inches wide and 6 inches long. Each marker shall use adhesive to secure marker to the road surface and the adhesive used will not stain the pavement and will allow the markers to be easily removed without damage to the roadway surface.

b. Visibility. Markers shall be visible a minimum of 300 feet in daytime and nighttime conditions. Retroreflectivity measured under field conditions may be used to determine visibility.

c. Retroreflectivity. Provide the markers in solid white and yellow which comply with the minimum requirements shown in **TABLE 2206-1**:

TABLE 2206-1: RETROREFLECTIVITY REQUIREMENTS

Color	Millicandelas/sq m/lux (min.) (measured at 0.2°observation angle and 0°entrance angle)
White	3.0
Yellow	1.8

d. Color. The marker shall be the same color as the retroreflective elements, which shall match the color of pavement marking they are intended to replace or supplement, or as shown in the Contract Documents. Marking color should be consistent throughout the body of the device.

2206.3 TEST METHODS

Test for retroreflectivity in accordance with ASTM E 809.

2206.4 PREQUALIFICATION

None required.

2206.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.
Visual inspection for condition and dimensional requirements.

SECTION 2207

COLD PLASTIC PAVEMENT MARKING MATERIAL

2207.1 DESCRIPTION

This specification covers cold plastic pavement marking materials for use on both concrete and asphalt surfaces.

2207.2 REQUIREMENTS

Provide cold plastic pavement marking material that complies with ASTM D 4505 Reflectivity Level II.

2207.3 TEST METHODS

ASTM D 4505

2207.4 PREQUALIFICATION

Submit a sample of at least 100 linear feet of each color of material to the Engineer of Tests.

If the material complies with all laboratory requirements, the manufacturer will be contacted to arrange for the field evaluation. The field evaluation will consist of 2 or 3 test projects at times and locations as determined by the Bureau of Transportation Safety and Technology. Manufacturers must specify if the material may be used on both asphalt and concrete surfaces or only on asphalt or concrete surfaces.

Duration of the test project will be dependent on the submittal of test data from the AASHTO National Transportation Product Evaluation Program (NTPEP). Forward an official copy of the test data along with evidence that the material referenced is identical to that submitted for prequalification to the Engineer of Tests for evaluation. Materials with no test data will have a test project duration of 18 months; materials with test data will have a test project duration of 12 months. Materials will be evaluated initially and every 3 to 6 months throughout the duration of the test project for retroreflectivity, color and durability.

The material will be evaluated for compliance with this specification, and the manufacturer will be notified of the results. The Bureau of Construction and Materials will maintain a list of qualified materials and installation instructions. Products will remain on the prequalified list as long as field performance is satisfactory and the results of verification testing are consistently acceptable. Report any changes in formulation to the Engineer of Tests for review and evaluation to determine if requalification is necessary.

2207.5 BASIS OF ACCEPTANCE

a. Long Line Markings.

(1) Prequalification as stated in **subsection 2207.4**.

(2) Satisfactory results of Verification Testing. Except for symbols, the Engineer will sample each lot or batch. Collect samples of each lot in accordance with KT-81.

b. Preformed Symbols.

(1) Prequalification as stated in **subsection 2207.4**.

(2) Receipt and approval of a Type C certification as specified in **DIVISION 2600.** Include all lot numbers from the material used to fabricate the symbols.

SECTION 2208

PATTERNED COLD PLASTIC PAVEMENT MARKING MATERIAL

2208.1 DESCRIPTION

This specification covers patterned cold plastic pavement marking material for use on both concrete and asphalt surfaces.

2208.2 REQUIREMENTS

Provide patterned cold plastic pavement marking material that complies with ASTM D 4505 Reflectivity Level I with the following additions:

a. Dimensions. Provide material with a thickness of not less than 0.02 in. at the thinnest portion of the cross section. Provide material whose thickest portion of the cross section is 0.07 – 0.09 in. All measurements are exclusive of the adhesive.

2208.3 TEST METHODS

ASTM D 4505

2208. 4 PREQUALIFICATION

Submit at least 100 linear feet of each color of material to be prequalified to the Engineer of Tests.

If the material complies with all laboratory requirements, the manufacturer will be contacted to arrange for the field evaluation. The field evaluation will consist of 2 or 3 test projects at times and locations as determined by the Bureau of Transportation Safety and Technology. Manufacturers must specify if the material may be used on both asphalt and concrete surfaces or only on asphalt or concrete surfaces.

Duration of the test project will be dependent on the submittal of test data from the AASHTO National Transportation Product Evaluation Program (NTPEP). Forward an official copy of the test data along with evidence that the material referenced is identical to that submitted for prequalification to the Engineer of Tests for evaluation. Materials with no test data will have a test project duration of 18 months; materials with test data will have a test project duration of 12 months. Materials will be evaluated initially and every 3 to 6 months throughout the duration of the test project for retroreflectivity, color and durability.

The material will be evaluated for compliance with this specification, and the manufacturer will be notified of the results. The Bureau of Construction and Materials will maintain a list of qualified materials and installation instructions. Products will remain on the prequalified list as long as field performance is satisfactory and the results of verification testing are consistently acceptable. Report any changes in formulation to the Engineer of Tests for review and evaluation to determine if requalification is necessary.

2208.5 BASIS OF ACCEPTANCE

a. Long Line Markings.

(1) Prequalification as stated in **subsection 2208.4**.

(2) Satisfactory results of Verification Testing. Except for symbols, the Engineer will sample each lot or batch. Collect samples of each lot in accordance with KT-81.

b. Preformed Symbols.

(1) Prequalification as stated in **subsection 2208.4**.

(2) Receipt and approval of a Type C certification as specified in **DIVISION 2600.** Include all lot numbers from the material used to fabricate the symbols.

SECTION 2209

HIGH DURABILITY PAVEMENT MARKING MATERIAL

2209.1 DESCRIPTION

This specification covers white or yellow high durability pavement markings designed to be used in severe wear conditions such as repeated shear actions from crossover or encroachment traffic and turning, stopping or starting traffic. This includes material for use on both portland cement concrete and asphalt surfaces.

2209.2 REQUIREMENTS

Provide high durability pavement marking material that complies with ASTM D 4505 Reflectivity Level II with the following exceptions and additions:

a. The material must have a strong topcoat with glass beads distributed to provide immediate and continuing retroreflection. Bond ceramic particles to the top layer to provide a skid resistant surface.

b. Delete all references to application temperatures.

c. Tensile Strength. The material must have a minimum tensile strength of 500 psi when measured in the direction of the roll.

d. Adhesion. 8 lbf, minimum.

e. Dimensions. With the exception of patterned, provide material with a 0.05 inch minimum thickness. Provide patterned material with a thickness of not less than 0.02 inch at the thinnest portion of the cross section and 0.07 – 0.09 inch at the thickest portion of the cross section. All measurements are exclusive of the adhesive.

2209.3 TEST METHODS

ASTM D 638 with the following exception:

- Test a 1 by 6 inch sample at a temperature between 70 and 80ºF using a jaw speed of 10 - 12 inches per minute.

ASTM D 4505.

2209.4 PREQUALIFICATION

Submit at least 100 linear feet of each color, and a complete set of installation recommendations and instructions to Engineer of Tests.

If the material complies with all laboratory requirements, the manufacturer will be contacted to arrange for the field evaluation. The field evaluation will consist of 2 or 3 test projects at times and locations as determined by the Bureau of Transportation Safety and Technology. Manufacturers must specify if the material may be used on both asphalt and concrete surfaces or only on asphalt or concrete surfaces.

Duration of the test project will be dependent on the submittal of test data from the AASHTO National Transportation Product Evaluation Program (NTPEP). Forward an official copy of the test data along with evidence that the material referenced is identical to that submitted for prequalification to the Engineer of Tests for evaluation. Materials with no test data will have a test project duration of 18 months; materials with test data will have a test project duration of 12 months. Materials will be evaluated initially and every 3 to 6 months throughout the duration of the test project for retroreflectivity, color and durability.

The material will be evaluated for compliance with this specification, and the manufacturer will be notified of the results. The Bureau of Construction and Materials will maintain a list of qualified materials and installation instructions. Products will remain on the prequalified list as long as field performance is satisfactory and the results of verification testing are consistently acceptable. Report any changes in formulation to the Engineer of Tests for review and evaluation to determine if requalification is necessary.

2209.5 BASIS OF ACCEPTANCE

a. Long Line Markings.

(1) Prequalification as required by **subsection 2209.4** above.

(2) Satisfactory results of Verification Testing. Except for symbols, the Engineer will sample each lot or batch. Collect samples of each lot in accordance with KT-81.

b. Preformed Symbols.

(1) Prequalification as required by **subsection 2209.4** above.

(2) Receipt and approval of a Type C certification as specified in **DIVISION 2600**, which also includes all lot numbers of material used to fabricate the symbols.

SECTION 2210

TEMPORARY PAVEMENT MARKING TAPE

2210.1 DESCRIPTION

This specification covers preformed plastic pavement markings designed for limited service life. This includes both Removable (Type I) and Non-removable (Type II) materials for use on both portland cement concrete and asphalt surfaces. Type I tape can be removed without damage to or discoloration of the pavement surface. Type II is not required to have the removal characteristics of Type I, though removal that leaves damage to or discoloration of the pavement surface may be required, as shown in the Contract Documents.

This specification also covers Removable Line Masking Tape. This is a highly durable, skid resistant, non-reflective, black or dark gray, pliant polymer tape designed for temporary obliteration of existing pavement markings. The tape must be able to be removed without residue or damage to the existing marking.

2210.2 REQUIREMENTS

Provide pavement markings that comply with ASTM D 4592 with the following exceptions and additions:

- Delete all references to application temperatures. Apply all markings according to the manufacturer's recommendations for proper surface conditions and preparation, air and surface temperatures, and other weather conditions.
- Store all material in accordance with the manufacturer's directions, including temperature and exposure to the elements.
- If recommended by the manufacturer, use a primer to precondition the pavement surface.
- Visibility. Pavement Marking Tape shall be visible a minimum of 300 feet in daytime and nighttime conditions. Retroreflectivity measured under field conditions may be used to determine visibility.
- Retroreflectivity. Retroreflectivity requirements are not applicable for Removable Line Masking Tape. Provide tape in white or yellow which complies with the minimum requirements shown in **TABLE 2210-1**:

TABLE 2210-1: RETROREFLECTIVITY	
Color	**Millicandelas/sq m/lux** (min.)
White	250
Yellow	175

2210.3 TEST METHODS

ASTM D 4592

2210.4 PREQUALIFICATION

None Required.

2210.5 BASIS OF ACCEPTANCE

Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

Visual observation of performance on the project.

SECTION 2211

THERMOPLASTIC PAVEMENT MARKING MATERIAL

2211.1 DESCRIPTION

This specification covers thermoplastic materials suitable for use as retroreflective pavement markings on asphalt and portland cement concrete pavements. Material will be prequalified for use on both asphalt and portland cement concrete surfaces or for use only on asphalt surfaces. The material is applied to the pavement in molten form. Glass beads are pre-mixed into the material furnished, and also dropped on the surface of the molten material immediately after it is applied to the pavement surface, at a rate specified. Upon cooling to normal pavement temperature, it produces an adherent retroreflectorized stripe of specified thickness and width, capable of resisting deformation by traffic.

2211.2 REQUIREMENTS

a. General.

(1) Provide the material in white and/or yellow as specified.

(2) A binder-sealer is required for applications involving asphalt over 2 years old, or for asphalt surfaces that are worn or oxidized to a condition where 50% or more of the wearing surface is exposed aggregate.

(3) Do not commingle materials from different manufacturers.

b. Thermoplastic Material and Premix Beads. Provide thermoplastic material that complies with AASHTO M 249 with the following restrictions:

(1) Only maleic modified glycerol ester alkyd based resins will be allowed for the binder system.

(2) Yellow pigments must comply with the latest OSHA standards for toxic heavy metals.

c. Glass Beads for Drop-on Application. Provide glass beads according to the thermoplastic manufacturer’s recommendations.

d. Binder-Sealer. When a binder-sealer is specified, provide one that is recommended by the manufacturer of the thermoplastic material, and apply it according to the manufacturer's instructions. The binder-sealer must be compatible with the pavement material, and form a tight bond between the pavement and the thermoplastic material.

e. Color. Provide thermoplastic that complies with the requirements of ASTM D 6628. The yellow lines must also display a nighttime presence of yellow when viewed under automobile headlights.

f. Retroreflectivity. Provide thermoplastic that complies with the minimum retroreflectivity requirements in **TABLE 2211-2** using an acceptable 30-meter retroreflectometer:

TABLE 2211-2: THERMOPLASTIC RETROREFLECTIVITY REQUIREMENTS

Color	millicandelas/sq m/lux (min.)
White	300
Yellow	225

2211.3 TEST METHODS

a. Thermoplastic Material.

(1) AASHTO T 250, plus,

(2) Verify the material is alkyd using KTMR-6, Determination of Alkyd Base in Thermoplastic Material.

(3) Glass Bead Content. ASTM D 4797.

(4) Titanium Dioxide. ASTM D 1394, Aluminum Reduction Method.

(5) Specific Gravity. AASHTO T 228.

2211.4 PREQUALIFICATION

a. Manufacturers interested in prequalifying material under this specification must provide a 10-lb sample of each color to the Engineer of Tests. Also include a copy of the quality control test report for each lot of material, material safety data sheets, and a complete set of installation recommendations and instructions.

b. If the material complies with all laboratory requirements, the manufacturer will be contacted to arrange for the field evaluation. The field evaluation will consist of 2 or 3 test projects at times and locations as determined by the Bureau of Transportation Safety and Technology. Manufacturers must specify if the material may be used on both asphalt and concrete surfaces or only on asphalt or concrete surfaces.

Duration of the test project will be dependent on the submittal of test data from the AASHTO National Transportation Product Evaluation Program (NTPEP). Forward an official copy of the test data along with evidence that the material referenced is identical to that submitted for prequalification to the Engineer of Tests for evaluation. Materials with no test data will have a test project duration of 18 months; materials with test data will have a test project duration of 12 months. Materials will be evaluated initially and every 3 to 6 months throughout the duration of the test project for retroreflectivity, color and durability.

c. The material will be evaluated for compliance with all requirements of this specification, and the manufacturer will be notified of the results. The Bureau of Construction and Materials will maintain a list of qualified materials and installation instructions. The list will differentiate between products prequalified for use on asphalt and concrete surfaces, or for use on asphalt surfaces only. Products will remain on the prequalified list as long as the results of verification testing and field performance are satisfactory. Any changes in formulation should be reported to the Engineer of Tests for review and evaluation to determine if requalification is necessary.

2211.5 BASIS OF ACCEPTANCE

a. Thermoplastic Material.

(1) Prequalification as required by **subsection 2211.4**.

(2) Receipt and approval of a Type C certification as specified in **DIVISION 2600** for each lot of material used.

b. Glass Beads for Drop-on Application.

(1) Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

(2) Copies of testing results for each lot of beads used on the project.

c. Binder-Sealer. If binder-sealer is required, it will be accepted on the basis of brand name as recommended by the thermoplastic material manufacturer, and visual observation of performance in the field.

SECTION 2212

PREFORMED THERMOPLASTIC PAVEMENT MARKING MATERIAL

2212.1 DESCRIPTION

This specification covers preformed thermoplastic materials suitable for use as reflecting pavement markings on either asphalt or concrete pavements. A manufacturer recommended heat source fuses the markings to the asphalt or concrete pavements. Glass beads are pre-mixed into the material furnished, and also must be applied to the surface either before or after fusion to the pavement. Upon cooling, the material produces an adherent reflectorized marking of specified thickness and width, capable of resisting deformation by traffic.

2212.2 REQUIREMENTS

a. General.

(1) Provide the material in white and/or yellow as specified.

(2) Provide material with a minimum thickness of 0.1 inch as supplied by the manufacturer.

(3) Provide material that is resistant to deterioration due to exposure to sunlight, water, oil, gasoline, salt, or adverse weather conditions.

(4) After application, the material must exhibit no appreciable deformation or discoloration, remain tack free, and not lift from the pavement under normal traffic conditions within a road temperature range of 20 to 150ºF.

(5) Provide material that is capable of conforming to pavement contours, breaks, and faults through the action of traffic at normal pavement temperatures.

b. Color. Provide thermoplastic that meets the requirements of ASTM D 6628.

c. Retroreflectivity. Provide preformed thermoplastic that meets the minimum retroreflectivity requirements in **TABLE 2212-1**, using an acceptable 30-meter retroreflectometer.

TABLE 2212-1: PREFORMED THERMOPLASTIC RETROREFLECTIVITY REQUIREMENTS

COLOR	millicandelas/sq m/lux (min.)
White	300
Yellow	225

d. Thermoplastic Material and Premix Beads.

(1) Provide thermoplastic material that complies with AASHTO M 249 with exception of the relevant differences due to the material being supplied in a preformed state.

(2) All pigments must be heavy metal free, including, but not restricted to lead, cadmium, and mercury.

e. Glass Beads for Drop-on Application. Provide glass beads according to the thermoplastic manufacturer's recommendations.

2212.3 TEST METHODS

a. Thermoplastic Material and Premix Beads. AASHTO T 250

2212.4 PREQUALIFICATION

a. Manufacturers interested in prequalifying material under this specification must provide at least 100 linear feet of each color to the Engineer of Tests. Also, include a copy of the quality control test report for each lot of material, material safety data sheets, and a complete set of installation recommendations and instructions.

b. If the material complies with all laboratory requirements, the manufacturer will be contacted to arrange for the field evaluation. The field evaluation will consist of 2 or 3 test projects at times and locations as determined by the Bureau of Transportation Safety and Technology. Manufacturers must specify if the material may be used on both asphalt and concrete surfaces or only on asphalt or concrete surfaces.

Duration of the test project will be dependent on the submittal of test data from the AASHTO National Transportation Product Evaluation Program (NTPEP). Forward an official copy of the test data along with evidence that the material referenced is identical to that submitted for prequalification to the Engineer of Tests for evaluation. Materials with no test data will have a test project duration of 18 months; materials with test data will have a test project duration of 12 months. Materials will be evaluated initially and every 3 to 6 months throughout the duration of the test project for retroreflectivity, color and durability.

c. The material will be evaluated for compliance with all requirements of this specification, and the manufacturer will be notified of the results. The Bureau of Construction and Materials will maintain a list of qualified materials and installation instructions. Products will remain on the prequalified list as long as field performance is satisfactory and the results of verification testing are consistently acceptable. Report any changes in formulation to the Engineer of Tests for review and evaluation to determine if requalification is necessary.

2212.5 BASIS OF ACCEPTANCE

a. Thermoplastic Material.

(1) Prequalification as required by **subsection 2212.4**.

(2) Receipt and approval of a Type C certification as specified in **DIVISION 2600** for each lot of material used.

b. Glass Beads for Drop-on Application.

(1) Receipt and approval of a Type D certification as specified in **DIVISION 2600.**

(2) Copies of testing results for each lot of beads used on the project.

SECTION 2213

SPRAYED THERMOPLASTIC PAVEMENT MARKING MATERIAL

2213.1 DESCRIPTION

This specification covers thermoplastic materials suitable for use as retroreflecting pavement markings on asphalt pavement. The material is applied to the pavement in molten form by spray means. Glass beads are pre-mixed into the material furnished, and also dropped on the surface of the molten material immediately after it is applied to the pavement surface, at a rate specified. Upon cooling to normal pavement temperature, the material produces an adherent retroreflective marking of specified thickness and width, capable of resisting deformation by traffic.

2213.2 REQUIREMENTS

a. General.

(1) Provide the material in white and/or yellow as specified.

(2) Provide 100% solids thermoplastic material that is homogeneously composed of pigment, filler, resins and glass beads. The material must have a minimum binder content of 25% by mass composition and be free of foreign objects that would cause bleeding, staining, or discoloration. Upon heating to application temperature, the material will not exude fumes that are toxic, or injurious to persons or property.

b. Pigment.

(1) Use high-grade titanium dioxide as the pigment for the white material. The material must contain a minimum of 10% titanium dioxide by mass.

(2) Use heat resistant and colorfast yellows, golds, or oranges to produce a material to comply with color requirements.

(3) Yellow pigments must comply with the latest OSHA standards for toxic heavy metals.

(4) Use a filler consisting of white calcium carbonate, silica, or an approved substitute.

c. Glass Beads. Provide glass beads according to the thermoplastic manufacturer's recommendations.

d. Thermoplastic Material. Provide thermoplastic material that complies with the following:

(1) Specific Gravity--2.0 maximum

(2) Daylight Reflectance (Y)

(a) White—75% minimum

(b) Yellow—45% minimum

(3) Color—meets the requirements of ASTM D 6628. Yellow lines must display a nighttime presence of yellow when viewed under automobile headlights.

(4) Retroreflectivity—Provide sprayed thermoplastic that meets the following minimum retroreflectivity requirements using an acceptable 30-meter retroreflectometer:

TABLE 2213-2: SPRAYED THERMOPLASTIC RETROREFLECTIVITY REQUIREMENTS

Color	Millicandelas/sq m/lux (min.)
White	300
Yellow	225

(5) Softening Point--180°F minimum

(6) Cracking Resistance at Low Temperature--No visible cracks when observed from a distance of one foot.

e. Binder-Sealer. When a binder-sealer is specified, provide one that is recommended by the manufacturer of the thermoplastic material, and apply it according to the manufacturer's instructions. The binder-sealer must be compatible with the pavement material, and form a tight bond between the pavement and the thermoplastic material.

2213.3 TEST METHODS

a. Thermoplastic Material. Use AASHTO T 250 except for:

(1) Softening Point-Heat the material for 4 hours ± 5 minutes at 375 ± 2ºF.

(2) Cracking Resistance at Low Temperature-Heat the material for 4 hours ± 5 minutes at 375 ± 2ºF.

(3) Glass Beads content. ASTM D 4797 and AASHTO T 247.

(4) Titanium Dioxide. ASTM D 1394, Aluminum Reduction Method.

2213.4 PREQUALIFICATION

a. Manufacturers interested in prequalifying material under this specification must provide a 10-lb sample of each color to the Engineer of Tests. Also include a copy of the quality control test report for each lot of material, material safety data sheets, and a complete set of installation recommendations and instructions.

b. If the material complies with all laboratory requirements, the manufacturer will be contacted to arrange for the field evaluation. The field evaluation will consist of 2 or 3 test projects at times and locations as determined by the Bureau of Transportation Safety and Technology. Manufacturers must specify if the material may be used on both asphalt and concrete surfaces or only on asphalt or concrete surfaces.

Duration of the test project will be dependent on the submittal of test data from the AASHTO National Transportation Product Evaluation Program (NTPEP). Forward an official copy of the test data along with evidence that the material referenced is identical to that submitted for prequalification to the Engineer of Tests for evaluation. Materials with no test data will have a test project duration of 18 months; materials with test data will have a test project duration of 12 months. Materials will be evaluated initially and every 3 to 6 months throughout the duration of the test project for retroreflectivity, color and durability.

c. The material will be evaluated for compliance with all requirements of this specification, and the manufacturer will be notified of the results. The Bureau of Construction and Materials will maintain a list of qualified materials and installation instructions. Products will remain on the prequalified list as long as the results of verification testing and field performance are satisfactory. Any changes in formulation should be reported to the Engineer of Tests for review and evaluation to determine if requalification is necessary.

2213.5 BASIS OF ACCEPTANCE

a. Thermoplastic Material.

(1) Prequalification as required by **subsection 2213.4**.

(2) Receipt and approval of a Type C certification as specified in **DIVISION 2600** for each lot of material used.

b. Glass Beads for Drop-on Application.

(1) Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

(2) Copies of testing results for each lot of beads used on the project.

c. Binder-Sealer. If binder-sealer is required, it will be accepted based on brand name as recommended by the thermoplastic material manufacturer, and visual observation of performance in the field.

SECTION 2214

EPOXY PAVEMENT MARKING MATERIAL

2214.1 DESCRIPTION

This specification covers epoxy resin and glass beads suitable for use as reflective pavement markings on portland cement concrete or asphalt pavement.

2214.2 REQUIREMENTS

a. Epoxy Pavement Marking Material.

(1) General. Provide an epoxy resin material that is toxic heavy metal free, 2-component, 100% solids, and is formulated and tested to perform as a pavement marking material with glass beads applied to the surface. The 2 components are an epoxy resin and an amine curing agent. Provide complete manufacturer's specifications and material safety data sheets to the Engineer for all material provided.

Provide a material that does not exude toxic fumes when heated to application temperature.

Provide a material that, when mixed in the proper ratio and applied at 0.02 inch wet film thickness at 75ºF with the proper saturation of glass beads, has a no tracking time of less than 40 minutes for slow curing material and less than 10 minutes for rapid curing material. Provide a material that is capable of fully curing under a constant surface temperature of 32ºF or above.

(2) Properties of Cured Material.

(a) Color. Provide material that complies with the requirements of ASTM D 6628. Provide white and yellow material that complies with the following Daylight Reflectance values:

TABLE 2214-1 DAYLIGHT REFLECTANCE

Color	45 Degrees-0 Degrees, % Min.
White	75
Yellow	45

(b) Retroreflectivity. Provide epoxy pavement marking material that meets the following minimum retroreflectivity requirements using an acceptable 30-meter retroreflectometer:

TABLE 2214-3: EPOXY RETROREFLECTIVITY REQUIREMENTS

Color	millicandelas/sq m/lux (min.)
White	325
Yellow	250

(c) Hardness. Provide material with Shore D hardness of 75 minimum.

(d) Bond Strength to Concrete. Provide material that when catalyzed, has such a high degree of adhesion to the specified concrete surface that there is a 100% concrete failure. Apply the material at a film thickness of 0.01 ± 0.001 inch to concrete with a minimum compressive strength of 4000 psi. Allow the material to cure for 72 hours at 77ºF before the test is performed.

(e) Yellowness Index. White only. Value after 72 hours in QUV – 30 maximum when tested at 0.01 ± 0.001 inch and a 72-hour cure.

b. Glass Beads For Drop-On Application (double drop system). Provide glass beads according to the epoxy manufacturer's recommendations.

2214.3 TEST METHODS

a. Bond Strength to Concrete. AASHTO T 237

b. Hardness. ASTM D 2240

c. Yellowness Index. ASTM E 313

2214.4 PREQUALIFICATION

a. Manufacturers interested in prequalifying material under this specification must provide a 1-quart sample of each color plus 1 quart of hardener to the Engineer of Tests. Also include a copy of the quality control test report for each lot of material, an infrared spectroscopy analysis for each component, material safety data sheets and a complete set of installation recommendations and instructions. .

b. The material will be evaluated for compliance with all requirements of this specification, and the manufacturer will be notified of the results. Each color and the hardener will be analyzed and "fingerprinted" using infrared spectroscopy for use in screening future verification samples to verify that materials submitted for use are of an identical formulation as originally approved.

c. If the material complies with all laboratory requirements, the manufacturer will be contacted to arrange for the field evaluation. The field evaluation will consist of 2 or 3 test projects at times and locations as determined by the Bureau of Transportation Safety and Technology. Manufacturers must specify if the material may be used on both asphalt and concrete surfaces or only on asphalt or concrete surfaces.

Duration of the test project will be dependent on the submittal of test data from the AASHTO National Transportation Product Evaluation Program (NTPEP). Forward an official copy of the test data along with evidence that the material referenced is identical to that submitted for prequalification to the Engineer of Tests for evaluation. Materials with no test data will have a test project duration of 18 months; materials with test data will have a test project duration of 12 months. Materials will be evaluated initially and every 3 to 6 months throughout the duration of the test project for retroreflectivity, color and durability.

d. The Bureau of Construction and Materials will maintain a list of qualified materials and installation instructions. Products will remain on the prequalified list as long as the results of verification testing and field performance are satisfactory. Any changes in formulation should be reported to the Engineer of Tests for review and evaluation to determine if requalification is necessary.

2214.5 BASIS OF ACCEPTANCE

a. Epoxy Material.

(1) Prequalification as required by **subsection 2214.4**.

(2) Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

b. Glass Beads for Drop-on Application.

(1) Receipt and approval of a Type D certification as specified in **DIVISION 2600**.

(2) Copies of testing results for each lot of beads used on the project.

SECTION 2215

PAVEMENT MARKING PAINT

2215.1 DESCRIPTION

This specification covers water-borne pavement marking paint and glass beads suitable for use as retroreflective pavement markings on portland cement concrete or asphalt pavement.

2215.2 REQUIREMENTS

a. Paint. Use white or yellow paint that is specifically manufactured for use as pavement markings. Formulate the paint to consist of acrylic resin, lead free pigments and water as the solvent. The paint must comply with volatile organic compound (VOC) requirements, be lead and other toxic heavy metal free, and exhibit the following qualities:

(1) Formulation:

Yellow paint- The pigment of the Yellow paint shall consist of the following for each 100 gallons of paint:

A. 30 lbs. of approved Hansa Yellow
B. 17 lbs. of Rutile Titanium Dioxide
C. Other such extender pigments as necessary to produce a close match to the yellow color requirement.

White and yellow paint shall be composed of 100% acrylic polymer, which shall be Rohm and Haas HD-21 acrylic resin or Dow Chemical's DT400.

(2) Dry-Opacity: A contrast ratio of not less than 0.96 when the paint is applied with a 0.012 inch film applicator.

(3) Daylight Reflectance: Daylight Reflectance of the white paint not less than 80% relative to magnesium oxide.

(4) Color: Provide paint that meets the requirements of ASTM D 6628.

(5) Bead Embedment: At least 90% of the glass beads must be embedded between 50 and 70%.

(6) Dry to No Pick-Up Time: Maximum 5 minutes when tested according to KT-MR1

b. Glass Beads for Pavement Marking Paint (Double Drop System). Provide glass beads according to the paint manufacturer's recommendations.

2215.3 TEST METHODS

a. Paint.

(1) Dry Opacity. ASTM D 2805.

(2) Daylight Reflectance. ASTM E 1347.

(3) Bead Embedment. Apply paint to a Leneta plain white paper chart at a wet film thickness of 0.025 inch followed immediately by an application of glass beads (AASHTO M 247, Type 3) dropped onto the surface of the paint. After drying for at least 24 hours observe the amount of bead embedment with a 30-power microscope.

(4) No Pick-Up Time. ASTM D 711.

2215.4 PREQUALIFICATION

None Required.

2215.5 BASIS OF ACCEPTANCE

Acceptance of pavement marking paint and glass beads will be made on the basis of Type D certifications as specified in **DIVISION 2600**, copies of testing results for each lot of beads used on the project, and visual inspection of performance and consistency on the job site.

SECTION 2216

MULTI-COMPONENT LIQUID PAVEMENT MARKING MATERIAL

2216.1 DESCRIPTION

This specification covers multi-component, liquid materials* suitable for use as retroreflecting pavement markings on portland cement concrete or asphalt pavements. Glass beads or other reflective elements are dropped at a specified rate on the surface of the liquid material immediately after it is applied to the pavement surface. Upon curing, it produces an adherent retroreflective marking of specified thickness and width, capable of resisting deformation by traffic.

*****These can be modified urethanes, polyureas, methylmethacrylates, special epoxies or other applicable materials.

2216.2 REQUIREMENTS

a. Color. Provide material that complies with the requirements of ASTM D 6628. Provide white and yellow material that complies with the following Daylight Reflectance values:

TABLE 2216-1: DAYLIGHT REFLECTANCE

Color	45 Degrees-0 Degrees, % Min.
White	75
Yellow	45

b. Provide material that is a homogeneous blend of liquid resins, pigments, and fillers and is also free of lead and other toxic heavy metals.

c. Provide one of the above-mentioned liquid marking materials or a material as approved by KDOT. The burden of proof of a product rests with the producer. Provide all supporting technical data, including test reports, field test data, etc. for consideration of the product.

d. Retroreflectivity. Provide multi-component pavement marking material that meets the following minimum retroreflectivity requirements using an acceptable 30-meter retroreflectometer:

TABLE 2216-2: MULTI-COMPONENT RETROREFLECTIVITY REQUIREMENTS

Color	millicandelas/sq m/lux (min.)
White	325
Yellow	250

e. Glass Beads For Drop-On Application (double drop system). Provide glass beads according to the multi-component manufacturer's recommendations.

2216.3 TEST METHODS

a. Bond Strength to Concrete. AASHTO T 237

b. Hardness. ASTM D 2240

c. Yellowness Index. ASTM E 313

2216.4 PREQUALIFICATION

a. Manufacturers interested in prequalifying material under this specification must provide a 1-quart sample of each color plus 1 quart of hardener to the Engineer of Tests. Also include a copy of the quality control test report for each lot of material, an infrared spectroscopy analysis for each component, material safety data sheets and a complete set of installation recommendations and instructions. .

b. The material will be evaluated for compliance with all requirements of this specification, and the manufacturer will be notified of the results. Each color and the hardener will be analyzed and "fingerprinted" using infrared spectroscopy for use in screening future verification samples to verify that materials submitted for use are of an identical formulation as originally approved.

c. If the material complies with all laboratory requirements, the manufacturer will be contacted to arrange for the field evaluation. The field evaluation will consist of 2 or 3 test projects at times and locations as determined by the Bureau of Transportation Safety and Technology. Manufacturers must specify if the material may be used on both asphalt and concrete surfaces or only on asphalt or concrete surfaces.

Duration of the test project will be dependent on the submittal of test data from the AASHTO National Transportation Product Evaluation Program (NTPEP). Forward an official copy of the test data along with evidence that the material referenced is identical to that submitted for prequalification to the Engineer of Tests for evaluation. Materials with no test data will have a test project duration of 18 months; materials with test data will have a test project duration of 12 months. Materials will be evaluated initially and every 3 to 6 months throughout the duration of the test project for retroreflectivity, color and durability.

d. The Bureau of Construction and Materials will maintain a list of qualified materials and installation instructions. Products will remain on the prequalified list as long as the results of verification testing and field performance are satisfactory. Any changes in formulation should be reported to the Engineer of Tests for review and evaluation to determine if requalification is necessary.

2216.5 BASIS OF ACCEPTANCE

a. Multi-Component Liquid Material

(1) Prequalification as required by **subsection 2216.4**.
(2) Receipt and approval of a Type C certification as specified in **DIVISION 2600**.

b. Glass Beads/Reflective Elements for Drop-on Application.

(1) Receipt and approval of a Type D certification as specified in **DIVISION 2600**.
(2) Copies of testing results for each lot of beads used on the project.

SECTION 2301

WOOD POSTS

2301.1 DESCRIPTION

This specification governs wood posts and spacer blocks for guardrail, and wood sign support posts. This specification does not cover wood fence posts. It establishes a quality control/quality assurance (QC/QA) and prequalified plant system for producers of wood products.

2301.2 REQUIREMENTS

a. General.

(1) Any plant producing wood posts and spacer blocks for guardrail, and wood sign support posts through this specification must be currently prequalified. A plant is any facility that produces the posts as the final treated product. Prequalification requires a thorough inspection by KDOT and comparison testing to verify the plant has the capability to comply with this specification. Procedures for prequalification are outlined in **subsection 2301.4**.

(2) Unless shown otherwise in the Contract Documents, produce all posts provided under this specification to meet the applicable subsections.

(3) Quality Assurance inspection of wood posts and spacer blocks for guardrail; and wood sign support posts will be done at the job site on a random, project by project basis as outlined in **subsection 2301.4e.**

(4) Wood species not listed but meeting or exceeding these specifications will be considered by the Bureau Chief of Construction and Materials upon written request.

(5) Unless shown otherwise in the Contract Documents, treat material listed under this section with a preservative treatment in accordance with **subsection 2301.2e.**

b. Material Specifications and Grading Rules. Comply with the applicable parts of the following:

(1) ASTM D 245.

(2) Standard grading rules as set forth by Southern Pine Inspection Bureau.

(3) Standard grading rules as set forth by Western Wood Products Association.

(4) Product Standard 20 American Softwood Lumber Standard as set forth by the U. S. Department of Commerce.

(5) Any commercial grading rules that will provide material of equal or greater stress value may also be used. The burden of proof regarding the equality of the proposed rules lies with the supplier.

(6) Provide materials that are free of decayed wood, rot, red heart, and detrimental compression wood.

(7) **F_b defined.** F_b is the minimum extreme fiber strength in bending under dry conditions (from grading rules tables). Specific requirements for each type of product supplied are outlined in the paragraphs below.

c. Guardrail Posts and Spacer Blocks.

(1) Posts and spacer blocks provided under this specification are surfaced on four sides (S4S) and complies with the dimensions and details shown in the Contract Documents.

(2) Unless shown otherwise in the Contract Documents, provide posts and spacer blocks graded No. 1 (posts and timbers – 5 inch X 5 inch and larger), with a minimum extreme fiber strength in bending, F_b, of 1200 psi, regardless of species. Sterilize posts and spacer blocks by kiln drying.

d. Sign Support Posts.

(1) Posts provided under this specification are S4S and comply with the dimensions and details shown in the Contract Documents.

(2) Unless shown otherwise in the Contract Documents, provide posts graded as follows:

Southern Pine:

4 inch X 4 inch, No. 1 Dense, F_b = 2000 psi

4 inch X 6 inch, No. 1 Dense, F_b = 1750 psi

Douglas Fir:

4 inch X 4 inch and 4 inch X 6 inch

Select Structural, Base Value F_b = 1450 psi

Note: Douglas Fir base value does not include size factors.

e. Preservative Treatment and Handling of Wood Products.

(1) General. Treat all wood products with a wood preservative registered by the U.S. Environmental Protection Agency under the Federal Insecticide, Fungicide and Rodenticide Act.

(a) Unless shown otherwise in the Contract Documents, treat all wood products provided under this section to meet the applicable subsections in American Wood Protection Association (AWPA) Standard C14, "Wood for Highway Construction—Preservative Treatment by Pressure Processes".

(b) Treatment processes not listed but meeting or exceeding this section will be considered by the Bureau Chief, Construction and Materials, upon written request.

(2) Preservative Types. Use preservatives that comply with AWPA Standard U1, Commodity Section A: Sawn Products or Commodity Section B: Posts, or AASHTO M 133.

(3) Fabrication. No field fabrication will be permitted, unless shown otherwise in the Contract Documents. Complete all adzing, boring, chamfering, framing, gaining, incising, surfacing, and trimming prior to treatment.

(4) Treatment Processes.

(a) Use preservative treatments that comply with the latest requirements of AWPA Standard U1, Commodity Section B: Posts, or AASHTO M 133.

(b) Stamp or tag each treated piece with the plant identification and minimum specified treatment recorded in pounds per cubic foot (PCF).

(5) Handling. Load, unload or transfer treated posts and blocks using procedures specified in AWPA M4, "Standard for the Care of Preservative-Treated Wood Products".

(6) Shipments. Do not ship treated material while still dripping. Unless kiln dried, retain it in the treatment yard for a minimum of 3 days. Retain the material in the treatment yard a minimum of 7 days when the ambient temperature remains below 60°F.

(7) Storage.

(a) Place treated wood products on treated or non-decaying skids or cribbing, that are positioned to support the material to minimize distortion.

(b) Sign Support Posts. Stack and tightly band with spaced layers to permit air flow between each layer and minimize warping. Banding consists of 1 band for each 4 feet of bundle length, with a maximum spacing of four feet between bands, end bands being not more than 1 foot from the end of the bundles. Place spacers (stickers), a minimum of 1/8 inch in thickness, between each horizontal layer of posts at each banding location.

(c) Others. Tightly band all other wood products to minimize warping.

(d) Place the material in an area free of debris, decayed wood, and dry vegetation, and with sufficient drainage to prevent material from being subjected to standing water.

(8) Damage During Shipment. Damage affecting the structural integrity or utility of the item is cause for rejection.

2301.3 TEST METHODS

Conduct all measurements, visual inspection, and grading for the wood products according to the procedures specified in **subsection 2301.2b.** For preservative treatment, analysis will be performed as set forth in AWPA Standard A9, "Standard Method for Analysis of Treated Wood and Treating Solutions by X-Ray Spectroscopy".

2301.4 PREQUALIFICATION

a. General.

(1) Contact the Bureau Chief of Construction and Materials to arrange for the required sampling, observation of testing procedures and review of the plant quality control program.

(2) The plant is to absorb all expenses associated with the inspection by the Engineer's representative. This includes travel, subsistence and lodging, and the expenses of shipping any selected specimens to KDOT.

(3) It is the option of the Bureau Chief of Construction and Materials to grant prequalified status to a plant based upon the qualification test and inspection results of transportation agencies of other states.

(4) A plant will be notified in writing in the event of any change in their prequalified status. The Bureau of Construction and Materials will maintain a list of all plants that are prequalified to provide wood guardrail posts and spacer blocks, and wood sign support posts to KDOT projects.

b. Plant Quality Control Requirements. The plant must have a quality control section identified within its organization that is adequately staffed to perform the required lot-by-lot testing. The plant laboratory must have proper equipment, calibrated annually according to the requirements of the equipment manufacturer's recommendations, with which to adequately perform all measurements, visual inspection, and testing related to **subsections 2301.2b.** and **2301.2e.** Provide a copy of the plant quality control plan to the Engineer's representative during the plant inspection. As a minimum, the plan will include 1) grading procedures and personnel qualifications, 2) treatment procedures and personnel qualifications, 3) record keeping procedures and personnel, 4) copy of plant identification stamp or tag, and 5) notification and resubmittal in the event of any changes to procedures and personnel, or the quality control plan.

c. Sampling and Testing Procedure. The Engineer's representative will select the test samples, at random, at the plant. Provide access to all facilities necessary for the Engineer's representative to randomly select samples from all bundles/charges as defined below. Samples for grading comparisons will be selected from material "in the white", and samples for comparison of treatment testing will be selected from the finished product. Provide plant personnel to handle and label necessary bundles/charges from the randomly selected samples.

(1) Lot size. All stock within a lot is subject to sampling unless exceptions are authorized by the Bureau Chief of Construction and Materials. Lots are defined separately for "in the white" and finished products:

(a) "In the white." The lot of wood that is subject to sampling for grading comparison includes all sizes and grades of material described in this specification that are in stock.

(b) Treated. The lot of wood that is subject to sampling for treatment comparison includes all finished products of material described in this specification that are in stock.

(2) The lot sample size will be:

(a) 10 bundles of "in the white", and

(b) 10 charges of finished product.

(3) Sample preparation. Storage and handling of the products will be evaluated during this phase.

(a) Transport the "in the white" bundles selected by the Engineer's representative to an area of the plant that will be suitable for breaking, re-grading, and re-bundling. Provide plant personnel to handle, break and re-bundle the randomly selected samples.

(b) Take borings from the finished product bundles where they are stored. They may need to be broken open and moved around for sampling access. Take borings of the finished product as described in the AWPA Standard M2, "Standard for Inspection of Wood Products Treated with Preservatives". Take 20 borings from each of the 10 selected charges of finished product. Assign each sample, consisting of the 20 borings, a unique identification number. Trim all 20 cores and grind as required by the test method. Place each sample in a sealed container and durably affix the sample identification number to each container. The sample, or a portion thereof, is tested by the plant. After plant testing is completed, combine the tested and untested portions of the sample so that comparison testing can be performed by KDOT. Conduct all sample preparation operations in the presence of the Engineer's representative.

(4) Testing.

(a) All items in each bundle "in the white" will be graded for comparison. Provide the Engineer's representative with the plant's grading for each "in the white" lot sampled for use in this comparison. The Engineer's representative will grade the test bundles according to the procedures and requirements of the applicable specifications and grading rules as referenced in **subsection 2301.2b.**

(b) Test each sample according to the procedures and requirements of the applicable AWPA Standard A9. For the purpose of comparing the plant and KDOT testing laboratories, each of the 10 samples is to be tested by each laboratory. Provide all the necessary facilities and test records required by the Engineer's representative to witness the tests. Record the plant test results onto a KDOT form and sign the form. Provide these results and the remaining companion samples to the Engineer's representative.

(5) Comparison of Test Results.

(a) KDOT grading results will be compared with the producer's results for the total of the sampled lot. The differences between KDOT and producer results may not exceed 5% of the sample total.

(b) KDOT's treatment testing results will be compared to the producer's results for each sample, taking into consideration the reproducibility expressed in the precision table in AWPA Standard A9. None of the samples may fall outside the acceptable range.

(c) A sample that fails the comparison requirements may be re-sampled 1 time only, and on a 2-for-1 basis (both samples must pass or the entire lot fails). It is preferable that the resample be removed from the same lot that failed if it is still available. The results of the resample specimens will replace the initial test results.

d. Plant Status.

(1) Attainment of prequalified status. In order for a plant to be prequalified to provide wood guardrail posts and spacer blocks, and wood sign support posts to KDOT projects, comply with the requirements referenced in **subsection 2301.4c. (5)**.

(2) Renewal of prequalified status. The following schedule will apply to plants that have attained their initial prequalification status:

(a) One year after the initial prequalification, the plant will again be evaluated according to **subsection 2301.4**.

(b) For plants that retain prequalification after the second evaluation, the next evaluation will be required after a 2-year time interval.

(c) For plants that retain prequalification after the third evaluation, the required evaluation time interval will be extended to 3 years thereafter provided the plant maintains continuous prequalification and is not disqualified.

(d) A prequalified plant that becomes disqualified may regain prequalified status at the next annual renewal inspection, but must comply with all the requirements that apply to initial prequalification including the re-inspection schedule outlined above. The disqualified plant may petition for an immediate re-evaluation provided it can be demonstrated that the disqualifying deficiencies have been corrected.

(e) A plant that chooses not to renew it prequalified status, but then later chooses to again prequalify must comply with all the requirements that apply to initial prequalification, including the re-inspection schedule outlined above.

(3) Disqualification. All prequalified plants that are currently providing wood posts for KDOT projects will have their product quality monitored through the use of verification inspections as described in **subsection 2301.4e.** Failure of 2 verification samples within 1 year of each other will result in disqualification of the plant and removal from the prequalified source list. In the event of disqualification, the plant is subject to the requirements of **subsection 2301.4d.(2)(d)**. A plant that fails to comply with these requirements 2 times, consecutive or otherwise, will be permanently disqualified unless an exception is granted by the Bureau Chief of Construction and Materials due to change in ownership, plant management or other significant reorganization.

e. Quality Assurance.

(1) Verification Inspections. During the course of each year, the Wichita Regional Materials Laboratory will randomly select a minimum of 1 project or contract containing wood posts provided by each of the prequalified plants. The Wichita Regional Materials Laboratory will contact the District administering these projects or contracts for scheduling of the field verification testing. Upon notification of a verification inspection, the Contractor is required to store materials in a manner allowing easy access for inspection and, upon arrival of the Engineer's representative, provide adequate manpower for the handling and re-stacking of the product.

(2) Verification Testing.

(a) All materials used on the project are considered to be 1 lot and will be subject to both grade and treatment verification testing. A minimum of 20 randomly selected pieces will be graded. In addition, a single sample, consisting of a single boring from each of the same graded pieces will be treatment tested. Borings will be taken as described in AWPA Standard M2 and tested in accordance with AWPA Standard A9. If the sample fails to meet the specifications for grading or treatment, it is cause for rejecting the entire lot.

(b) In the event that the verification samples fail to comply with the preceding, the Engineer's representative may randomly resample the lot 1 time only on a 2 to 1 basis, or reject the lot. If the lot is re-sampled, then both samples must pass, or the entire lot is rejected. The results of the resample specimens will replace the initial test results.

(c) The Contractor is to replace the rejected lot at no additional cost to KDOT. Remove the rejected lot from the job storage site.

(3) Verification Related Costs. KDOT costs for verification inspection and testing will be borne by KDOT. Excessive inspections for replacement of rejected material may be charged to the Contractor.

2301.5 BASIS OF ACCEPTANCE

a. The plant must be currently prequalified.

b. Provide the Engineer's representative of the project with a copy of plant test reports that govern the analysis of the wood post and block lots delivered to the project. Include a report of the preservative treatment analysis for each lot. Mail a copy of the reports to the Wichita Regional Materials Laboratory, Bldg. 1, 3200 E 45th N, Wichita, KS 67220. Verify that the project number and/or the contract number appear on each report.

c. Provide the Engineer's representative of the project with shipping orders, an invoice, or cover letter that documents the project number, wood post and block sizes, job, or producer order numbers, and the total number of each lot of the represented wood posts and blocks delivered to the project.

d. Provide the Engineer's representative of the project with a certification stating that the wood posts and blocks delivered to the project comply with this specification, and that the preservative treatment complies with the applicable AWPA standards. This documentation must bear the signature and title of an official of the plant with contract binding authority, and must be notarized. This requirement may be included on the test reports referenced in **subsection 2301.5b.**

e. As a minimum, wood posts and blocks must be legibly stamped with the lumber grade, producers' identification, and minimum specified treatment recorded in PCF.

f. The final disposition of the wood posts and blocks will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition and approval of the associated required documentation.

SECTION 2302

WOOD FENCE POSTS

2302.1 DESCRIPTION

This specification governs wood fence posts.

2302.2 REQUIREMENTS

a. General

(1) Unless shown otherwise in the Contract Documents, produce all posts provided under this specification to meet the applicable subsections.

(2) Quality Assurance inspection of wood fence posts will be done at the job site on a random, project by project basis as outlined in **subsection 2302.2d**.

(3) Wood species not listed but meeting or exceeding these specifications will be considered by the Bureau Chief of Construction and Materials upon written request.

(4) Unless shown otherwise in the Contract Documents, treat material listed under this section with a preservative treatment according to **subsection 2302.2c**.

b. Material Specifications and Grading Rules.

(1) General. Comply with the applicable parts of the following:

(a) Standard grading rules as set forth by Southern Pine Inspection Bureau.

(b) Standard grading rules as set forth by Western Wood Products Association.

(c) Product Standard 20 American Softwood Lumber Standard as set forth by the U. S. Department of Commerce.

(d) Any commercial grading rules that provide material of equal or greater quality may also be used. The burden of proof regarding the equality of the proposed rules lies with the supplier.

(2) Additional Requirements

(a) Provide round posts that comply with the dimensions and details shown in the Contract Documents.

(b) Cut the posts from round, live, sound, and solid trees, free of decayed wood, rot, red heart, and detrimental compression wood. Unsound knots are not permitted. Sound knots will be permitted provided the diameter of the knot does not exceed one-third of the diameter of the post where it occurs.

(c) Groups of knots, or any combination of defects which impair the strength more than the maximum knot size, will not be allowed.

(d) When measured over the outer 2 inch of a radial line from the pith, display the following results:

- Douglas Fir with less than 5 annual rings per inch.
- Southern Pine with less than 4 annual rings per inch.
- None with less than 30% of summer wood.

(e) Provide straight posts such that a line drawn from the center of the top to the center of the bottom does not fall outside the center of the post by more than 1 ½ inch.

(f) Do not permit the diameter of the bottom of the post to exceed the diameter of the top of the post by more than ¼ inch per linear foot of post. The diameter of the post must vary uniformly from top to bottom.

(g) Cleanly peel the posts with by mechanical process or by hand. Follow the natural taper of the post in machine peeling operations. Keep the post free from the glazed surface left by dried sap. Trim all protruding knots flush with the sided of the posts and remove all spurs and splinters. Saw both ends of each post square with the longitudinal axis of the post.

c. Preservative Treatment and Handling of Wood Products

(1) General. Treat all wood products with a wood preservative registered by the U.S. Environmental Protection Agency under the Federal Insecticide, Fungicide and Rodenticide Act.

(a) Unless shown otherwise in the Contract Documents, treat all wood products provided under this specification to meet the applicable subsections in American Wood Protection Association (AWPA) Standard U1, Commodity Section B: Posts, or AASHTO M 133.

(b) Treatment processes not listed but meeting or exceeding these specifications will be considered by the Bureau Chief, Construction and Materials, upon written request.

(2) Preservative Types. Use preservatives that comply with AWPA Standard U1, Commodity Specification A: Sawn Products or Commodity Specification B: Posts, or AASHTO M 133.

(3) Fabrication. Complete all adzing, boring, chamfering, framing, gaining, incising, surfacing, and trimming prior to treatment.

(4) Treatment Processes.

(a) Use preservative treatments that comply with the latest requirements of AWPA Standard U1 or AASHTO M 133.

(b) Stamp or tag each treated piece with the plant identification and minimum specified treatment recorded in pounds per cubic foot (PCF).

(5) Handling. Load, unload or transfer treated posts and blocks using procedures specified in AWPA M4, "Standard for the Care of Preservative-Treated Wood Products".

(6) Shipments. Do not ship treated material while still dripping. Unless kiln dried, retain it in the treatment yard for a minimum of 3 days. Retain the material in the treatment yard a minimum of 7 days when the ambient temperature remains below 60°F.

(7) Storage.

(a) Place treated wood products on treated or non-decaying skids or cribbing, that are positioned to support the material to minimize distortion.

(b) Stack and tightly band with spaced layers to permit air flow between each layer and minimize warping.

(c) Place the material in an area free of debris, decayed wood, and dry vegetation, and with sufficient drainage to prevent material from being subjected to standing water.

(8) Damage During Shipment. Damage affecting the utility of the item is cause for rejection.

d. Quality Assurance.

(1) Verification Inspections. During the course of each year, the Wichita Regional Materials Laboratory will randomly select a minimum of 1 project or contract containing wood fence posts provided by each of the supplying plants. The Wichita Regional Materials Laboratory will contact the District administering these projects or contracts for scheduling of the field verification testing. Upon notification of a verification inspection, the Contractor is required to store materials in a manner allowing easy access for inspection and, upon arrival of the Engineer's representative, provide adequate manpower for the handling and re-stacking of the product.

(2) Verification Testing.

(a) All materials used on the project are considered to be 1 lot and will be subject to both grade and treatment verification testing. A minimum of 20 randomly selected pieces will be graded. In addition, a single sample, consisting of a single boring from each of the same graded pieces, will be treatment tested. Borings will be taken as described in AWPA Standard M2, "Standard for Inspection of Wood Products treated with Preservatives" and tested in accordance with AWPA Standard A9, "Standard Method for Analysis of treated Wood and Treating Solutions by X-Ray Spectroscopy". If the sample fails to meet the specifications for grading, including additional requirements, or treatment, it is cause for rejecting the entire lot.

(b) In the event that the verification samples fail to comply with the preceding, the Engineer's representative may randomly resample the lot 1 time only on a 2 to 1 basis, or reject the lot. If the lot is re-sampled, then both samples must pass, or the entire lot is rejected. The results of the resample specimens will replace the initial test results.

(c) The Contractor is to replace the rejected lot at no additional cost to KDOT. Remove the rejected lot from the job storage site.

(3) Verification Related Costs. KDOT's costs for verification inspection and testing will be borne by KDOT. Excessive inspections for replacement of rejected material may be charged to the Contractor.

2302.3 BASIS OF ACCEPTANCE

a. Provide the Engineer's representative of the project with a copy of plant test reports that govern the analysis of the wood fence posts delivered to the project. Include a report of the preservative treatment analysis. Mail a copy of the reports to the Wichita Regional Materials Laboratory, Bldg. 1, 3200 E 45th N, Wichita, KS 67220. Verify that the project number and/or the contract number are on each report.

b. Provide the Engineer's representative of the project with shipping orders, an invoice, or cover letter that documents the project number, wood fence post sizes, job, or producer order numbers, and the total number of wood fence posts delivered to the project.

c. Provide the Engineer's representative of the project with a certification stating that the wood fence posts delivered to the project comply with this specification, and that the preservative treatment complies with the applicable AWPA standards. The documentation must bear the signature and title of an official of the plant with contract binding authority. This requirement may be included on the test reports referenced in **subsection 2302. 3 a.**

d. As a minimum, wood fence posts must be legibly stamped with the producers' identification, and minimum specified treatment recorded in PCF.

e. The final disposition of the wood fence posts will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition and approval of the associated required documentation.

SECTION 2303

FIELD HANDLING AND PRESERVATIVE TREATMENT OF WOOD PRODUCTS

2303.1 DESCRIPTION

This specification governs the field handling and preservative treatment of treated wood products.

2303.2 REQUIREMENTS

a. General.

(1) Apply preservative treatment to areas of field fabrication or minor injuries, cuts, abrasions, nail and spike holes sustained during shipment and handling, using procedures outlined below. Shipping damage affecting the structural integrity or utility of the item is cause for rejection.

(2) Apply the same type of treatment solution as that used in the original treatment. Use preservatives that comply with American Wood Protection Association (AWPA) Standard M4, “Standard for the Care of Preservative-Treated Wood Products”.

(3) A Copper Naphthenate complying with AWPA Standard P36, “Standard for Copper Naphthenate (CuN)” may be used in lieu of original treatment solution for field treatment only. With solvent, provide a Copper Naphthenate solution that contains a minimum of 2% copper metal.

b. Field Treatment.

(1) Protect field cuts, holes, framing, and injuries of treated materials by brushing, spraying, dipping, soaking, or coating the materials with the approved wood preservative solution.

(2) Take care to verify that all injuries, cuts, abrasions, nail and spike holes, and other damaged areas are thoroughly saturated with wood preservative solution according to AWPA Standard M4.

c. Field Handling. Load, unload or transfer treated wood products using procedures specified in AWPA M4. Use slings, padding, or any method to prevent or minimize damage to treated wood products. Treat any damage sustained during handling as specified above.

2303.3 TEST METHODS

None specified.

2303.4 PREQUALIFICATION

None required.

2303.5 BASIS OF ACCEPTANCE

Field treatment solutions will be accepted on the basis of receipt and approval of a Type A certification that includes a detailed formulation of the solution, including all ingredients and their percentages, and a material safety data sheet (MSDS) for the solution. Treatment will be accepted on the basis of visual inspection of the completed work.

SECTION 2401

WATER FOR USE WITH CEMENT

2401.1 DESCRIPTION

This specification covers water for use with cement.

2401.2 REQUIREMENTS

a. Source. Use only water from sources approved by the Engineer for cement. Approval of a water source may be withdrawn during construction if changes in quality occur.

b. Purity.

(1) Do not use water containing injurious quantities of oil, alkali, vegetable matter and salt.

(2) The water for use in cement cannot contain more than 0.25% solids by mass. If the specific conductance is less than 1500 mircomhos per cm., the total solids content requirement will be waived.

(3) Water for use in prestressed concrete must have less than 400 parts per million of chlorides when calculated as sodium chloride and less than 400 parts per million sulfates when calculated as sodium sulfate.

c. Mortar Strength and Time of Set. Mortar prepared with water submitted for approval can show no marked change in time of set and have no more than 10% reduction in mortar strength when compared to mortar made with water from an approved source.

2401.3 TEST METHODS

TABLE 2401-1: REQUIRED TEST METHODS

Requirement	Test Method
Specific Conductance	ASTM D 1125
Sodium Chloride	ASTM D 512
Sodium Sulfate	ASTM D 516
Total Solids	Standard Methods for Examination of Water and Wastewater, American Public Health Association, Inc.
Time of Set (Gillmore)	ASTM C 266
Mortar Strength	ASTM C 109

2401.4 PREQUALIFICATION

None Required.

2401.5 BASIS OF ACCEPTANCE

a. Acceptance of all water for prestressed concrete will be based on the results of tests conducted at MRC.

b. Water for use with cement in other applications will be accepted for use if it is obtained from a city water supply that is approved for domestic use by the Kansas Department of Health and Environment (KDHE). Water from other sources will be tested before acceptance for use.

SECTION 2402

WATER FOR MISCELLANEOUS USES

2402.1 DESCRIPTION

This specification covers water requirements for use with:

- Aggregate Base
- Cement Treated Base
- Cold In-Place Recycled Asphalt Construction
- Earthwork Compaction
- Emulsified Asphalt
- Flexible Pavement
- Fly Ash Treated Subgrade
- Hydrated or Quicklime
- Lime Treated Subgrade
- Stabilized Shoulders
- Subgrade Modification

2402.2 REQUIREMENTS

Use water that is reasonably clear, compatible with the materials to which it is to be added and free from excessive quantities of oil or vegetable matter. Approval of the water source by the Engineer is required before use.

2402.3 METHOD OF TEST

None Specified.

2402.4 PREQUALIFICATION

None Required.

2402.5 BASIS OF ACCEPTANCE

Acceptance of water will be based on visual examination by the Field Engineer and its performance during the progress of the work.

SECTION 2501

PART V

2501.1 GENERAL

In order to properly monitor materials on a project, follow all applicable procedures as outlined in the KDOT Construction Manual, Part V. This includes, but is not limited to, the sampling frequencies quantities and procedures; testing frequencies and procedures. Whenever a test procedure is required, use the Kansas Test (KT) procedures as outlined in Part V.

Copies of Part V can be obtained by contacting the Plans and Proposals Section in the Bureau of Construction and Materials, the local DME, or the Quality Assurance Section at MRC. **TABLE 2501-1** represents the current Part V revision dates applicable to the Contract.

TABLE 2501-1: PART V REVISION DATES

SECTION	TITLE	REVISED
5.1	GENERAL	2014
5.1.1	Materials Control Functions of the Bureau of Construction and Materials	2014
5.2	QUALITY CONTROL/QUALITY ASSURANCE	2014
5.2.1	Statistics	2014
5.2.2	Rounding Off and Random Sampling	2014
5.2.2.1	Rounding-Off of Numbers	2012
5.2.2.2	Random Sampling	2014
5.2.3	Reasons for Quality Control/Quality Assurance (QC/QA) and the Certified Inspection and Testing Training Program (CIT^2)	2014
5.2.4	Procedures for Quality Assurance	2010
5.2.5	Quality Control/Quality Assurance (QC/QA) Tests	2014
5.2.6	Comparison of Quality Control and Verification Tests	2014
5.2.7	Contractor's Quality Control Plan	2014
5.2.7.1	HMA: Contractor's Quality Control Plan	2014
5.2.7.2	Guide for Quality Control and Acceptance Requirements for HMA	2010
5.2.7.3	Example of a Laboratory Quality Manual for HMA	2014
5.2.7.4	Concrete: Contractor's Quality Control Plan	2015
5.2.7.5	Example of a Laboratory Quality Manual for Concrete	2015
5.2.7.6	Concrete Structures: Contractor's Quality Control Plan	2014
5.2.7.7	Example of a Contractor's Concrete Structures Quality Control Plan for Controlling Evaporation	2010
5.2.7.8	Cement Treated Base: Contractor's Quality Control Plan (CTB)	2014
5.2.7.8.1	Example of a Laboratory Quality Manual for CTB	2014
5.3	MIX DESIGN METHODS	2010
5.3.1	Concrete Mix Design	2010
5.3.2	Bituminous Mix Design	2014
5.3.3	Superpave Mix Design	2010
5.3.4	Mix Design Procedures for CIR (Cold in Place Recycling) Material	2015
5.4	LABORATORY AND SAMPLE IDENTIFICATION	2014
5.4.1	Laboratory Identification	2014

TABLE 2501-1: PART V REVISION DATES		
SECTION	**TITLE**	**REVISED**
5.4.2	Sample Identification	2014
5.4.3	Sample Identification Forms	2014
5.5	REQUIRED SAMPLE SIZES	2015
5.6	AGGREGATES	2014
5.6.1	General	2014
5.6.2	Types of Production	2014
5.6.3	Inspection Responsibilities	2014
5.6.4	Approval of Deposits	2014
5.6.5	Inspection, Sampling and Testing	2014
5.7	INSPECTION AND SAMPLING OF MATERIALS	2014
5.7.1	Asphalt Materials	2014
5.7.2	Brick and Concrete Masonry Units	2014
5.7.3	Concrete Curing Materials	2014
5.7.4	Joint Sealing and Joint Filler Material	2014
5.7.5	Miscellaneous Materials	2014
5.7.6	Miscellaneous Metals	2014
5.7.7	Bridge Paints and Pavement Marking Materials	2014
5.7.8	Culvert, Sewer, and Underdrain Pipe	2014
5.7.9	Cementitious Material	2014
5.7.10	Materials for Roadside Improvement	2014
5.7.11	Steel and Iron	2014
5.7.12	Timber, Lumber, Piling, and Posts	2014
5.7.13	Water for Use with Portland Cement	2014
5.8	NUCLEAR GAUGE	2014
5.8.1	1.13.2 SOM – RADIOLOGICAL SAFETY GUIDELINES	2014
5.8.2	Independent Assurance Replicate (ASR) Check for Nuclear Gauges	2010
5.8.3	Segregation Check Using the Nuclear Density Gauge	2014
5.8.4	Joint Density Evaluation Using the Nuclear Gauge	2014
5.9	SAMPLING AND TEST METHODS FOREWARD	2014
5.9.1 KT-1	Sampling and Splitting of Aggregates	2014
5.9.2 KT-2	Sieve Analysis of Aggregates	2015
5.9.3 KT-3	Material Passing No. 200 (75 µm) Sieve by the Wash Method	2014
5.9.4 KT-4	Percent Retained on the No. 200 (75 µm) Sieve by Dry Screening	2014
5.9.5 KT-5	Unit Weight of Aggregate	2014
5.9.6 KT-6	Specific Gravity and Absorption of Aggregates	2015
5.9.7 KT-7	Clay Lumps and Friable Particles in Aggregate	2014
5.9.8 KT-8	Shale or “Shalelike” Materials in Aggregate	2014
5.9.10 KT-10	Plasticity Test	2014
5.9.11 KT-11	Moisture Tests	2014

TABLE 2501-1: PART V REVISION DATES		
SECTION	TITLE	REVISED
5.9.12 KT-12	Standard Compaction Test	2014
5.9.13 KT-13	Field Density Tests of Soils, Treated Base Courses, and Water Bound Base Courses	2015
5.9.14 KT-14	Marshall Test of Bituminous Mixes	2015
5.9.15 KT-15	Bulk Specific Gravity and Unit Weight of Compacted Asphalt Mixtures	2014
5.9.16 KT-16	Deleted	2010
5.9.17 KT-17	Sampling Freshly Mixed Concrete	2012
5.9.18 KT-18	Air Content of Freshly Mixed Concrete by the Pressure Method	2015
5.9.19 KT-19	Air Content of Freshly Mixed Concrete by the Volumetric Method	2014
5.9.20 KT-20	Mass per Cubic Foot (Meter), Yield Cement Factor and Air Content (Gravimetric) of Freshly Mixed Concrete	2014
5.9.21 KT-21	Slump of Portland Cement Concrete	2012
5.9.22 KT-22	Making and Curing Compression and Flexural Test Specimens in the Field	2014
5.9.23 KT-23	Flexural Strength of Concrete (Third – Point Loading Method)	2015
5.9.24 KT-24	Determination of Free Moisture or Absorption of Aggregate for Use in Concrete	2014
5.9.25 KT-25	Sampling and Splitting Plant Mixed Asphalt Mixtures	2015
5.9.26 KT-26	Sampling Asphalt Materials	2012
5.9.27 KT-27	Sampling Joint Compound Materials	2014
5.9.28 KT-28	Sampling Bridge Paint	2012
5.9.29 KT-29	Field Sampling of Portland Cement, Lime and Fly Ash	2012
5.9.30 KT-30	Field Sampling of Thermoplastic Pavement Marking Material	2010
5.9.31 KT-31	Determination of Percentage of Crushed Particles in Crushed Gravel	2014
5.9.32 KT-32	Method of Test for Density of Compacted Asphalt Mixtures by Nuclear Method	2014
5.9.33 KT-33	Deleted See KTMR-39	2010
5.9.34 KT-34	Sieve Analysis of Extracted Aggregate	2014
5.9.35 KT-35	Sticks in Aggregate	2014
5.9.36 KT-36	Density of Freshly Mixed Concrete in Bridge Deck Overlays by Nuclear Gauge	2014
5.9.37 KT-37	Making, Curing, and Testing Cement Treated and Unbound Bases in the Laboratory	2014
5.9.38 KT-38	Density of Freshly Mixed Concrete in Pavement by Nuclear Gauge	2014
5.9.39 KT-39	Theoretical Maximum Specific Gravity of Asphalt Paving Mixtures	2014
5.9.41 KT-41	Determination of Density and Moisture Content of Portland Cement Treated Bases Aggregate Bases and Aggregate Shoulders by Nuclear Method	2014
5.9.42 KT-42	Sieve Analysis for Acceptance of Lime or Cement Treated Soils	2014
5.9.43 KT-43	Moisture Content of Asphalt Mixtures or Mineral Aggregates – Microwave Oven Method	2014
5.9.44 KT-44	Method of Testing the Strength of Portland Cement Concrete Using the Maturity Method	2014
5.9.45 KT-45	Determination of Dry Paint Film Thickness with the Magnetic Gauge	2010
5.9.46 KT-46	Determination of Pavement Profile with the Profilograph	2014
5.9.47 KT-47	Depth Determination of Hot – in – Place Recycled Asphalt Pavement (HIPR)	2014
5.9.49 KT-49	Method for Obtaining and Testing Drilled Cores from PCCP and Precast Girders	2015

TABLE 2501-1: PART V REVISION DATES		
SECTION	**TITLE**	**REVISED**
5.9.50 KT-50	Uncompacted Void Content of Fine Aggregate	2014
5.9.51 KT-51	Field Density and Moisture Tests of Soils by Nuclear Gauge	2015
5.9.54 KT-54	Deleted See KT-46	2010
5.9.55 KT-55	Plastic Fines in Combined Aggregates by use of the Sand Equivalent Test	2015
5.9.56 KT-56	Resistance of Compacted Asphalt Mixture to Moisture Induced Damage	2015
5.9.57 KT-57	Determination of Asphalt Content and Gradation of Hot Mix Asphalt Concrete by the Ignition Method	2014
5.9.58 KT-58	Method for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor	2014
5.9.59 KT-59	Flat and Elongated Particles in Coarse Materials Test	2014
5.9.60 KT-60	Indirect Tensile Test	2014
5.9.61 KT-61	Raveling Test on Recycled Asphalt Specimens	2010
5.9.62 KT-62	Percent Solids of Lime Slurry	2012
5.9.63 KT-63	Method for Determining Draindown Characteristics in Uncompacted Asphalt Mixtures	2014
5.9.64 KT-64	Method for Determining Volume of Voids in Compacted Filler or Fines	2014
5.9.65 KT-65	Sampling and Splitting Cement Treated Base Mixtures	2014
5.9.66 KT-66	Sampling Epoxy Pavement Marking	2010
5.9.67 KT-67	Sampling Glass Beads	2010
5.9.68 KT-68	Sampling Traffic Paint	2010
5.9.69 KT-69	Relative Density	2015
5.9.70 KT-70	Method for Testing Polymer Overlays for Surface Preparation and Adhesion	2014
5.9.71 KT-71	Air –Void Analyzer	2014
5.9.72 KT-72	Measuring Flowing Concrete	2014
5.9.73 KT-73	Density, Absorption and Voids in Hardened Concrete	2015
5.9.76 KT-76	Method for Testing the Compressive Strength of Molded Cylindrical Concrete Specimens	2014
5.9.77 KT-77	Method for Capping Cylindrical Concrete Specimens	2014
5.9.78 KT-78	Method for Determining the Tensile Adhesive Strength of Asphalt Pavement Tack Coat	2014
5.9.79 KT-79	Surface Resistivity of Concrete	2015
5.9.80 KT-80	Uncompacted Void Content of Coarse Aggregate	2014
5.9.81 KT-81	Sampling Cold Plastic Pavement Marking, Patterned Cold Plastic Pavement Marking Tape and High Durability Pavement Marking Tape	2015
5.9.82 KT-82	Determination of Excessive Moisture in Concrete Surfaces	2015
5.9.83 KT-83	Strand Bond in Prestressed Concrete Members	2015
5.10	CALCULATIONS	2010
5.10.1	Absolute Volume and Percent of Voids in a Unit Volume of Aggregate	2010
5.10.2	Theoretical Specific Gravity of a Combination of Aggregates	2010
5.10.3	Volume of Asphalt Materials	2012
5.10.4	Calculations for the Marshall Mix Design of Bituminous Mixtures	2012
5.10.5	Fineness Modulus of Aggregates (Gradation Factor)	2012

TABLE 2501-1: PART V REVISION DATES		
SECTION	**TITLE**	**REVISED**
	APPENDICES	
Appendix A	Sampling and Testing Frequency Chart – Non Quality Control/Quality Assurance Specifications	2015
Appendix B	Sampling and Testing Frequency Chart – Quality Control/Quality Assurance Specifications	2015
Appendix C	Test Procedure Criteria for the Independent Assurance Program	2014
Appendix D	Policy and Procedure Manual for the Inspection of Kansas Department of Transportation District Laboratories	2014

2501.2 KANSAS TEST, MATERIALS AND RESEARCH (KTMR) TEST METHODS

KTMR tests are procedures found at MRC and are not expected to be performed in the field. Copies can be obtained by contacting the Quality Assurance Section at MRC if required within a specification.

TABLE 2501-2: KTMR TEST METHODS	
TITLE	**TEST NUMBER**
Determination of Polymer Additive Percentages in Polymer Modified Asphalt Cements	KTMR-2
Permeability for Base Course Material	KTMR-5
Determination of Alkyd Base in Thermoplastic Material	KTMR-6
Roundness of Glass Beads for Traffic Markings	KTMR-7
Moisture Resistance of Glass Beads for Traffic Markings	KTMR-8
Field Evaluation of Pavement Marking Materials	KTMR-9
Removability of Temporary Pavement Marking Tape	KTMR-10
Rotational Capacity Testing of High Strength Fasteners - FHWA Supplemental Specification	KTMR-11
Dry to No-Pick-Up Time for Water-Borne Traffic Paint	KTMR-12
Method of Test for Determination of Volume Change of Soils	KTMR-14
Determining if Fly Ash is Present in Plastic Portland Cement Concrete or Portland Cement	KTMR-15
Testing of Dowel Bars Placed in Concrete for Resistance to Removal (Pull Out)	KTMR-16
Recovery of Asphalt from Solution by Abson Method	KTMR-18
Method of Testing Release Compounds for Asphalt Mixes	KTMR-19
Chemical Analysis of Asphalt Rejuvenating Agents	KTMR-20
Soundness and Modified Soundness of Aggregates by Freezing and Thawing	KTMR-21
Durable Aggregate Test	KTMR-22
Wetting and Drying Test of Sand-Gravel Aggregate for Concrete	KTMR-23
Procedures for Testing Lightweight Aggregates	KTMR-24
Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inches or [50 mm] Cube Specimens)	KTMR-26
Modified Specific Gravity and Absorption of Aggregate	KTMR-27
Determination of Total Acid Insoluble Residue	KTMR-28
Wetting and Drying Test of Steam Cured Reinforced Concrete Pipe with Fly Ash	KTMR-29
Preparation of Bridge Coating Test Panels for Cyclic Corrosion/UV Exposure	KTMR-30
Solvent Test for Artificial Wood	KTMR-31
Particle Size Analysis	KTMR-32

TABLE 2501-2: KTMR TEST METHODS	
TITLE	**TEST NUMBER**
Durable Aggregate Test	KTMR-33
Determining Dynamic Modulus of Hot-Mix Asphalt Concrete and Cold-in-Place Recycle Mixtures	KTMR-34
Strand Bond in Prestressed Concrete Members	KTMR-36
See KT-61	KTMR-38
Bitumen Content of Paving Mixtures By Reflux Extraction	KTMR-39
See KT-69	KTMR-40

2501.3 AASHTO TEST METHODS

In addition to the test methods referenced above, the following American Association of State Highway and Transportation Officials (AASHTO) test methods are used as written in the current edition of the AASHTO Materials Manual, Part II. Copies can be obtained from AASHTO, or can be viewed at the offices of the local DME, Construction and Materials Headquarters, or the Quality Control Section in MRC.

TABLE 2501-3: AASHTO TEST METHODS	
TITLE	**AASHTO TEST METHOD**
Organic Impurities in Fine Aggregates for Concrete	AASHTO T 21
Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine	AASHTO T 96
Lightweight Pieces in Aggregate	AASHTO T 113

SECTION 2601

MATERIALS CERTIFICATIONS

2601.1 DESCRIPTION

This specification governs the requirements for the content and distribution of certifications when dictated, in part or in whole, as the basis of acceptance for a material.

2601.2 REQUIREMENTS

a. General

(1) The contractor is responsible for obtaining all certifications and arranging for their delivery to the proper destinations prior to use of the material and allowing sufficient time for review as stated herein.

(2) **Provide the following information on all certifications regardless of type.**

(a) Identification of the organization submitting the certification.

(b) KDOT project number and KDOT contract number.

(c) Name of contractor.

(d) Identification markings on the shipment. As a minimum, this must include the name of the manufacturer. Also include the lot or heat number referenced in the certification, the serial number if applicable, and the date of manufacture if available.

(e) Quantity of material represented by the certification. If multiple lot/heat numbers are submitted, the quantity should be listed per lot/heat number.

(f) KDOT Contract line number (bid item) and item code number of the material represented by the certification.

(g) Statement that all material complies with the applicable specifications. List the specifications by responsible organization, number, section reference or other appropriate identification.

(h) Additional information as required in the specification for the material, or as added requirements for the various types of certifications in **subsection 2601.2b** below.

(3) The general information outlined above may be provided by the supplier on a cover sheet to the manufacturer's certification(s). An example of a cover sheet is included at the end of this specification. Verify that the cover sheet and certification(s) are so well cross referenced and identified as a unit that they can be reunited if accidently separated.

(4) When lot or heat numbers are required in a certification, the manufacturer is required to provide information with regard to the typical quantity of material and production time intervals represented by these numbers. Also include the dates of manufacture for the lots or heats involved. This information will be evaluated by the KDOT and may constitute a basis for rejection if the quantities or time intervals are considered excessive.

(5) A signature is not required on laboratory reports or manufacturer's certifications unless specifically required by other applicable specifications. However, the document must clearly identify the organization submitting the report or certification. The organization submitting certifications, reports, and related written statements is responsible for the contents of these documents whether they are signed or not.

b. Types of Certifications.

(1) Type "A" certification. This certification is to include a copy of the results of tests conducted by the manufacturer's or other qualified laboratory on samples obtained from the lot or lots of material in the shipment.

When a mill test report is submitted as the laboratory report, the quantity in the shipment does not need to be included on the report, provided that the identifying heat or lot numbers involved are roll stamped, embossed, or durably affixed to each item of material in the shipment represented by the report. In this case, provide the necessary quantity information on a cover sheet, clearly identifying the quantity of each heat or lot in the shipment.

(2) Type "B" certifications. This certification is to include a current summary of the maximum to minimum range of the manufacturer's quality control test results as determined by the manufacturer's or other qualified laboratory. These summaries must provide data on all major specification requirements. Also include the range of lots and manufacture dates represented by the data. When combining multiple components into a single item, submit a detailed parts summary indicating the lot/heat number, part description and quantity for each part. Summary reports dated more than six months prior to the date of manufacture or shipment of the product will not be

accepted. The Engineer of Tests may also request copies of detailed test reports for material produced during a specified time interval for verification of the certification.

(3) Type "C" certifications. This certification is to include a statement certifying that the material in the shipment is essentially the same as material that is prequalified.

(4) Type "D" certifications. This certification is to comply with **subsection 2601.2a**.

(5) Type "E" certifications. This certification applies to assemblies or structures that are composed of two or more components or materials. These components or materials have been approved previously on an individual basis for KDOT projects, but lose their identity when they are incorporated into an assembly or structure. This certification would apply to signs, overhead sign and lighting structures, etc. The certification is to state that all the components or materials used in the fabrication of the represented assembly or structure were previously approved for KDOT use.

c. Responsibility for Preparation. The manufacturer of the individual item is responsible for preparing certifications of Type "A", Type "B", Type "C", and Type "D" certifications. The fabricator or assembler of individual items is responsible for preparing a Type "E" certification.

d. The Engineer reserves the right to sample and test any material or product that is governed by a certification. If deviations from the applicable specifications are found, the results will be reviewed by the Engineer to determine the final disposition of the material or product. Serious deviations may be cause for removal from prequalified status.

e. Distribution of Certifications.

(1) Types "A" and "B" certifications.

(a) Submit one copy of the certification via hard copy or e-mail to:

Materials and Research Center
Attn: Materials Certification Technician
2300 Van Buren
Topeka, KS 66611
E-mail address: typeABcerts@ksdot.org

These certifications will be evaluated for compliance with the applicable specifications as well as this section. The appropriate personnel will be notified of a certification's disposition status through the issue of a hardcopy or electronic report, whichever is most expedient.

(b) Submit one copy to the Field Engineer responsible for the project construction.

(2) Types "C," "D" and "E" certifications.

(a) Issue one copy to the Field Engineer responsible for the project construction.

(b) Do not issue these certifications to the Bureau of Construction and Materials, the Materials Certification Technician, or the Engineer of Tests unless they are specifically requested.

f. Certification of Aggregates. Provide the Engineer a certification for each classification of aggregate utilized in a project.

(1) Aggregates Delivered to the Site: Certify each classification of aggregate delivered to a project or product preparation site. Prepare these certifications under the signature of the aggregate producer or their designated representative.

(a) Certify aggregates that are tested at their destination to determine final disposition as to the locations of the deposits from which they were produced.

(b) Certify aggregates that are tested at their production site to determine final disposition. These certifications state that the aggregates were removed from a KDOT tested and approved stockpile at the production site, or that they were removed from a plant while it was producing aggregate that was in compliance with the applicable specifications.

(2) Aggregates Incorporated into the Project: At locations where aggregates and products that incorporate aggregates are produced for KDOT **and** non-KDOT use, provide certifications stating that only KDOT tested and approved aggregate was provided for the KDOT projects.

(3) Frequency of Certification:

(a) Prior to the initial delivery of aggregates to a project or product preparation site, provide the Engineer a certification. This certification is to be under the signature of the aggregate producer or their designated representative and state that all aggregates to be provided for the project are in compliance with all the applicable KDOT specifications.

(b) Upon completion of the project, provide certifications as specified in **subsection 2601.2f.(1) and (2)** of this specification to the Engineer. These certifications apply to all aggregates that were delivered to the project or product preparation site and ultimately used in the project.

These certifications are to indicate the approximate quantities in tons or cubic yards of each aggregate delivered to the project and the approximate quantities in tons or cubic yards of each aggregate delivered to the product preparation site and incorporated into a product that was utilized in the project.

2601.3 TEST METHODS

Not applicable.

2601.4 PREQUALIFICATION

Not applicable.

2601.5 BASIS OF ACCEPTANCE

When certifications are incorporated into a material or product specification, acceptance will be based on the following:

a. All applicable requirements are complied with. This includes the requirements of this section as well as the requirements of specifications unique to the product or material.

b. The final disposition of any product or material will be completed at the final destination as the result of inspection for the quality of workmanship and the delivery condition.

2601 - MATERIALS CERTIFICATIONS

Date:

Submitted by: (include name, address, phone number, email address)
(Note, as per the specification, although the Contractor is responsible to submit certifications, the party submitting them is responsible for the contents of this certification packet.)

Kansas Department of Transportation
Materials Certifications
2300 Van Buren
Topeka, Kansas

Project Number:

Contract Number:

Line Number: **Item Code:**

Contractor Name:

ID Markings on Shipment:

Additional Information:

This is to certify that the following items furnished by our firm for use on the reference project meet or exceed the requirements of section _____ of the _____ edition of the Kansas Department of Transportation Standard Specification.

or

This is to certify that the following items furnished by our firm for use on the reference project meet or exceed the requirements of special provision _____ of the _____ edition of the Kansas Department of Transportation Standard Specification.

Quantity	Description	Heat/Lot	Manufacturer

Total quantity if applicable

PAY ITEMS INDEX

A

B

D

E

M

O

P

Q

R

S

T

U

W

SUBJECT INDEX

A

B

SUBJECT INDEX

C

F

P

Q

R

S

T

U

V

W

Z