

# PROPOSAL CONTRACT

FOR THE CONSTRUCTION OF

**Contract No. 111887**

PIN: 129888.00

County: Wilson

State Project No.: 95LPLM-F3-011

Local Agency Reference No.: 15-00-00-0000

Description Of Project: Hartsville Pike Resurfacing and Intersection Improvement Project

Project Length: 1.13 Miles

Completion Time: On or Before 3/31/18

By: \_\_\_\_\_

City, \_\_\_\_\_

St.: \_\_\_\_\_

Surety: \_\_\_\_\_

TDOT Version: 3/9/18

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***The above Supplemental Specifications, revised as noted, are incorporated by reference for bidding purposes and will be printed with the Contract after awards. These Supplemental Specifications may be obtained from the Department at Suite 700, James K. Polk Bldg., Nashville, Tennessee or viewed on the Department’s website at <http://www.tn.gov/tdot/section/tdot-construction-division>.***

Special Provisions.....	Special Provision Number, Regarding: .....	<u>Date</u>
102B	Unbalanced Bids .....	02/17/2015
102I	Employing & Contracting w/Illegal Immigrants.....	10/10/2016
108A	Specialty Items .....	N/A
1275	Debarment, Suspension, etc. ....	01/01/2015
1290	Non-Discrimination in Employment.....	01/01/2015

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## **ATTENTION**

It shall be the bidders' responsibility to confirm that the Proposal Contract contains all the documents indicated on the Table of Contents.

Should any omissions occur, the appropriate documents may be obtained from the Construction Division upon request.

**THE CITY OF LEBANON**

**INSTRUCTIONS TO BIDDERS**

**BIDS TO BE RECEIVED**

**11/15/2018**

Sealed bids for the construction of the following projects will be received by the CITY OF LEBANON, **200 North Castle Heights Avenue, Lebanon, TN 37087200 North Castle Heights Avenue, Lebanon, TN 37087** until **10:00 AM 11/15/2018** and opened publicly at **200 North Castle Heights Avenue, Lebanon, TN 37087200 North Castle Heights Avenue, Lebanon, TN 37087, 10:00 AM 11/15/2018**. The reading of the bids will begin at **10:00 AM**.

The proposed construction shall be performed in accordance with the most current version of the Standard Specifications for Road and Bridge Construction of the Tennessee Department of Transportation, and the Standard Roadway and Structures Drawings of the Tennessee Department of Transportation which are incorporated herein by reference and made a part hereof. In addition, only the Special Provisions contained within the applicable Proposal Contract will be considered binding. Any reference to any Special Provision not contained within the applicable Proposal Contract shall be disregarded. All questions related to the Proposal Contract, Plans, Specifications or Special Provisions shall be directed to the **Engineering Department (615-888-9393)**. Information received from other offices of the CITY OF LEBANON strictly advisory.

**IMPORTANT NOTICE TO BIDDERS:**

Prospective bidders should read the following instructions carefully before submitting their bids. Special attention is called to the regulations of the CITY OF LEBANON that total bids, rather than unit prices, will be read. Proposals shall be rejected as being irregular if they fail to contain a unit price for each item listed. Extensions of the various items must be sub-totaled, carried forward, and shown as a grand total following the last proposal item. All entries must be in ink.

After a bidder has deposited a proposal with the CITY OF LEBANON, he can withdraw it only on written request in accordance with Subsection 102.07 of the Tennessee Department of Transportation Standard Specifications.

Totals read at the opening of the bids are not guaranteed to be correct and no final award of the contract will be made until bids and extensions have been checked and re-checked.

On all projects which are financed in whole or in part by funds received through Federal agencies and/or the Tennessee Department of Transportation, the awarding of contracts by the CITY OF LEBANON will be subject to approval by the Tennessee Department of Transportation. The CITY OF LEBANON reserves the right to reject any bid proposal which is not acceptable to the parties as listed, although such bid proposal would otherwise qualify as

the lowest and best bid under the Tennessee Department of Transportation Standard Specifications.

The CITY OF LEBANON reserves the right to reject any or all Proposals, to waive technicalities or to advertise for new Proposals, if in the judgment of the awarding authority and subject to TDOT concurrence, the best interest of the CITY OF LEBANON will be promoted thereby.

The CITY OF LEBANON reserves the right to cancel the award of any Contract, at any time prior to execution of said Contract by all parties without any liability against the CITY OF LEBANON.

The awarding of the contract or rejection of all proposals will be made within 60 days after the formal opening of the proposals. Upon award, a detailed letter of instructions will be forwarded along with appropriate documents to the low bidder.

The CITY OF LEBANON hereby notifies all bidders, that it will affirmatively insure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full opportunity to submit bids in response to this invitation and will not be discriminated against on the basis of age, race, color, religion, national origin, sex or disability in consideration for an award.

The CITY OF LEBANON is an equal opportunity affirmative action employer, drug-free, with policies of nondiscrimination on the basis of race, sex, religion, color, national or ethnic origin, age, disability, or military service.

#### **PREQUALIFICATION OF BIDDERS:**

Each prospective bidder and subcontractor will be required to file a document entitled "Prequalification Questionnaire." The foregoing shall be filed on a form provided by the Tennessee Department of Transportation. The form must be filled out completely, and the truth and accuracy of the information provided must be certified by a sworn affidavit signed by an officer, partner, owner or other authorized representative of the applicant who has authority to sign contracts or other legal documents on behalf of the applicant. A prospective bidder must be prequalified by and in good standing with the Tennessee Department of Transportation prior to the issuance of a proposal form. A prospective subcontractor must be prequalified by and in good standing with the Tennessee Department of Transportation prior to being approved as a subcontractor. Each prospective bidder or subcontractor shall notify the Tennessee Department of Transportation if there is any subsequent change in the name, organization or contact information provided.

Prospective bidders' "Prequalification Questionnaire" shall be filed with the Tennessee Department of Transportation at least fourteen (14) days prior to the date of opening bids on any letting in which the applicant intends to submit a bid to the CITY OF LEBANON, or at least fourteen (14) days prior to the date on which the applicant requests approval as a subcontractor under a contract awarded by the CITY OF LEBANON. Bidders intending to submit proposals consistently shall complete and submit the prequalification application annually; however, this document may be changed during such period upon submission of additional favorable reports or upon receipt by the Tennessee Department of Transportation of substantiated evidence of unsatisfactory performance. The Tennessee Department of Transportation reserves the right to

request additional information and documentation to clarify and/or verify any information submitted in an applicant's prequalification application.

**The prequalification form can be found at the web address  
<http://www.tn.gov/tdot/section/tdot-construction-division>**

A proposal to be used for non-bidding purposes may be issued to any interested party regardless of prequalification. **This proposal Contract will be marked "Void for Bidding"**. A contractor that has purchased a proposal contract that was marked "void for bidding" can buy another book once they are fully prequalified before the bid date.

### **LICENSING REQUIREMENTS**

According to the types of funds used, contractor bidding requirements differ. When using State or Local Government funds and without any Federal funds, proposals shall be completed as described below:

Proposals shall be submitted by a bidder licensed with the Tennessee Department of Commerce and Insurance (TDCI), Board for Licensing Contractors (BLC) on construction contracts where the total cost is twenty-five thousand (\$25,000) or more. In accordance with T.C.A. 62-06-119, proposals and bid documents shall be prepared and administered as follows:

#### **62-06-119. Bid documents -- Penalties.**

(a) Any person or entity preparing plans, specifications or any other documentation for inclusion in an invitation to bid or comparable bid document including any electronic bidding documents, shall reference this chapter in such documentation and include a specific statement informing the invited bidder that it is necessary for such bidder to be properly licensed at the time of the bid and provide evidence of compliance with the applicable provisions of this chapter before such bid may be considered.

(b) The person or entity involved in the preparation of the invitation to bid or comparable bid documents, including any electronic bid documents, shall direct that the following information be written upon the bid envelope or provided within the electronic bid document:

(1) The name, license number, expiration date thereof, and license classification of the contractor applying to bid for the prime contract;

(2) The name, license number, expiration date thereof, and license classification of the contractor applying to bid for the masonry contract where the total cost of the materials and labor for the masonry portion of the construction project exceeds one hundred thousand dollars (\$100,000);

(3) The name, license number, expiration date thereof, and license classification of the contractor applying to bid for the electrical, plumbing, heating, ventilation, or air conditioning contracts except when such contractor's portion of the construction project is less than twenty-five thousand dollars (\$25,000);

(4) For each vertical closed loop geothermal heating and cooling project, the company name, department of environment and conservation license number, classification (G, L or G,L) and the expiration date, except when the geothermal portion of the construction project is in an amount less than twenty-five thousand dollars (\$25,000);

(5) Prime contractor bidders who are to perform the masonry portion of the construction project which exceeds one hundred thousand dollars (\$100,000), materials and labor, the electrical, plumbing, heating, ventilation or air conditioning or the geothermal heating and cooling must be so designated; and

(6) Only one (1) contractor in each of the classifications listed above shall be written on the bid envelope or provided within the electronic bid document.

(c) Failure of any bidder to furnish the required information shall void such bid and such bid shall not be considered. Upon opening of the bid envelope or initial opening of an electronic bid, the names of all contractors listed shall be read aloud at the official bid opening and incorporated into the bid. Prior to awarding a contract, the awarding person or entity and its authorized representatives shall verify the accuracy, correctness and completeness of the required information, and any discrepancies found in the spelling of names of bidders, transposition of license numbers, or other similar typographical errors or omissions may be corrected within forty-eight (48) hours after the bid opening excluding weekends and state-recognized holidays.

(d) No invitation to bid may require that any subcontractor be identified, listed or designated until the final bid submission by the prime contractor, or that any prime contractor accept the bid of any subcontractor until the final bid submission by the prime contractor. This subsection (d) shall apply only to design/bid/build procurements where cost is the primary criterion for the contract award.

(e) Any person or entity, public and private, awarding a bid to a contractor who is not licensed in accordance with this chapter shall be subject to the penalty provided in T.C.A. 62-06-120(b).

(f) Notwithstanding the Uniform Administrative Procedures Act, compiled in title 4, chapter 5, relative to the amount of civil penalties that may be imposed, the board may impose a civil penalty not to exceed five thousand dollars (\$5,000) for willful violation of this section.

Because TDOT work classifications and the BLC licensing classifications slightly differ, the Local Government will verify only that the apparent low bidder is licensed in the general classification (e.g., Heavy Construction (HC), Highway, Railroad, Airport Construction (HRA), Specialty (S), Municipal and Utility Construction (MU), or Electrical Contracting (CE)) and not the specific subcategories of these classifications for the type of work involved in the project. This is in recognition that the prime contractor is required to complete 30% of the specific project work and may subcontract the remainder of the work.

Title 48 of Tennessee Code requires all contractors and subcontractors that are domestic or foreign Corporations, Limited Liability Companies, Limited Partnerships, or Limited Liability Partnerships to be in good standing with the Secretary of State (i.e., have a valid Certificate of Existence/Authorization). This includes being duly incorporated, authorized to transact business, and/or in compliance with other requirements as detailed by the Secretary of State.

Bidders that are domestic or foreign corporations, limited liability companies, limited partnerships, or limited liability partnerships, must be in good standing with the Secretary of State (i.e., have a valid Certificate of Existence/Authorization) on or before twenty-one (21) days after proposals are opened.

## **PROPOSAL BOND**

Each proposal must be accompanied by a bidder's bond, or Cashier's Check, or Certified Check made payable to the CITY OF LEBANON in an amount equaling not less than five percent (5%) of the amount bid. In the case of optional items in the proposals, the amount of the bidder's bond or check must be in an amount equaling not less than five percent (5%) of the total amount of the bid based on the high option.

If the bidder's bond is offered as guaranty, the bond must be on the form furnished by the CITY OF LEBANON and made by a surety company, qualified and authorized to transact business in the State of Tennessee and must be acceptable to the CITY OF LEBANON.

If a check is offered as guaranty, the check of the successful bidder will be cashable at the discretion of the CITY OF LEBANON, pending the satisfactory execution and acceptance of the contract and the contract bond.

## **ISSUANCE OF BIDDING DOCUMENTS**

This CITY OF LEBANON and the Tennessee Department of Transportation are on a cash basis for sales of Plans, Proposal Contracts, Standard Specifications, Standard Drawings, Standard Drawing Books and Tabulations of Bids. Requests for documents must be accompanied by cash, check, money order, or they may be mailed to the buyer C.O.D.

A charge of **\$50.00** plus **9.25%** sales tax, for in-state delivery, will be made for each Proposal Contract. This charge is applicable regardless of whether the Proposal is to be used for bidding or non-bidding purposes. Proposals will be obtainable until the time set for opening bids. The charge for Plans and/or Cross-sections will be as specified in the Notice to Contractors and this charge will be applicable before the letting and for three months after the letting. Plans ordered after the three month period will be furnished at **\$1.00** per sheet. Individual Plan sheets and individual Standard Drawings will be furnished at **1.00** per sheet. Tabulations of bids will be furnished at **\$1.00** per sheet. Tennessee Department of Transportation Standard Drawing Books will be furnished by the Tennessee Department of Transportation at **\$100.00** per book plus **9.25%** sales tax, for in-state delivery. The most recent version of the Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction will be furnished by the Tennessee Department of Transportation at **\$12.00** per book plus **9.25%** sales tax, for in-state delivery. There will be a minimum charge of \$2.00 on any purchase. All documents will be furnished without refund and transmitted at your risk.

When two or more contractors wish to bid together in a joint venture, each contractor will be required to make a written request for such a proposal to the CITY OF LEBANON. This request shall be signed by an authorized signatory of each firm.

Requests for joint venture proposals may be made in person or by telephone. However, the proposal for said joint venture will not be issued until the request in writing, as set forth above, is received by the CITY OF LEBANON.

## **REJECTION OF PROPOSALS**

Proposals will be rejected as irregular if prior to the formal opening of the Proposal all of the following documents have not been signed: (1) the bidder shall sign by written signature the Proposal form, (2) the bidder shall sign by written signature the Proposal Certification form, (3)



the bidder shall sign by written signature the Proposal Bond form or the Proposal Guarantee, whichever is applicable, (4) the Agent or Attorney-in-Fact representing a Surety Company shall sign by written signature the Proposal Bond, if applicable. In addition, Proposals will be rejected if any of the above signatures are a reproduced copy, such as, but not limited to a photostatic copy or a facsimile transmission. An original, dated and valid Power of Attorney for the Attorney-in-Fact must accompany the Proposal and the Contract. The accompanying Power of Attorney must be dated, and the date must be the exact same date as the date on the Proposal Bond. The Proposal and the Proposal Bond, including the attached Power of Attorney, shall be valid and binding for 60 days subsequent to the date of opening bids.

Proposals shall be completed on the forms as issued. Proposals will be rejected as being irregular if they are not prepared on the prescribed forms; if they show any omissions, alterations of form, additions, or conditions not called for, unauthorized alternate bids, or irregularities of any kind; or if they fail to contain a unit price for each item listed. Proposals may be rejected if any of the unit prices contained therein are mathematically unbalanced, either excessive or below the Engineer's Estimate.

Written alterations to unit prices and extensions of the various items in the bid item sheets of the Proposal or, for computer assisted bids (CAB), in the CAB program generated set of bid item sheets will not be cause for rejection of the Proposal, provided each alteration is made in ink and is initialed by a duly authorized official of the company. In case of conflict between altered unit prices or extensions thereof, the unit price in numerals will govern.

The Plans and Specifications are as much a part of the proposal form as if they were bound therein. All of the documents contained therein are part of the proposal. Proposals shall not be taken apart. Proposals taken apart may be subject to rejection. Photostatic or facsimile copies of Proposal sheets may not be attached to the Proposal. Proposals containing forms not issued by the CITY OF LEBANON may be subject to rejection.

Proposals will be rejected as irregular if the bidder fails to acknowledge all addenda.

Proposals will be rejected as irregular when submitted by a bidder who is not prequalified and in good standing on the date of letting in accordance with Subsection 102.01 of the Tennessee Department of Transportation Standard Specifications and Chapter 1680-5-3, Prequalification of Contractors, of the Rules of the Tennessee Department of Transportation.

Proposals will be rejected as irregular when submitted by a bidder who is not licensed according to the requirements as detailed above.

Reasonable grounds for believing that there has been collusion among the Bidders will cause a rejection of all Proposals in which the Bidders involved are interested.

#### **ADDENDA**

Addenda to the Proposal will be acknowledged by all bidders. Failure to acknowledge receipt of Addendum Letters is grounds for rejection.

#### **RETAINAGE**

Effective for all contracts, the CITY OF LEBANON will not hold retainage. In addition, the Contractor will not be able to hold retainage from the subcontractor.

### **SUBCONTRACTS**

Your special attention is called to Section 105 - Control of Work, and Section 108 - Prosecution and Progress of the Tennessee Department of Transportation Standard Specifications, concerning duties of the contractor and subletting of contracts.

### **CHANGED CONDITIONS**

Your special attention is called to Section 104.02 of the Tennessee Department of Transportation Standard Specifications, concerning changed conditions on this contract.

The following information applies to Federal-Aid construction projects:

**NOTICE TO ALL BIDDERS**

**To report bid rigging activities call:**

**1-800-424-9071**

**The U.S. Department of Transportation (DOT) operates the above toll-free "hotline" Monday through Friday, 8:00 a.m. to 5:00 p.m. eastern time. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report such activities.**

**The "hotline" is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.**

**S T A T E**

(Rev. 3-30-15)  
(Rev. 11-16-15)  
(Rev. 6-27-16)  
(Rev. 12-2-16)  
(Rev. 5-15-17)  
(Rev. 11-6-17)  
(Rev. 5-14-18)  
(Rev. 7-2-18)  
(Rev. 10-8-18)

**O F**

**T E N N E S S E E**

January 1, 2015

**Supplemental Specifications - Section 100**

**of the**

**Standard Specifications for Road and Bridge Construction**

**January 1, 2015**

**Subsection 101.03** (pg. 10) 5-15-17; Terms - Add the following definition for Specialty Items:

“**Specialty Item.** Work items identified in the contract which are not bid normally associated with highway construction and require highly specialized knowledge, abilities, craftsmanship, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid on the contract in general, these items are to be limited to minor components of the overall contract.”

**Subsection 102.11** (pg. 18), 3-30-15; Licensing of Bidders Add the following to the second paragraph:

“The Department may retain the Proposal Guaranty, not as a penalty, but as liquidated damages in the event a bidder does not have a license at the time of award.”

**Subsection 104.04** (pg. 27), 3-30-15; Maintenance of Traffic - Add the following as the first full paragraph on page 27:

“If a holiday falls on Saturday or Sunday, do not close lanes or restrict traffic from the preceding Friday at 6 am to the following Monday at 6 am.”

**Subsection 105.03** (pg. 38), 12-2-16; Conformity with Plans and Specifications - Add the following to the end of the section:

“Products listed on the QPL which fail to comply with Departmental performance expectations shall be removed from the QPL. Products removed from the QPL shall be replaced with an equivalent product from the QPL. At the Departments discretion, an equitable adjustment may be made to the contract for invoice price deviations.”

**Subsection 105.03** (pg. 38), 6-27-16; Conformity with Plans and Specifications - Add the following to the end of the section:

“All products must be listed on the Qualified Products List (QPL) and perform as specified at the time of use regardless of Letting date. Any products removed from the QPL or that do not perform as specified, must be supplied or replaced at the Contractor’s expense.”

**Subsection 105.06** (pg. 40), 3-30-15; Planning of the Operations-Preconstruction Conference - Replace 2<sup>nd</sup> sentence of 1<sup>st</sup> paragraph:

“The contractor must attend a preconstruction conference arranged by the Engineer.”

**Subsection 105.10** (pg. 46), 5-15-17; Authority and Duties of Inspectors - Revise 2<sup>nd</sup> sentence of the first paragraph:

“Such inspection may extend to any part or to all of the Work and to the preparation, fabrication, or manufacture of materials to be used.”

**Subsection 105.11** (pg. 46), 5-15-17; Inspection of Work - Revise the 1<sup>st</sup> sentence:

“The Engineer or its representative will inspect all materials and each part or detail of the Work .”

**Subsection 105.13** (pg. 48), 5-15-17; Completion of Specific Sections of a Project - Remove the 2<sup>nd</sup> paragraph.

**Subsection 105.15** (pg. 49), 5-15-17; Acceptance - Remove last paragraph:

**Subsection 106.06** (pg. 61), 5-15-17; Field Laboratory - Revise the first paragraph of A. and subsection A.2:

“Provide a Type A Laboratory consisting of a building, room, or dedicated area having at least 120 square feet of floor area with a minimum width of 8 feet and a minimum height of 7 feet. Provide laboratory space that is floored, roofed, sealed inside, weather-tight,

and furnished with electricity. Furnish the space with adequate work benches, cabinets, and drawers. Provide suitable heat and air conditioning, and equip the laboratory with a laboratory oven capable of maintaining a temperature of  $230\text{ }^{\circ}\text{F} \pm 9\text{ }^{\circ}\text{F}$ . Stove tops and hot plates may be used to determine moisture conditions of aggregates. Provide lights, electrical outlets, and adequate ventilation for the tests being performed.

When the determination of aggregate gradation is required, furnish the following equipment:

1. Scales of appropriate capacity and design to weigh the required samples. Scales are to be sensitive to within 0.2% of the sample to be weighed. Provide standard weights for scale calibration.
2. Screens of appropriate size and mesh to separate the samples into the required series of sizes. Woven wire cloth shall conform to AASHTO M 92. Screens for running gradations of coarse aggregates shall meet AASHTO T27.
3. A mechanical shaker approved by the Engineer and suitable for running both coarse and fine aggregate.
4. Facilities to perform wash tests according to AASHTO T 11 that include an adequate and suitable water supply.”

**Subsection 107.08** (pg. 69), 5-15-17; Protection of Streams, Lakes, and Reservoirs - Add the following to the end of the third paragraph:

“All costs associated with any support activities including obtaining permission from landowners, permits, and compliance are to be included in the bid cost for the project.”

**Subsection 107.08** (pg. 71), 11-6-17; Migratory Birds - Add the following as section E:

“E. Migratory Birds

The following procedure will be automatically implemented by TDOT, unless FWS approves in writing deviations due to special circumstances, or for a specific variance.

Cliff swallow and barn swallow nests, eggs, or birds (young and adults) will not be disturbed between April 15 and July 31. From August 1 to April 14, nests can be removed or destroyed, and measures implemented to prevent future nest building at the site (i.e., closing off area using netting).

Exceptions:

- (1) If there are no eggs in the nests prior to April 15, TDOT will be allowed to destroy the nests and prevent further nest building at the site, by installing netting. Net openings shall be ½ inch or smaller after installation, and shall be installed securely and in such a manner that it will not pose a safety hazard. Absence of eggs prior to net

installation must be documented by using appropriate means for determination, such as, but not limited to, site visits and photographs.

(2) If there are no birds (young or adult) left in any of the nests at a specific site prior to July 31, the nests can be removed or destroyed. Absence of birds must be documented by using appropriate means for determination, such as, but not limited to, site visits, photographs, and observations of no birds using the nests.

Osprey, Double Crested Cormorants, Great Horned Owls, Barn Owls, Black Vulture, and Eastern Phoebes:

If these avian species are encountered on a bridge project, TDOT Ecology should be contacted immediately for further assistance.

The Contractor will be assessed the amount of any and all fines and penalties assessed against and cost incurred by TDOT which are the result of the Contractor's failure to comply with this specification. TDOT will not be responsible for any delays or costs due to the Contractor's failure to comply. Additional compensation or contract time due to noncompliance will not be granted.

All costs incurred with this specification will not be measured or paid for separately, but will be considered included in the contract unit prices bid for other items of the contract."

**Subsection 108.01** (pg. 78) 5-15-17; Subletting of Contract - Add the following list of specialty items:

"Do not sublet, allow second tier sublet, sell, transfer, assign, or otherwise dispose of the Contract or any portion thereof or a right, title, or interest in the Contract without the Engineer's written consent. If the Engineer consents to subletting or second tier subletting a portion of the Contract, the Contractor shall self-perform work amounting to not less than 30% of the total original Contract cost. For items designated in the Contract as "specialty items," the Contractor may sublet or second tier sublet this work and deduct the cost of such specialty items from the total original cost before computing the amount of the Work required to be self-performed by the Contractor with its own organization.

As stated above, unless there is a Special Provision 108A in the proposal, the following items are designated as Specialty Items:

Item 105-01 - Construction Stakes, Lines and Grades

Item 202-01.02 – Removal of Asbestos

Item 209 - EPSC Item 411-12. \*\*Shoulder Scoring

Item 501-03.12 – Concrete Shoulder Rumble Strip

Item 602-03 - Steel Structures

Item 602-04 - Steel Structures

Item 602-10.13 / .14 - Navigational Lighting Item 602-10.81 – Heat Straightening

Item 603-02 - Repainting Steel Structures

Item 603-05 - Containment and Disposal of Waste

Item 604-04.01 - Applied Texture Finish (New Structures),  
Item 604-04.02 - Applied Texture Finish (Existing Structures)  
Item 604-04.62 - Clean and Texture Finish Median Barrier  
Item 604-05.31 - Bridge Deck Grooving (Mechanical)  
Item 604.07 – Retaining Wall  
Item 604-42.01 – Underwater Divers  
Item 606-26.05 – Core Drilling for Piles (Abandoned)Item 617 - Bridge Deck Sealant  
Item 624 – Retaining Wall Items  
Item 625-01.08,10,11 – Inclinator, Drilled Shaft Inspections  
Item 640 - Weigh Station Items  
Item 705 - Guardrail, Anchors, etc.  
Item 706 - Guardrail Items  
Item 707 - Fencing ItemsItem 712 - Traffic Control Items  
Item 713 - Signing Items  
Item 714 - Lighting Items  
Item 716 - Pavement Marking Items  
Item 720-03, 720-04, 720-05, 720-06, 720-07, 720-08, 720-09 – Railroad Highway Crossing  
Item 721-01.06 – Irrigation System Repair  
Item 721-10, 721-11.20, 721-11.30, 721-12 – Landscape and Irrigation  
Item 725 – ITS items  
Item 730 - Traffic Signal Items  
Item 7\*\* - Utility Items  
Item 750.01 – Mitigation Site  
Item 801 - Seeding  
Item 802 - Landscaping Items  
Item 803-01 - Sodding  
Item 805 - Erosion Control  
Item 806 - Project Mowing”

**Subsection 108.09** (pg. 90) 5-14-18; Failure to Complete the Work on Time - Table 108.09-1:  
Modify the Daily Charge (\$/Day) as shown below:



**Table 108.09-1: Liquidated Damages for Failure to Complete the Work on Time**

<b>Original Contract Amount (\$)</b>	<b>Daily Charge (\$/day)</b>
0 to 500,000	400.00
> 500,000 to 1,000,000	580.00
> 1,000,000 to 2,000,000	800.00
> 2,000,000 to 10,000,000	1,000.00
>10,000,000 to 20,000,000	1,600.00
>20,000,000	2,500.00

**Subsection 109.01** (pg. 98-100) 11-16-15; Measurement of Quantities, E. Weight; Remove the 12<sup>th</sup> paragraph and replace with the following:

“The scales shall be checked by an independent certified scale company. The check shall be performed on a semiannual basis; January through June and July through December. The results shall be maintained onsite and made available for review to Departmental personnel. If deficiencies are reported, all corrections shall be performed, documented, and verified prior to supplying material for TDOT projects.”

**Subsection 109.01** (pg. 98-99) 5-15-17; Measurement of Quantities, E. Weight, Modify the 6<sup>th</sup> paragraph to the following:

“Employ a Certified Public Weigher as defined in the Certified Public Weigher Law of 1981, Tennessee Code Annotated, Section 47-26-801, et seq., as amended. The Engineer will measure all applicable materials in accordance with the Certified Public Weigher Law and Department policy on scales approved by the Engineer. Provide weight (haul) tickets in accordance with Department policy and as directed by the Engineer. These requirements apply to entities located both inside and outside the state of Tennessee”

**Subsection 109.01** (pg. 98-100) 5-15-17; Measurement of Quantities, E. Weight, Modify the 12<sup>th</sup> paragraph to the following:

“The scales shall be calibrated and certified by an independent certified scale company. The calibration and certification shall be performed on a semiannual basis; January

through June and July through December. Scales shall be validated on a quarterly basis to ensure their continued accuracy. Validation shall be made by a verified known weight, or other scales that are approved by the Department or other State agency. A verified known weight shall be checked for continued accuracy each time the scales are calibrated. The results shall be maintained onsite and made available for review to Departmental personnel. If deficiencies are reported, all corrections shall be performed, documented, and verified prior to supplying material for TDOT projects.”

**Subsection 109.01** (pg. 98-100), 11-9-17; Measurement of Quantities E. Weight, Revise subsection to the following:

“E. Weight

The term “ton” will mean the short ton consisting of 2,000 pounds avoirdupois.

Unless otherwise specified, the Engineer will accept certified weights for materials measured or proportioned by weight that are shipped by rail or truck transport, provided that only the actual weight of the material used is paid for.

For bituminous materials, net certified scale weights or weights based on certified volumes in the case of rail or truck transport shipments, unless otherwise specified, will be used as a basis of measurement, subject to correction when bituminous material has been lost, wasted, or otherwise not incorporated in the Work.

In all cases where measurement of materials is based on certified weights, provide the Engineer with certified weigh bills showing the net tons of materials received in each shipment. The Engineer will not pay for materials in excess of the amounts represented by the certified weigh bills.

Certified Weigh Tickets for Asphalt Mixtures and Aggregate Materials shall list on the ticket:

1. Date
2. Time
3. The ticket number
4. Gross weight of the loaded truck
5. Tare weight of the truck
6. Net weight of the material to be paid
7. Running Daily Total for the particular material
8. Truck number

## 9. Truck Legal limit

Employ a Certified Public Weigher as defined in the Certified Public Weigher Law of 1981, Tennessee Code Annotated, Section 47-26-801, et seq., as amended. The Engineer will measure all applicable materials in accordance with the Certified Public Weigher Law and Department policy on scales approved by the Engineer. Certified Weigher licenses shall be posted near the scale beam or weight indicator in full view at all times. Certified Weigher shall be the only person allowed to operate the scale or weigh recording equipment. Provide weight (haul) tickets in accordance with Department policy and as directed by the Engineer. These requirements apply to entities located both inside and outside the state of Tennessee.

Certified Weigher shall weigh each load with the maximum load not to exceed the legal limit established by law. The proposed haul route shall be known prior to deployment.

Provide a standard brand of platform truck scales with a sufficient rated capacity to weigh the maximum gross load to which they will be subjected. Do not use truck scales to measure weights in excess of the manufacturer's rated capacity. Clearly post the manufacturer's rated capacity on the scale manufacturer's plate and in the shelter provided for the weigher.

At the time of installation or modification of existing scales, test the scales before using to ensure they are within the allowable tolerances. Use a qualified scale technician to perform any alteration (e.g., electrical readout) or change in the rated capacity. Document all changes or alterations made by the scale technician and furnish a copy of the documentation to the Department.

House the recording mechanism of the scale in a suitable shelter furnished with adequate light, heat, chairs, tables, and storage drawers as needed for the convenience of the weigher. In addition, keep the scale platform and scale pit free of debris that could affect the accuracy of the scales.

Provide digital readout and scale printers as the primary weight indicator or as accessory equipment. The Department will inspect and approve all scale control and recording equipment.

Ensure the scale's accuracy within a tolerance of 0.5%. Provide a straight approach at each end of the platform scale in the same plane as the platform and of sufficient length and width to ensure the level positioning of vehicles longer than the scale platform during weight determinations. Weigh each truck and trailer with no brakes set on any wheel. Locate the scale platform so that surface water will drain away from it and to allow for an adequate foundation of concrete or other approved materials. Construct the foundation of

sufficient strength and durability to withstand repeated capacity loading without affecting the accuracy of the scales.

The scales shall be calibrated and certified by an independent certified scale company. The calibration and certification shall be performed on a semiannual basis; January through June and July through December. Scales shall be validated on a quarterly basis to ensure their continued accuracy. Validation shall be made by a verified known weight, or other scales that are approved by the Department or other State agency. A verified known weight shall be checked for continued accuracy each time the scales are calibrated. The results shall be maintained onsite and made available for review to Departmental personnel. If deficiencies are reported, all corrections shall be performed, documented, and verified prior to supplying material for TDOT projects.

Weigh tickets shall be certified either manually or electronically. If certified manually, the Certified Weigher shall sign his official registered signature and place his seal on the original ticket. The ticket shall be filled out in ink and delivered to the project site with the material.

For materials directly paid for by the ton, the Engineer will be furnished a daily recap of all materials delivered to the project. The daily recap sheet must list the ticket number, type of material by item number, and a quantity of materials for each load hauled. Any discrepancy between the certified weigh bills and the daily recap will be reviewed along with the contractor's initialed copy of weigh bills.

Due to possible variations in the specific gravity of aggregates, the tonnage used may vary from the proposal quantities and the Department will not make adjustments in the Contract unit price because of such variations.

The truck tare to be used in the weighing operation shall be the weight of the empty truck determined with full tank(s) of fuel and the operator seated in the cab. A daily weight shall be recorded at the beginning of each work day prior to use of truck. If preferred, a new tare may be determined for each load. When a new tare is obtained for each load, the requirement for full tank(s) of fuel shall be waived.

All weight of trucks shall be recorded to the nearest 20 pounds. The cost of providing facilities and equipment for the accurate weighing, proportioning, or measuring of materials is incidental to the associated pay items in the Contract.”

**Subsection 109.01** (pg. 98-100), 10-8-18; Measurement of Quantities, E. Weight - Replace the last sentence to the previously modified 6<sup>th</sup> paragraph with the following:

“Loads in excess of the Legal Weight limit shall be rejected and no payment will be issued.”

**Subsection 109.02** (pg. 100-101), 11-9-17; Replace the last paragraph:

“Document on the Prompt Payment Certification Form the actual amount paid to all subcontractors, during the estimate period for which the certification is being made. Ensure all Disadvantaged Business Enterprise (DBE) or certified Small Business Enterprise (SBE) are listed and classified on the form, including DBE or SBE off-site haulers and DBE or SBE material suppliers”

**Subsection 109.02** (pg. 100-101), 7-2-18; Scope of Payment - Remove paragraphs 5, 6 and 7, beginning with, “Provide a monthly payment certification....” and replace with the following:

**“Scope of Payment**

The Department will pay, and the Contractor agrees to accept, the compensation provided in the Contract for the work acceptably completed and measured for payment under each Contract item. Payment of a Contract item is full compensation for furnishing all materials, equipment, tools, labor, and incidentals required to complete the item; and for all risk, loss, damage, or expense arising out of the nature or the performance of the work, subject to **107.19** and **109.11**.

If the "Basis of Payment" clause in the Specifications relating to a unit price in the bid schedule requires that the price of the Contract item cover and be considered compensation for certain work or material essential to the item, the Department will not measure or pay for this same work or material under any other pay item that may appear elsewhere in the Specifications.

When two or more projects are included in the same Contract, the Contractor will be required to furnish any item listed in the Contract to any or all of the projects at the Contract unit price.

The Department requires that the Contractor pay subcontractors, material suppliers, and haulers promptly for their work after receipt of payment for the associated work from the Department. The Contractor shall pay each subcontractor, material supplier, and hauler for work performed or materials supplied under its subcontract no later than thirty (30) calendar days from the date the Contractor receives payment for the work from the Department. Any payment to the Contractor from which any amount has been withheld in accordance with **107.19** or **109.11** shall constitute full payment for the associated work, and the Contractor shall remain obligated to pay all subcontractors, material suppliers,

and haulers fully and promptly for all associated work. The same prompt payment requirements apply to subcontractors at all tiers.

Ensure each subcontractor, including all Disadvantaged Business Enterprises (DBE), certified Small Business Enterprises (SBE), and DBE or SBE haulers or material suppliers, has registered for AASHTOWare Project Civil Rights & Labor (CRL) prior to commencing Work.

Document within CRL the actual amount paid to all subcontractors, material suppliers, and haulers during the monthly estimate period for which the certification is being made. The Department will withhold estimate payments if the required information is not submitted or if subcontractors, at any tier, material suppliers, or haulers are not paid after the thirty (30) calendar day time period. Any delay or postponement of payment beyond the thirty (30) calendar day time frame will be subject to terms listed in TCA §12-4-707(b). The Contractor shall remain obligated to pay all subcontractors, material suppliers, and haulers fully and promptly for all work associated with a pay estimate from the Department, notwithstanding any withholding of payment from the Contractor for failure to pay a subcontractor, material supplier, or hauler within thirty (30) calendar days.

The prime contractor, subcontractors, at any tier, material suppliers, or haulers shall not withhold any retainage from progress payments made to their subcontractors.

**Subsection 109.04** (pg. 106), 3-30-15; Replace C. Force Account, 4. Equipment, c. with:

“Idle or standby cost will not be paid for more than 8 hours in a day or 40 hours in a week”.

**S T A T E**

**O F**

**T E N N E S S E E**

(Rev. 5-18-15)  
(Rev. 11-16-15)  
(Rev. 12-2-16)  
(Rev. 5-15-17)  
(Rev. 5-14-18)  
(Rev. 10-8-18)

January 1, 2015

**Supplemental Specifications - Section 200**

**of the**

**Standard Specifications for Road and Bridge Construction**

**January 1, 2015**

**Subsection 201.03 Clearing and Grubbing, A. General** (pg. 118-119), 5-15-17; remove the third paragraph:

**Subsection 201.03 Clearing and Grubbing, C. Clearing and Grubbing Activities, 5. Borrow Pit Areas** (pg. 120), 5-15-17; remove the last sentence in the last paragraph:

“In areas approved as borrow pits by the Engineer, clear and grub all trees, stumps, brush, and heavy vegetation.

In areas designated for obtaining construction material other than borrow, clear and grub trees, stumps, brush, and vegetation, and strip overburden lying above the material to be obtained.

Complete this work prior to removing borrow or construction materials.”

**Subsection 202.03 General** (pg. 125), 5-15-17; remove the last sentence of the 2<sup>nd</sup> paragraph:

“Remove materials designated for salvage in readily transportable pieces, and store the removed pieces at specified locations within the Project limits. Replace with new material, at no additional cost to the Department, those materials designated for salvage that are damaged during removal, transport, or storage operations. Take ownership of material not designated for the Department’s use, and dispose of such material beyond view from the Project limits.”

**Subsection 203.02 B. Borrow Excavation** (pg. 134), 5-15-17; remove the last sentence of the 1<sup>st</sup> paragraph:

“Borrow Excavation consists of material required for the construction of embankments or other portions of the work.”

**Subsection 203.04** (pg. 139), 5-15-17; add 5. to the list of provisions:

- “1. The cost of this material is more economical than borrow excavation.
2. The material is available within the adjusted balance where the shortage exists or the material may be hauled outside the limits of adjusted balance if the cost of the material is more economical than borrow after considering the additional cost of overhaul.
3. The material can be excavated without blasting.
4. There is a minimum of 20 feet between the top of the existing slope and the top of the new slope and a minimum of 5 feet between the top of the new slope and right-of-way line or Control Access fence. The 20-foot minimum will not apply when the existing slope is 4:1 or flatter or to overlapping or near overlapping slopes in medians or between parallel roads or ramps. The Engineer may reduce the 20-foot minimum at the Contractor’s written request.
5. The material has not been designated as potentially acid producing material.”

**Subsection 203.04** (pg. 139-140), 5-15-17; add the 2<sup>nd</sup> paragraph as follows, revise the 5<sup>th</sup> paragraph to remove the reference to the *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects*:

#### “E. Borrow Areas

Notify the Engineer before opening any borrow area to allow adequate time for the Engineer to take cross-section elevations and measurements of the ground surface after being stripped, and to test the borrow material before use. Obtain approval for the borrow area according to the *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects*. Allow at least 14 days for testing borrow materials or other material from roadside pits proposed for construction purposes.

Borrow materials shall not contain acid producing materials. Representative samples of the proposed borrow material shall be tested for pH (EPA600/2-78-054 or ASTM D4239). Material with a pH less than 5 is considered acid producing and will not be accepted.

Unless otherwise allowed, do not place borrow material until after the roadway excavation material has been placed in the embankments. If the Contractor places more borrow than is required and thereby causes a waste of excavation, the Department will deduct the amount of such waste from the measured borrow volume. Do not excavate beyond the dimensions and elevations established.



The Contractor may remove highway fencing to obtain borrow materials. Replace the fencing removed with new fence at no cost to the Department, and assume responsibility for confining livestock, as necessary.

Excavate borrow pits to be self-draining where possible and practicable, and of a shape that can be easily cross-sectioned.

After completing excavation operations, provide the area with a neat appearance. Cover all self-draining borrow areas with topsoil and stabilize. Provide and place topsoil and seeding (with mulch) as specified in **203.06** and **801**, respectively.

For borrow pits 1 acre or larger in size that are not self-draining, refer to Sections 53-801 through 53-809 of the TCA. Full information regarding the requirements to be complied with and the necessary permits that the property owner must secure for the construction of a pond, lake, borrow pits, etc., 1 acre or larger that is not constructed to drain, will be supplied upon application to the TDEC.”

**Subsection 203.07** (pg. 141-142), 5-15-17; replace the last paragraph:

“Ensure the offsite disposal grading plan is properly designed (including but not limited to slope stability and fill placement recommendations) regulated, and implemented.”

**Subsection 204.06 – 2** (pg.152-154), 5-14-18; replace Table 204.06-3 with the following:

**Table 204.06-3: Specification Limits for EFF**

<b>Property</b>	<b>Specification Limit</b>
Air content (ASTM D6023)	Maximum 30% <sup>(1)</sup>
Load Application (ASTM D6024)	24 hours maximum in any condition
Consistency	15 inches minimum as tested per <u>204.06.B.1</u>
Compressive strength (ASTM D4832) <sup>(2)</sup>	30 psi minimum at 28 days 100 psi maximum at 28 days

<sup>(1)</sup> When using air entrained mixture design  
<sup>(2)</sup> ASTM D4832 4 x 8 inch cylinder molds may be used. The preferred capping method to be used is wetsuit neoprene restrained in rigid retainers.

**Subsection 204.06 – 2** (pg.152-154), 5-18-15; replace Tables 204.06 with the following:

1. General Use Flowable Fill

**Table 204.06-2: Specification Limits for General Use Flowable Fill**

<b>Property</b>	<b>Specification Limit</b>
Load Application (ASTM D6024)	24 hours maximum in any condition
Consistency	15 inches minimum tested as specified in this <b>204.06.B.1</b>

Page 153

2. Excavatable Flowable Fill (EFF)

**Table 204.06-3: Specification Limits for EFF**

<b>Property</b>	<b>Specification Limit</b>
Air content (ASTM D6023)	Maximum 30% <sup>(1)</sup>
Load Application (ASTM D6024)	24 hours maximum in any condition
Consistency	15 inches minimum as tested per <b>204.06.B.1</b>
Compressive strength (ASTM D4832) <sup>(2)</sup>	30 psi minimum at 28 days

<sup>(1)</sup> When using air entrained mixture design

<sup>(2)</sup> ASTM D4832 4 x 8 inch cylinder molds may be used. The preferred capping method to be used is wetsuit neoprene restrained in rigid retainers.

Page 154

3. Early Strength Flowable Fill (ESFF)

**Table 204.06-4: Specification Limits for ESFF**

<b>Property</b>	<b>Specification Limit</b>
Air content (ASTM D6023)	Maximum 30% <sup>(1)</sup>
Load Application (ASTM D6024)	6 hours maximum in any condition
Consistency	15 inches minimum as tested per <b>204.06.B.1</b>
Compressive strength (ASTM D4832) <sup>(2)</sup>	30 psi minimum at 24 hours

<sup>(1)</sup> When using air entrained mixture design

<sup>(2)</sup> ASTM D4832 4 x 8 inch cylinder molds may be used. The preferred capping method to be used is wetsuit neoprene restrained in rigid retainers.

**Subsection 204.06** (pages. 153-154) 11-16-15; Excavatable Flowable Fill - delete the first sentence of the first full paragraph after Table 204.06-3 on page 153, Early Strength Flowable Fill – delete the first sentence of the second paragraph below Table 204.06-4 on page 154

**Subsection 204.11** (pg. 162), 12-2-16; Revise Section B. Pipe Culverts as follows:

**“B. Pipe Culverts**

**1. Placing Backfill Material.** After the bedding has been prepared and the pipe installed, backfill the trench with bedding material, fine compactable soil selected from excavation or borrow, or both, as shown on the Plans. Before backfilling concrete pipe, allow the joints to cure as specified in **607.07**. Place the material along each side of the pipe in layers not more than 8 inches in loose depth. Moisten or dry, if necessary, each layer to near optimum moisture content and thoroughly compact with mechanical tampers. Thoroughly compact the material under the haunches of the pipe and ensure that the backfill material is in intimate contact with the side of the pipe. Uniformly place and raise backfill on both sides of the pipe for the full required length. Except as may be required for the imperfect trench method, place backfill material for the full depth of the trench.

**2. Placing Embankment Material.** When the top of the pipe is above the top of the trench, place and compact embankment material in layers of not more than 8 inches in loose depth for a width on each side of the pipe equal to at least twice the horizontal inside diameter of the pipe or 12 feet, whichever is less. The embankment on each side of the pipe, for a distance equal to the horizontal inside diameter of the pipe, shall be of the same material and compacted in the same manner as specified for backfill in **204.11.B.1**. For the remainder of the fill material, use soil that can be readily compacted and that contains no frozen lumps, chunks, or plastic clay, stones that would be retained on a 3-inch sieve, or other objectionable material. Compact the material as required for backfill or by rolling as specified in the applicable requirements of **204**. Place the embankment

material evenly on both sides of the pipe for the full width of the roadbed up to an elevation a minimum of 1 foot above the top of the pipe. Above this elevation, and also above the top of a backfilled trench that is 1 foot or more above the top of the pipe, place embankment as specified in the applicable requirements of **205**, except for those requirements related to the imperfect trench method.

**3. Plastic Pipe.** For plastic pipe, work structural backfill into the haunch area and compact the materials by hand after placing the pipe. Special compaction means may be necessary in the haunch area. Place structural backfill in layers of not more than 8 inches in loose lift thickness and bring up evenly and simultaneously on both sides of the pipe to an elevation not less than 1 foot above the pipe. Use a vibratory plate to achieve a minimum compaction level of 90% Standard Proctor Density according to AASHTO T 99. Do not use hydrohammer type compactors over the pipe. Obtain the Engineer's approval of all compaction equipment."

**Subsection 205.04** (pg. 175) 10-7-19, Formation of Embankments, add the following sentence to the 2<sup>nd</sup> paragraph on the original page:

"The Department inspector conducting the density tests shall be a certified Nuclear Gauge Technician."

**Subsection 206.03** (pg. 180-181), 5-15-17; remove the reference to the *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects* in the next to last sentence of the first paragraph:

"Perform final dressing by hand work and machines to produce a uniform satisfactory finish to all parts of the roadway and other components of the Project. Shape the roadbed, shoulders, ditches, and slopes to within reasonably close conformity to the specified lines, grades, and cross-sections. Dress spoil banks, borrow areas, waste areas, and similar areas. Clear rock cuts of all loose fragments, and leave in a neat, safe, and workmanlike condition."

**Subsection 209.01** (pg.190), 5-15-17; revise the 1<sup>st</sup> sentence of the 2<sup>nd</sup> paragraph:

"Implement erosion prevention and sediment control (EPSC) measures during all phases of construction. Ensure that all EPSC measures shown on the Stormwater Pollution Prevention Plan (SWPPP) are in place before beginning soil disturbing activities."

**STATE**  
(Rev. 11-16-15)  
(Rev. 6-27-16)  
(Rev. 12-2-16)  
(Rev. 5-15-17)  
(Rev. 10-8-18)

**OF**

**TENNESSEE**  
January 1, 2015

**Supplemental Specifications - Section 300**  
  
**of the**  
  
**Standard Specifications for Road and Bridge Construction**  
  
**January 1, 2015**

**Subsection 303** (pg. 220), 10-8-18; Mineral Aggregate Base, Remove 303.04 Sodium Chloride from Index.

**Subsection 303.01** (pg. 220) 5-15-17; add the following sentence as the last sentence of the 2<sup>nd</sup> paragraph:

“Mineral aggregates base shall be Type A or Type B, whichever is shown on the Plans and called for in the bid schedule. Reclaimed Concrete Aggregate (RCA) may be used as an alternate for Type A or Type B base material.”

**Subsection 303.02** (pg. 220-221) 5-15-17; add the following sentence to the last sentence of the 1<sup>st</sup> paragraph:

“Depending upon whether the Plans require Type A or Type B base, provide mineral aggregate meeting 903.05. For Type A base, use aggregate of Grading D. For Type B base, the Contractor may use aggregate of Grading C or D. For RCA, use grading specified in 903.05-C.”

**Subsection 303.04** (pg. 221) 10-8-18; Sodium Chloride, remove all information pertaining to Sodium Chloride from subsection:

~~“303.04 Sodium Chloride  
Provide sodium chloride meeting 921.03.”~~

**Subsection 303.07** (pg. 222-223) 5-15-17; modify the 1<sup>st</sup> sentence of the 1<sup>st</sup> paragraph to the following:

“Construct Mineral Aggregate Base, Type A, Type B, or RCA in one or more layers, to the compacted thickness shown on the Plans.”

**Subsection 303.08** (pg. 223-224) 5-15-17; add the last sentence to the last paragraph of subsection A:

“For Mineral Aggregate Base, Type A, use the stationary plant method. For Mineral Aggregate Base, Type B, requiring the blending of two or more materials, use either the stationary plant method or the road mix method (mechanical mixer), except as provided for in 903.05. For Mineral Aggregate Base, Type B, requiring additive, use either stationary plant mixing

or road mixing. When using RCA as a replacement for Mineral Aggregate Base, Type A or Type B, use the intended method of mixing for the material listed above.”

**Subsection 303.08** (pg. 225) 10-8-18; Mixing, B. Use of Calcium Chloride and Sodium Chloride, Remove all information pertaining to Sodium Chloride:

**“B. Use of Calcium Chloride ~~and Sodium Chloride~~**

If using calcium chloride, incorporate it in either the solid or liquid form, at the approximate rate of 6 pounds per ton of aggregate, noting that:

- 6 pounds is equivalent to 1.29 gallons 60 °F 32% solution
- 6 pounds is equivalent to 1.02 gallons 60 °F 38% solution

~~If using sodium chloride, incorporate it at the approximate rate of 5 pounds per ton of aggregate.~~

For stationary plant mixing, proportion chloride material, in solid form, through a hopper equipped with an approved vibratory feeder and an adjustable opening capable of accurately controlling the flow of material. Proportion calcium chloride liquor using an approved calibrated meter that has a registering capacity capable of indicating the total amount of liquid used during any single day’s operation.

For road mixing, add the chloride material to the aggregate at the point in the mixing operation and in the manner directed by the Engineer.”

**Subsection 303.10** (pg. 225-227) 5-15-17; add subsection c.:

**“2. Density Requirements**

- a. **Type A Base.** The average density of each lot of Type A base, unless otherwise specified, shall be within 100% of maximum density as determined according to AASHTO T 99, Method D, with no individual test less than 97% of maximum density.
- b. **Type B Base.** The average density of each lot of Type B base, unless otherwise specified, shall be not less than 97% of maximum density as determined according to AASHTO T 99, Method D, with no individual test being less than 95% of maximum density.
- c. **RCA Base.** The average density of each lot of RCA base, unless otherwise specified, shall be not less than 100% of maximum density as determined according to AASHTO T 99, Method D, with no individual test less than 97% of maximum density. The moisture content shall be within  $\pm 3\%$  of the optimum moisture content as determined by an independent laboratory analysis. Mixing of the material with water shall be completed per Section 303.08.”

**Subsection 303.14** (pg. 228) 5-15-17; revise the first sentence of A.:

**“A. Mineral Aggregate for Mineral Aggregate Base, Type A or Type B, or RCA**

The Department will measure Mineral Aggregate for Mineral Aggregate Base, Type A, Type B, or RCA, by the ton, in accordance with 109.”

**Subsection 303.14** (pg. 228) 10-8-18, C. Sodium Chloride, remove part C. which covers Sodium Chloride:

~~**“C. Sodium Chloride**~~

~~The Department will measure sodium chloride by the ton in accordance with 109.”~~

**Subsection 303.15** (pg 229) 10-8-18, Basis of Payment; remove item for Sodium Chloride:

**303.15 Basis of Payment**

The Department will pay for accepted quantities at the contract prices as follows:

<i>Item</i>	<i>Pay Unit</i>
Mineral Aggregate, Type ____ Base	Ton
Calcium Chloride	Ton
<del>Sodium Chloride</del>	<del>Ton</del>
Water	MG

The Department will pay for the work required to prepare the subgrade in accordance with 303.07 as provided for in the applicable Section or Subsection under which the work is performed.

Subsection 307.03 (pg. 246) 11-16-15; Modify Table 307.03-3:

B. Recycled Asphalt Pavement for Bituminous Plant Mix Base, Table 307.03-3

**Table 307.03-3: Mixtures Using RAP**

Mix Type	% RAP (Non-processed) <sup>(1)</sup>	Maximum % RAP (Processed) <sup>(2)</sup>	Maximum % RAP Processed & Fractionated <sup>(3)</sup>	Maximum Particle Size (inches)
307-ACRL	0	00	-	-
307-AS	0	00	15	-
307-A	15	20	35	1-1/2
307-B	15	30	35	1-1/2
307-BM	15	30	35	3/4
307-BM2	15	30	35	3/4
307-C	15	30	35	3/8
307-CW	15	30	35	1/2
307-CS	0	15	25	5/16

<sup>(1)</sup> “Non-processed” refers to RAP that has not been crushed and screened or otherwise sized prior to its use.

<sup>(2)</sup> “Processed” refers to RAP that has been crushed and screened or otherwise sized such that the maximum recycled material particle size is less than that listed in Table 307.03-3 prior to entering the dryer drum.

<sup>(3)</sup> “Fractionated” refers to RAP that has been processed over more than one screen, producing sources of various maximum particle sizes (e.g., 3/4 to 1/2 inch, 1/2 inch to #4, etc.). The Contractor may use the larger percentages of fractionated RAP specified only if individual fractions of two different maximum particle size are introduced into the plant as separate material sources for increased control.

<sup>(4)</sup> RAP for 307-AS must be processed in a manner such that the minimum particle size is no smaller than 3/4” prior to solvent extraction. For RAP containing gravel as coarse aggregate, the maximum allowable RAP content shall be 10%.

2. Recycled Asphalt Shingles (RAS) RAS may be included to a maximum of 3% of the total weight of the mixture.



Subsection 307.03 (pg. 246) 5-15-17; Modify Table 307.03-3:

B. Recycled Asphalt Pavement for Bituminous Plant Mix Base, Table 307.03-3

**Table 307.03-3: Mixtures Using RAP**

Mix Type	% RAP (Non-processed) <sup>(1)</sup>	Maximum % RAP (Processed) <sup>(2)</sup>	Maximum % RAP Processed & Fractionated <sup>(3)</sup>	Maximum Particle Size (inches)
307-ACRL	0	00	-	-
307-AS	0	10	10	-
307-A	15	20	35	1-1/2
307-B	15	30	35	1-1/2
307-BM	15	30	35	3/4
307-BM2	15	30	35	3/4
307-C	15	30	35	3/8
307-CW	15	30	35	1/2
307-CS	0	15	25	5/16

<sup>(1)</sup> “Non-processed” refers to RAP that has not been crushed and screened or otherwise sized prior to its use.

<sup>(2)</sup> “Processed” refers to RAP that has been crushed and screened or otherwise sized such that the maximum recycled material particle size is less than that listed in Table 307.03-3 prior to entering the dryer drum.

<sup>(3)</sup> “Fractionated” refers to RAP that has been processed over more than one screen, producing sources of various maximum particle sizes (e.g., 3/4 to 1/2 inch, 1/2 inch to #4, etc.). The Contractor may use the larger percentages of fractionated RAP specified only if individual fractions of two different maximum particle size are introduced into the plant as separate material sources for increased control.

**Subsection 307.03** (pg. 250) 6-27-16; C. revise the last paragraph to the following:

“Mix an approved antistrip agent with the asphalt cement at the dosage as specified in **921.06.B.**”

**Subsection 307.06** (pg. 250) 12-2-16; add the following as the second paragraph:

“Do not place AS/ACRL which cannot be covered by the next course of pavement within the same construction season.”

**Subsection 310.02** (pg. 260) 10-8-18, Materials, Remove materials information for sodium chloride:

**“310.02 Materials**

Provide materials as specified in:

Aggregate for Conditioning Base .....	<b>903.05</b>
Calcium Chloride, Type 1, Type 2 or Calcium Chloride Liquor .....	<b>921.02</b>
<del>Sodium Chloride .....</del>	<del><b>921.03</b></del> ”

**Subsection 310.04** (pg.261) 10-8-18, Conditioning, remove sodium chloride from the 3<sup>rd</sup> paragraph:

**“310.04 Conditioning**

Condition the existing base by applying water, blading, and compacting as directed by the Engineer. Scarify sections of existing base that are pot-holed to the full depth of the pot holes. Scarify and shape warped and distorted sections as directed by the Engineer. Moisten the material as necessary, and mix, shape, and roll until the base is uniformly and thoroughly compacted. Continue applying water, blading, and rolling until a smooth, dense, well-bonded surface is obtained that meets the Engineer’s approval.

The Department will divide the completed base into lots of approximately 10,000 square yards for density testing purposes, and will perform five density tests in each lot. The average dry density shall be not less than 100% of maximum density as determined according to AASHTO T 99 Method D, and no individual test shall be less than 97% of maximum density. Smaller lots may be considered when approved or directed by the Engineer.

Distribute calcium chloride ~~or sodium chloride~~, when specified, at the approximate rate of 1 pound per square yard and incorporate it in the base material during blading and rolling operations as directed by the Engineer.

If additional material is to be added to the existing base, lightly scarify the existing base, add the material, and condition the base as specified above.

**Subsection 310.06** (pg. 262)10-8-18, Method of Measurement, Remove 3. Sodium Chloride information from the subsection, renumber 4. to 3.:

**“310.06 Method of Measurement**

The Department will measure:

1. Conditioning Mineral Aggregate Base by the linear mile, based on a horizontal measurement made along the median centerline of the Project for divided sections and along the centerline of the pavement for two-lane sections, excluding bridges.

- 2. Calcium Chloride by the ton in accordance with 303.14.D.

~~Sodium Chloride by the ton in accordance with 109.~~

- 3. Water by M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate water meters.

If the Contract requires the construction of a mineral aggregate base and a surface course, the Department will not directly measure or pay for conditioning of the base but will consider this work to be incidental to the unit price bid for the base material.

If the Contract requires the addition of base material to sections or the entire length of a previously constructed base, the Department will not directly measure or pay for conditioning of the base on the sections where base material is added. Sections where base material is not added will be measured for payment by the linear mile.

If the Contract requires a surface to be constructed on a previously constructed base and no additional material is added to the base, the Department will measure and pay for conditioning of the base by the linear mile.”

**Subsection 310.07**(pg. 262) 10-8-18, Basis of Payment, Remove all information for sodium chloride:

**“310.07 Basis of Payment**

The Department will pay for accepted quantities at the contract prices as follows:

*Item Pay Unit*

Conditioning Mineral Aggregate Base	Linear Mile
Calcium Chloride	Ton
<del>Sodium Chloride</del>	<del>Ton</del>
Water	MG

Payment for Conditioning Mineral Aggregate Base is full compensation for conditioning all base on interchanges, approaches, service roads, ramps, frontage roads, roadside rest areas, and all other base within the limits of the Project that requires conditioning to receive a succeeding stage of construction under the Contract.”

**Subsection 313.03** (pg. 273) 11-16-15; B. Bituminous Treated Permeable Base, add the following sentence to the end of the paragraph:

“Recycled Asphalt Pavement (RAP) meeting the requirements of 307.03.B may be incorporated into asphalt treated permeable base up to 15% by weight of aggregate. RAP must be processed in a manner such that the minimum particle size is no smaller than ¾” prior to solvent extraction. Treated permeable base mixtures containing RAP shall contain at least 65% virgin asphalt binder. For RAP containing gravel as a coarse aggregate, the maximum allowable RAP content shall be 10%”

**Subsection 313.03** (pg. 273) 5-15-17; B. Bituminous Treated Permeable Base, revise the sentence added on 11-16-15 to the following sentence:

“Recycled Asphalt Pavement (RAP) meeting the requirements of 307.03.B may be incorporated into asphalt treated permeable base up to 10% by weight of aggregate. Treated permeable base

mixtures containing RAP shall contain at least 65% virgin asphalt binder. For RAP containing gravel as a coarse aggregate, the maximum allowable RAP content shall be 10%.

Mix an approved antistrip agent with the asphalt cement at the dosage as specified in **921.06.B.**”

**Subsection 313.10** (pg. 276) 5-15-17; Basis of Payment, add the sentence as the third paragraph:

“The cost of antistrip additive used in Bituminous Plant Mix (Hot Mix) will be included in the price of Treated Permeable Base.”

**S T A T E**

**O F**

**T E N N E S S E E**

- (Rev. 5-18-15)
- (Rev. 7-13-15)
- (Rev.11-16-15)
- (Rev. 6-27-16)
- (Rev. 12-2-16)
- (Rev. 1-6-17)
- (Rev. 5-15-17)
- (Rev. 11-6-17)
- (Rev. 5-14-18)
- (Rev. 10-8-18)

January 1, 2015

**Supplemental Specifications - Section 400**

**of the**

**Standard Specifications for Road and Bridge Construction**

**January 1, 2015**

**Subsection 401.02**(pg. 278) 10-8-18, Mineral Aggregate Surface – Materials, Remove Sodium Chloride from the materials list:

**“401.02 Materials**

Provide materials as specified in:

- Aggregate, Class B ..... **903.05.B**
- Calcium Chloride, Type I, Type 2, or Calcium Chloride Liquor ..... **921.02**
- ~~Sodium Chloride ..... **921.03**~~

The Engineer will accept aggregate for gradation as specified in **303.02.**”

**Subsection 401.06** (pg. 280) 10-8-18, Mineral Aggregate Surface – Method of Measurement, Remove 4. Sodium Chloride from the subsection:

**” 401.06 Method of Measurement**

The Department will measure:

1. Mineral Aggregate Surface by the ton in accordance with **109.**
2. Water added to the materials at the direction of the Engineer by the M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate water meters.
3. Calcium Chloride by the ton in accordance with **303.14.D.**
- ~~4. Sodium Chloride by the ton in accordance with **109.**~~

When measuring Mineral Aggregate Surface, the Department will deduct the weight of all surface moisture on the aggregate at the time of weighing in excess of 8%.”

**Subsection 401.07** (pg. 280) 10-8-18, Mineral Aggregate Surface – Basis of Payment, Remove Sodium Chloride from the basis of payment list:

“The Department will pay for accepted quantities of Mineral Aggregate Surface, complete in place, at the contract prices as follows:

*Item Pay Unit*

Mineral Aggregate	Ton
Calcium Chloride	Ton

~~Sodium Chloride~~ ~~Ton~~  
Water MG”

**Subsection 402.03** (pg. 282) 5-27-16; revise 0.2 to 0.05 in the range as shown in the 2<sup>nd</sup> paragraph:

“The distributor shall be designed, equipped, maintained, and operated so that bituminous material at even heat may be applied uniformly on variable surface widths at readily determined and controlled rates from 0.05 to 0.5 gallons per square yard, with uniform pressure, and with an allowable variation from any specified rate of plus or minus 0.02 gallons per square yard.”

**Subsection 403.02** (pg. 285-286) 10-8-18; Bituminous Materials, add RS-1, CRS-1 and remove emulsified from “Approved Emulsified Trackless Tack”, update Table 403.02-1 to adjust temperature range required and add approved trackless tack information:

Provide materials as specified in:

Emulsified Asphalt, SS-1, SS-1h, CSS-1, CSS-1h, TST-1P, CQS-1h, CQS-1hp, [RS-1](#), [CRS-1](#).....904.03 or Approved ~~Emulsified~~ Trackless Tack from the QPL.

Table 403.02-1: Tack Coat Application Temperatures

Material	Temperature Range
SS-1, SS-1h, CSS-1, TST-1P, CQS1h, CQS-1hp, CSS-1h,	<del>60 to 140 F</del> <a href="#">70 to 160 °F</a>
<a href="#">Approved Trackless Tack from the QPL</a>	<a href="#">Per Manufacturer’s Recommendation</a>

**Subsection 403.02** (pg. 285-286) 12-2-16; Bituminous Materials, remove trackless tack information from specifications and reference the QPL for approved Emulsified Trackless Tacks, remove trackless tacks from Table 403.02-1:

“Emulsified Asphalt, SS-1, SS-1h, CSS-1, CSS-1h, TST-1P, CQS-1h, CQS-1hp.....904.03 or Approved Emulsified Trackless Tack from the QPL.

**Table 403.02-1: Tack Coat Application Temperatures**

Material	Temperature Range
SS-1, SS-1h, CSS-1, TST-1P, CQS-1h, CQS-1hp and CSS-1h	60 to 140 °F

**Subsection 403.02** (pg. 285-286) 11-16-15; Bituminous Materials, update the reference to 904.03, add TTT-3 to Table 403.02-1:

“Emulsified Asphalt, SS-1, SS-1h, CSS-1, CSS-1h, TST-1P, CQS-1h, CQS-1hp, TTT-1, TTT-2, TTT-3 .....904.03”

**Table 403.02-1: Tack Coat Application Temperatures**

<b>Material</b>	<b>Temperature Range</b>
SS-1, SS-1h, CSS-1, TST-1P, CQS-1h, CQS-1hp and CSS-1h	60 to 140 °F
TTT-1	160 to 180 °F
TTT-2	120 to 160 °F
TTT-3	100 to 180 °F

**Subsection 403.05** (pg. 286) 11-16-15; A. Emulsified Asphalt, Add the following paragraph at the end of the subsection:

“Take a minimum of 3 cores throughout the length of the project for informational tack coat shear testing. Include the underlying layer. Not required for mats less than one inch thick.”

**Subsection 403.05** (pg. 287) 11-16-15; ) B. Test Strip, modify the 2<sup>nd</sup> paragraph to update the rate as 0.08 and 0.12:

“If placing the bituminous material upon a milled surface, apply the tack material at a rate of between 0.08 and 0.12 gallons of applied emulsion per square yard.”

**Subsection 403.05** (pg. 287) 6-27-16; revise the last sentence of the 2<sup>nd</sup> paragraph:

“If placing the bituminous material upon a milled surface, apply the tack material at a rate of between 0.08 and 0.12 gallons applied emulsion per square yard.”

**Subsection 403.05** (pg. 287), 11-6-17; Revise the 1<sup>st</sup> sentence of the 1<sup>st</sup> paragraph:

“When the Contract requires bituminous material for fog sealing of shoulders, provide emulsified asphalt meeting **403.02** or an item from QPL 40A.”

**Subsection 404** (pg. 289-293) 1-6-17; Remove the entire subsection. All specifications regarding Double Bituminous Surface Treatment has been incorporated into subsection 405. All references shall be updated to subsection 405.

**Subsection 405** (pg. 294-298) 1-6-17; replace subsection 405 with the following:

“405.01 Description

This work consists of constructing a bituminous seal coat consisting of one or more applications each of bituminous material and cover aggregate.

#### *MATERIALS*

405.02 Materials

Provide materials as specified in:

Mineral Aggregate, Size Nos. 7, 8, 78, 89..... 903.13  
 Mineral Aggregate..... 903.14  
 Emulsified Asphalt, CRS-2p ..... 904.03

Apply seal coat at a temperature range of 60 to 140 °F.

*EQUIPMENT*

405.03 Equipment

*Provide a power broom or other mechanical sweeping equipment, equipment for heating bituminous material, a pressure distributor meeting the requirements of 402.03, pneumatic-tire and steel-wheel rollers, self-propelled mechanical aggregate spreading equipment that can be adjusted so as to spread accurately at the specified rate, and such other equipment and small tools as may be required to perform the work in a satisfactory manner.*

*CONSTRUCTION REQUIREMENTS*

405.04 Limitations

Only apply bituminous material:

1. When the designated surface is dry, firm, and properly cured;
2. Between April 15 and October 1; and, unless otherwise directed,
3. When the ambient temperature in the shade and away from artificial heat is 70°F or more.

405.05 Preparing the Designated Surface

Before placing seal coat, clean all surfaces to be sealed by sweeping with a motorized broom to remove any loose material. Clean depressions and cracks not reached by the power broom using hand brooms or pressurized air.

Cover any utility installations to prevent adherence of the bituminous mixture. Suitable covering includes plywood disks, sand, craft paper, roofing felt or other approved methods. Remove the protective coverings before opening the road to traffic. The cost for these adjustments shall be included in the bid price for other items.

The Plans will indicate whether the surface is to be constructed on a treated or untreated subbase, a granular base, an asphalt base, or on an existing surface. The surface of the base or sub-base upon which the construction is to be placed shall meet the requirements of the applicable Section of Part 3, Bases and Subgrade Treatments, of these Specifications.

Condition existing surface, if called for on the Plans, as specified in 407.10. Condition existing mineral aggregate base as specified in 310.

Construct and maintain Prime Coat or Tack Coat, if shown on the Plans, as specified in 402 or 403, respectively.



## 405.06 Application

## A. Applying Bituminous Material:

Have all equipment calibrated prior to starting work. The TDOT inspector shall be present during calibration to determine aggregate spread rate and distributor rates. Distributor trucks shall have proper calibration of spray equipment. Spray nozzles should be clean, properly angled, and appropriately sized for the desired application rate. Stop work if the distributor is not applying material properly, such as gaps in application or streaking.

Place a 500 ft. test strip for the bituminous seal coat at the beginning of the project to assure proper coverage and proper equipment calibration. The test section is to verify break time of emulsion and chip retention. The test strip shall be able to carry normal traffic within 3 hours. If normal traffic cannot be carried, the emulsion shall be adjusted and another test strip is required.

At least 14 working days before the scheduled start of construction of any bituminous seal coat, submit a sample of aggregate intended for use for the determination of the appropriate application rates of bituminous material and aggregate. Apply emulsified asphalt by pressure distributor at a uniform rate in accordance with Table 405.06-1 below. The exact rate will be established by the Engineer.

Table 405.06-1: Application Rates for Bituminous Material

Aggregate Size (per 903.22)	Aggregate Spread Rate (lb/yd <sup>2</sup> )	Emulsion Shot Rate (gal/yd <sup>2</sup> )
7	25 – 30	0.30 – 0.45
78	22 – 28	0.28 – 0.38
8	20 – 25	0.20 – 0.35
89	17 – 23	0.17 – 0.28

Before beginning each spread, place building paper across the roadway surface with the forward edge exactly coinciding with the end of the preceding covered spread. Start distributors on the paper, the width of which shall allow the full force of all nozzles to be in effect before the forward edge of the paper is reached. If required by the Engineer, also stop the spread on building paper. Remove the paper immediately after its use, and dispose of properly. Immediately correct all defects in application.

The length of spread of bituminous material shall not exceed that which trucks loaded with cover material can immediately cover.

The spread of bituminous material shall not extend more than 6 inches wider than the width covered by the cover material. Do not allow the bituminous material to chill or otherwise impair retention of the cover material.

Do not allow traffic on the bituminous material until it has been covered with mineral aggregate.

Treat areas that are inaccessible to the distributor with either hand sprays or pouring pots as directed by the Engineer.

**B. Application of Double Bituminous Surface Treatment:****First Application**

Apply the first application of emulsified asphalt using pressure distributors at a uniform rate established by the Engineer within the range of 0.30 to 0.38 gallons per square yard. Apply each spread of bituminous material so as not to be more than 6 inches wider than the width covered by the immediate spread of cover aggregate. Each width of spread shall not be less than half the surface to be treated.

Before beginning each spread, place building paper across the roadway surface with the forward edge exactly coinciding with the end of the preceding covered spread. Start distributors on the paper, the width of which shall allow the full force of all nozzles to be in effect before the forward edge of the paper is reached. If required by the Engineer, also stop the spread on building paper. Remove the paper immediately after its use, and dispose of properly. Immediately correct all defects in application.

Treat areas that are inaccessible to the distributor with hand sprays or pouring pots as directed by the Engineer.

If treating less than the full width of the roadway, do not spread the aggregate on the inside 6 inches of either the first or second application until the adjacent lane has been treated. Immediately following each application, uniformly cover the applied bituminous material with Size No. 7 mineral aggregate that is reasonably free of surface moisture.

Spread the aggregate at a rate between 24 and 30 pounds per square yard, as established by the Engineer, using a self-propelled mechanical spreader; except on short projects of 1/2 mile in length or less, self-propelled mechanical spreading equipment will not be required. Back the truck on the aggregate being spread, without driving on or over uncovered bituminous material.

The length of bituminous material spread shall not exceed that which trucks loaded with cover material can immediately cover.

**Second Application**

Apply the second application of emulsified asphalt in the same manner as the first application, at a uniform rate established by the Engineer within the range of 0.20 and 0.35 gallons per square yard.

Spread mineral aggregate, Size No. 8, in the same manner as the first spread at a rate established by the Engineer within the range of 16 to 28 pounds per square yard.

Immediately after each spread of cover aggregate, broom to achieve uniform coverage. Use a power source, which is independent of the drive train that propels the equipment, to power the revolving brooms of mechanical sweeping equipment. Place additional aggregate by hand on thin or bare areas.

**405.07 Spreading and Rolling Aggregate****A. Spreading**

Immediately after bituminous material has been applied, no more than two minutes, spread and embed the mineral aggregate cover in the bituminous material. Spread the aggregate as close to the application of bituminous material as is practicable, and cover each distributor load applied immediately. Aggregates shall be moistened and visually damp at the time of placement.

Spread the aggregate in accordance with the rates specified in Table 405.06-1. The exact rate will be established by the Engineer. Back the truck on the aggregate being spread, without driving on or over uncovered bituminous material. If treating less than the full width of roadway, do not spread the aggregate on the inside 6 inches of the bituminous spread until the adjacent lane is treated. Immediately after spreading the aggregate, perform hand-brooming to achieve uniform coverage. Place additional aggregate by hand on thin or bare areas.

The speed of the spreader shall be such that the aggregates are not rolling over, and starting and stopping of the spreader is minimized. Use of previously used (swept) aggregates is not permitted.

**B. Rolling – Bituminous Seal Coat**

Immediately after distributing the aggregate, roll the entire surface by moving in a longitudinal direction, beginning at the outer edges and progressing toward the center of the roadway, with each trip of the roller overlapping the previous trip by half the width of the rear wheel. Perform initial rolling with a self-propelled pneumatic tire roller, and follow with steel-wheel rolling. The amount and sequence of rolling shall be as directed by the Engineer. Complete the initial rolling of the aggregate within 1 hour after applying the bituminous material.

Use power brooms to correct irregularities by sweeping the aggregates from areas of thick or heavy distribution to areas of thin or light distribution. Then continue rolling using both steel-wheel and pneumatic rollers until the aggregate is thoroughly embedded in the bituminous material. The Engineer may require additional rolling at a later date. Redistribute excess or loose aggregate that was thrown out of place.

Slow moving traffic may use the section or roadway upon which the aggregate has been spread.

**Rolling and Curing – Double Bituminous Seal Coat**

Immediately after spreading and brooming the cover aggregate, roll the entire surface, beginning at the edges and progressing to the center. Begin rolling within 30 minutes after spreading the aggregate. Perform initial rolling with a self-propelled pneumatic tire roller, and follow with steel-wheel rolling. The amount and sequence of rolling shall be as directed by the Engineer.

Allow the first application of bituminous material and aggregate to cure for as long as deemed necessary by the Engineer before beginning the second application. Immediately before the second application of bituminous material, roll the surface with a steel-wheel roller.

For the second application of bituminous material and cover aggregate, repeat the same rolling and curing procedures as required for the first application.

The Contractor may allow slow-moving traffic to use sections of the roadway where the bituminous material has been covered with mineral aggregate.

**405.08 Shoulders**

Restore shoulders that have been disturbed by the Contractor’s construction operations at no cost to the Department. Remove all objectionable material placed on the shoulders by the Contractor as directed by the Engineer.

Construct shoulders, when specified, as provided for under **208**.

405.09 Maintenance and Protection

Maintain in a satisfactory condition each completed section of seal coat until the entire Project is complete. Maintenance shall include making repairs where failures occur, and maintaining the seal coat in a smooth uniform condition; and brooming, dragging, and rolling when required.

After the final application, maintain the work in a satisfactory condition for at least 10 calendar days. If all other requirements of the Contract have been fulfilled, the Department will not charge working time during the 10-day maintenance period against the Contract time.

For final cleanup, sweep up all excessive quantities of loose, dislodged cover aggregate that may have collected along the edge of the completed seal coat, and dispose of this material as directed by the Engineer.

405.10 Method of Measurement

The Department will measure Mineral Aggregate and Bituminous Material by the ton in accordance with **109**. The Department may use net certified weights as a basis of measurement for mineral aggregate, subject to correction for aggregate that is lost, wasted, or otherwise not incorporated into the Work.

405.11 Basis of Payment

The Department will pay for accepted quantities of Bituminous Seal Coat, complete in place, at the contract prices as follows:

<i>Item</i>	<i>Pay Unit</i>
Bituminous Material	Ton
Mineral Aggregate	Ton

The Department will measure and pay for the work required to prepare the designated surface, as provided for under **405.05**, in accordance with the applicable Section or Subsection under which the work is performed.”

**Subsection 405.05** (pg. 295) 5-14-18; Add the following as the second paragraph:

“Before placing seal coat, clean all surfaces to be sealed by sweeping with a motorized broom to remove any loose material. Clean depressions and cracks not reached by the power broom using hand brooms or pressurized air.

Remove pavement markers and adhesives. Abrade all types of existing striping. Work shall be accomplished without the pavement being gouged or damaged and in a manner which ensures the bituminous treatment will adhere in all areas applied. Work shall be performed to the satisfaction of the Engineer.”

**Subsection 407.02** (pg. 300-301) 12-2-16; Replace the 4<sup>th</sup> paragraph:

“If anti-stripping additive, other than hydrated lime, meeting 921.06.B.1 is required, use approved in-line blending equipment, as specified in 407.04.A.6, to add it at the mixing plant or inject it at the asphalt terminal. Manufacture’s documentation that asphalt binders will continue to meet requirements listed in subsection **904** after the anti-stripping additive is added shall be provided by the contractor with the mix design submittal. For mix designs submitted more than six months in advance, the documentation shall be resubmitted prior to use of the mix design with updated test results.”

**Subsection 407.02** (pg. 300) 11-16-15; Materials, add the following at the end of the fourth paragraph:

“If anti-stripping additive, other than hydrated lime, meeting **921.06.B.1** is required, use approved in-line blending equipment, as specified in **407.04.A.6**, to add it at the mixing plant or inject it at the asphalt terminal. Provide manufacture’s documentation ensuring asphalt binders will continue to meet requirements listed in Subsection **904** after anti-stripping additives are added.”

**Subsection 407.03 E. 1.** (pg. 313) 10-8-18, Tensile Strength Ratio, modify the second paragraph:

“1. **Tensile Strength Ratio.** Perform testing for stripping and moisture susceptibility of the mixture according to ASTM D 4867, Standard Test Method for Effect of Moisture on Asphalt-Concrete

Paving Mixtures (~~For all mixtures requiring design, except OGFC, follow Root-Tunnecliff Procedure~~ASTM D4867. For OGFC follow ASTM D4867 except as noted:

- Modify step 8.6.1 so that the three conditioned samples are subjected to a partial vacuum of 26 inches Hg for 10 minutes to whatever degree of saturation achieved
- Subject the 3 condition samples to one freeze thaw cycle per note 6 listed in ASTM D4867 8.7. except as noted:

After 15h in freezer, remove samples and immediately immerse the still wrapped specimen in 77°F water for 2 hours

After 2 hours remove specimen from water bath and remove wrapping from specimen then immerse sample in 140°F water bath for 24 hours.)

~~Specimen~~All specimens tested for stripping and moisture susceptibility ~~according to Root-Tunnecliff Procedures~~ shall meet the criteria specified in Table 407.03-4.”

**Subsection 407.06** (pg. 327), 5-18-15; - A. Pavers. Replace the entire first paragraph with the following:

“Bituminous pavers shall be self-contained, power-propelled units provided with an activated screed, equipped to be heated, and capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thickness shown on the Plans. All screed extensions shall be full assembly extensions, including activated and heated screeds. Pavers shall include throw-back blades, reverse augers, or equivalent to place mix beneath the auger gearbox. Auger extensions shall be incorporated in a manner such that the

maximum distance from the augers to the end plate shall be 18 inches. Screed extensions may extend beyond the 18-inch maximum from auger extensions only when extending for short-term temporary deviations in pavement width such as driveways. Do not use strike-off boxes, with the exception of sections with continuously varying width.”

**Subsection 407.09** (pg. 329-331), 5-14-18; Revise the following: 3. Add two sentences as the end of the paragraph, 4. Remove the first sentence, add two sentences as new first and second sentence, Add second paragraph as shown:

“3. Do not place bituminous plant mix, with a compacted thickness of 1.5 inches or less, between November 30 and April 1. Do not place bituminous plant mix, with a compacted thickness greater than 1.5 inches, between December 15 and March 16. Only place 411-TL, 411-TLD, and 411-OGFC mixtures when the pavement surface temperature and the ambient air temperature are a minimum of 55 °F and rising; limit placement to the period from April 1 to November 1. If the temperature meets the above requirements, outside of normal paving season, a request for a seasonal limitation waiver may be submitted for Departmental consideration. Requests shall be submitted in writing at least one week before the anticipated need.

4. If determined necessary by the Department, the Contractor may request a variance from the above required temperatures and seasonal limitations to pave at lower temperatures by submitting a Cold Weather Paving and Compaction Plan. All projects requiring a Cold Weather Paving and Compaction Plan shall utilize Intelligent Compaction to demonstrate proper coverage and compaction temperature at no additional cost to the Department; with the exception of small quantity projects, such as, but not limited to, bridge approaches, intersections, and temporary traffic shifts. Upon completion, the documentation showing appropriate coverage and compaction temperature shall be provided to the Department. Submit requests in writing at least one week before the anticipated need, and include a Paving and Compaction Plan for Cold Weather that meets the Department’s Procedure. The plan shall identify what practices and precautions the Contractor intends to use to ensure the mixture is placed and compacted to meet the specifications. The plan shall include compaction cooling curves estimating the time available for compaction, the intended production, haul, and compaction rates, with paver and roller speeds estimated. The Contractor may consider using such practices as the addition of rollers, reduced production and paving rates, insulated truck beds, and heating the existing surface.

In no cases will a cold weather paving and compaction plan or seasonal limitation waiver be approved for 411-OGFC, 411-TL, or 411-TLD.

If the specified densities are not obtained, stop all paving operations and develop a new plan. All mixture failing to meet specifications will be subject to price adjustments or removal and replacement at no cost to the Department.”

**Subsection 407.11** (pg. 332) 12-2-16; Add the following to the paragraph below Table 407.11-1:

“Minimum temperature for OGFC mixes shall be 280°.”

**Subsection 407.14** (pg. 335) 10-8-18; modify paragraph 3. 1<sup>st</sup> sentence by adding lift thickness:  
“establish lift thickness or line, grade, and elevation”

**Subsection 407.15, C. Test Strips.** (pg. 340-341) 11-16-15; Add the following paragraph after the 7<sup>th</sup> paragraph of the subsection:

“Take an additional 3 cores after placement of the surface layer on the tack coat test strip described in subsection **403.05.B**. Include the underlying pavement layer for shear testing. These cores will be for informational testing only. Not required for mats less than one inch thick”

**Subsection 407.15** (pg. 341) 6-27-16; remove the 2<sup>nd</sup> sentence of the 8<sup>th</sup> paragraph:

“Take cores on the test strip at ten randomly selected locations as designated by the Engineer. Provide these cores to the Department for use in calibrating the nuclear gauge and to verify that the average density of the test strip meets the density requirements of the specifications. The Department will report all densities using the corrected nuclear gauge readings. Correction factors are specific to the nuclear gauges used during the test strip construction. If a different nuclear gauge needs to be used for acceptance, it will be necessary to cut new cores from the ongoing pavement construction to calibrate the new gauge.”

**Subsection 407.15** (pg. 341) 12-2-16; remove “randomly selected” from 1<sup>st</sup> sentence of the 8<sup>th</sup> paragraph as follows:

“Take cores on the test strip at ten locations as designated by the Engineer.”

**Subsection 407.15 A. 3. c.** (pg. 337-338) 5-15-17; update 10,000 square yards to 1,000 tons:

“c. Projects containing less than 1,000 tons or bituminous pavement.”

**Subsection 407.15 A. and B.** (pg. 337-342) 10-8-18;A. Add Roller Requirements by Mix Type, modify 1., 2., and 4., B. Modify Tables to condense into Table 407.15 – 1 Density Requirements for Bituminous Pavements, modify 1<sup>st</sup> sentence of the 1<sup>st</sup> paragraph below Table 407.15:

**407.15 Compaction**

**A. General**

After spreading and striking-off the bituminous mixture and adjusting surface irregularities, thoroughly compact the mixture using methods approved by the Engineer and that are capable of achieving the specified density while the material is in a workable condition. When no density requirements are specified, use a system of compaction for roadway pavements that has previously produced the required bituminous pavement densities. The Engineer may require a control strip and random density samples to evaluate the system.

In general, accomplish compaction using a combination of the equipment specified in **407.07**. As a minimum, meet the following roller requirements, but increase the number of rollers if the required results are not being obtained.

Table 407.15 - Roller Requirements by Mix Type

<u>Mix Type</u>	<u>Roller Requirements</u>
<u>307-A, 307-B, 307-BM-2, 307-C, 307-CW (except surface)</u>	<u>3 Rollers (Intermediate Roller shall be Pneumatic)</u>
<u>307-AS, 307-ACRL, 411-D, 411-E, 307-CW</u>	<u>3 Rollers (unspecified)</u>

<u>(surface), 313-Asphalt Treated Permeable Base</u>	
<u>411-TL, 411-TLD, 411-TLE, 307-CS (when paved as a continuous layer)</u>	<u>2 Rollers (unspecified)</u>
<u>411-OGFC</u>	<u>2 rollers (both rollers shall be static steel double drum, 10 Ton minimum)</u>
<u>Any mix used for scratch paving</u>	<u>2 rollers (breakdown shall be pneumatic)</u>

1. ~~Except as noted below, each paving train shall consist of a minimum of three rollers meeting 407.07. The intermediate roller in each train shall be a pneumatic type. If the surface course contains a latex or polymer additive, the Contractor may use a steel wheel type roller for intermediate rolling instead of a pneumatic type provided the surface course meets density requirements. If the compaction effort is detrimental to the quality of the mat, immediately stop and re-evaluate rolling patterns and equipment. To modify the roller train from that which is specified for the mix, submit to the engineer a written request of the rollers to be substituted and a narrative explanation of how the specified equipment has been detrimental to the quality of the pavement.~~
2. ~~Provide a minimum of two rollers when placing 307 CS, 411 TL, or 411 TLD mixtures. Perform breakdown rolling, as soon as possible and while the mixture is sufficiently hot, using a pneumatic tire roller having a minimum contact pressure of 85 pounds per square inch. Do not substitute a combination roller for a pneumatic roller when placing CS mix. Regulate the paver speed so rollers can maintain proper compaction of the mixture as determined by the Engineer. The Department will only consider requests for substitution of equipment when it is shown that best practices are being followed and that the problem is not due to improper operation or poor maintenance of the equipment. If this request is approved by the Engineer, a new test strip and roller pattern shall be established.~~
3. With the Engineer's approval, the Contractor may reduce the minimum number of rollers listed above to one roller of either the steel-wheel or vibratory type on the following types of construction and projects:
  - a. Shoulder construction,
  - b. Incidental construction such as bridge approaches and driveways, and
  - c. Projects containing less than 10,000 square yards of bituminous pavement.
4. ~~Compaction of 411-OGFC mixtures shall consist of a minimum of two passes with a steel double drum asphalt roller with minimum weight of 10 tons, before the material temperature has fallen below 185 °F. Provide a minimum of two roller units so as to accomplish the compaction promptly following the placement of the material. At no time shall a pneumatic tire roller be used or a steel wheel roller be used in vibratory mode. If the roller begins to break the aggregate, immediately stop rolling.~~

Unless otherwise directed by the Engineer, begin rolling at the low side and proceed longitudinally parallel to the road centerline. When paving in echelon or abutting a previously placed lane, roll the longitudinal joint first, followed by the regular rolling procedure. When paving in echelon, rollers shall not compact within 6 inches of an edge where an adjacent lane is to be placed. Operate rollers at a slow uniform speed with the drive wheels nearer the paver, and keep the rollers as nearly as possible in continuous operation. Continue rolling until all roller marks are eliminated. Do not park rollers on the bituminous pavement.

To prevent adhesion of the mixture to the rollers, keep the wheels properly moistened with water or water mixed with very small quantities of detergent or other approved material. Limit excess use of liquid.



Do not refuel rollers on bituminous pavements.

Along forms, curbs, headers, walls and other places not accessible to the rollers, compact the mixture thoroughly using hot hand tampers, smoothing irons, or with mechanical tampers. On depressed areas, the Contractor may use a trench roller to compact the mix.

**B. Density Requirements**

Meet the applicable density requirements specified in Tables 407.15-1 ~~to 407.15-4~~.

**Table 407.15-1: Density Requirements for ~~ADT 1,000 or less~~ Bituminous Pavement**

Mix Type	% of Maximum Theoretical Density ( <u>Lot</u> Average)	No Single Test Less Than, % ( <u>Sub Lot</u> )
<u>Travel Lanes</u> <u>ADT &lt; 1,000</u> <u>A, B, BM, BM2, C, CW, D, EA</u>	90.0	87.0
<del>B, BM &amp; BM2</del> <u>Travel Lane</u> <u>1,000 &lt; ADT &lt; 3,000</u> <u>A, B, BM, BM-2, C, CW, D, E</u>	<del>91</del> 90.0	<del>87</del> 87.0
<u>Travel Lane</u> <u>ADT &gt; 3,000</u> <u>A, B, BM, BM-2, C, CW, D, E C &amp; CW</u>	<del>92</del> 90.0	<del>90</del> 87.0
<u>Travel Lanes and Shoulders</u> <u>Any ADT</u> <u>CS, TL, TLD, TLE, OGFC D</u>	<del>90</del> NA	<del>87</del> NA
<u>Shoulders</u> <u>B, BM, BM-2, D, E E</u>	<del>90</del> 88.0	<del>87</del> 85.0

**Table 407.15-2: Density Requirements for ADT 1,000 to 3,000**

Mix Type	% of Maximum Theoretical Density (Average)	No Single Test Less Than, %
A	91	89
B, BM & BM2	91	89
C & CW	91	89
D	91	89
E	91	89

~~Table 407.15-3: Density Requirements for ADT 3,000 or greater~~

<del>Mix Type</del>	<del>% of Maximum Theoretical Density (Average)</del>	<del>No Single Test Less Than, %</del>
<del>A</del>	<del>92</del>	<del>90</del>
<del>B, BM &amp; BM2</del>	<del>92</del>	<del>90</del>
<del>C &amp; CW</del>	<del>92</del>	<del>90</del>
<del>D</del>	<del>92</del>	<del>90</del>
<del>E</del>	<del>92</del>	<del>90</del>

~~Table 407.15-4: Density Requirements for any ADT~~

<del>Mix Type</del>	<del>% of Maximum Theoretical Density (Average)</del>	<del>No Single Test Less Than, %</del>
<del>Shoulder Mix (B, BM, BM2, D or E)</del>	<del>88</del>	<del>85</del>
<del>AS and A-CRL</del>	<del>None<sup>(+)</sup></del>	<del>None</del>
<del>CS</del>	<del>None<sup>(+)</sup></del>	<del>None</del>
<del>TL, TLD, and OGFC</del>	<del>None</del>	<del>None</del>

~~(+)—The Department will waive density requirements on Bituminous Plant Mix Base Grading ACRL, Grading AS and Bituminous Plant Mix Leveling Course, Grading CS; however, the Contractor shall use a system of compaction for roadway pavements that has been approved by the Engineer. When placing Bituminous Plant Mix Base Grading ACRL and Grading AS, the Contractor may replace the specified intermediate roller (pneumatic tire) with a steel wheel type if irreparable damage to the pavement is occurring.~~

Correct ~~sublots~~~~base or surface course~~ that test below the minimum density so that the density of the area is equal to or above the minimum, at which point it can be used to determine the average density of the lot. Do not place any successive layers until the area has been corrected. As necessary to determine the classification of open graded or dense graded mixes and to measure segregation, use AASHTO T 269 or ASTM D3203.

Repair or replace defective mixture to the satisfaction of the Engineer and at no cost to the Department.

The Department will perform density testing in accordance with **407.20.B.5**.

**Subsection 407.20 A.** (pg. 345), 11-6-17; Revise the second paragraph as follows:

“The Department will pay for liquid anti-strip additive and hydrated lime anti-strip additive based on certified documentation of material costs not to exceed \$15 per gallon and \$90 per ton, respectively.”

**Subsection 407.20** (pg. 346) 5-18-15; Basis of Payment; B. Acceptance of Mixture; Modify the last paragraph to revise 500 tons to 1000 tons:

“When the total plan quantity of any mix is less than 1000 tons, the Department will accept the mix on the basis of visual inspection and Contractor Quality Control certification. The

Department may run extraction, gradation analysis, or other tests deemed necessary for acceptance purposes.”

**Subsection 407.20** (pg. 348) 10-8-18; Table 407.20-2, add OGFC information to table:

**Table 407.20-2: Acceptance Schedule of Payment  
(Asphalt Plant Mix Characteristics)**

Characteristics	Pay Factor	Average Arithmetic Deviation of the Lot Acceptance Test from the JMF	
		1 Test	2 Tests or more
<u>All mixes except 411-OGFC</u>	1.00	0.00-0.30	0.00-0.25
Asphalt Cement Content <sup>(1)</sup>	0.95	0.31-0.35	0.26-0.30
(Extraction or ignition oven)	0.90	0.36-0.40	0.31-0.35
	0.80 <sup>(2)</sup>	over 0.40	over 0.35
<u>411-OGFC only</u>	<u>1.00</u>	<u>0.00-0.30</u>	<u>0.00-0.25</u>
<u>Asphalt Cement Content</u>	<u>0.90</u>	<u>0.31-0.35</u>	<u>0.26-0.30</u>
<u>(Extraction or ignition oven)</u>	<u>0.80</u>	<u>0.36-0.40</u>	<u>0.31-0.35</u>
	<u>0.60 <sup>(2)</sup></u>	<u>over 0.40</u>	<u>over 0.35</u>
Gradation	1.00	0.00-6.50	0.00-5.70
3/8 inch sieve and larger	0.95	6.51-7.08	5.71-6.20
	0.90	7.09-7.66	6.21-6.69
	0.80 <sup>(2)</sup>	over 7.66	over 6.69
Gradation	1.00	0.00-4.62	0.00-4.00
No. 4 sieve <sup>(3)</sup>	0.95	4.63-5.20	4.01-4.50
	0.90	5.21-5.77	4.51-5.00
	0.80 <sup>(2)</sup>	over 5.77	over 5.00
Gradation	1.00	0.00-3.80	0.00-3.30
No. 8, 16, 30 & 50 sieves <sup>(3)</sup>	0.95	3.81-4.46	3.31-3.91
	0.90	4.47-5.12	3.92-4.52
	0.80 <sup>(2)</sup>	over 5.12	over 4.52
Gradation	1.00	0.00-1.80	0.00-1.60
No. 100 & 200 sieves <sup>(3)</sup>	0.95	1.81-2.00	1.61-1.75
	0.90	2.01-2.20	1.76-1.90
	0.80 <sup>(2)</sup>	over 2.20	over 1.90

<sup>(1)</sup> Does not apply to 307 Grading A, AS, or ACRL mixes.

<sup>(2)</sup> If approved by the Engineer, the Contractor may accept the indicated partial pay.

Characteristics	Pay Factor	Average Arithmetic Deviation of the Lot Acceptance Test from the JMF	
		1 Test	2 Tests or more
The Department may require removal and replacement at no cost. The Contractor may remove and replace at no cost to the Department at any time.			
<sup>(3)</sup> When there is more than one reduced payment relating to gradation in 1 lot of material, only the greatest reduction in payment will be applied. Reductions applicable for any other reason will be cumulative.			

**Subsection 407.20** (pg. 348) 11-16-15; Table 407.20 – 2, make the following changes:

**Table 407.20-2: Acceptance Schedule of Payment  
(Asphalt Plant Mix Characteristics)**

Characteristics	Pay Factor	Average Arithmetic Deviation of the Lot Acceptance Test from the JMF	
		1 Test	2 Tests or more
Asphalt Cement Content <sup>(1)</sup> (Extraction or ignition oven)	1.00	0.00-0.30	0.00-0.25
	0.95	0.31-0.35	0.26-0.30
	0.90	0.36-0.40	0.31-0.35
	0.80 <sup>(2)</sup>	over 0.40	over 0.35
Gradation 3/8 inch sieve and larger	1.00	0.00-6.50	0.00-5.70
	0.95	6.51-7.08	5.71-6.20
	0.90	7.09-7.66	6.21-6.69
	0.80 <sup>(2)</sup>	over 7.66	over 6.69
Gradation No. 4 sieve <sup>(3)</sup>	1.00	0.00-4.62	0.00-4.00
	0.95	4.63-5.20	4.01-4.50
	0.90	5.21-5.77	4.51-5.00
	0.80 <sup>(2)</sup>	over 5.77	over 5.00

**Subsection 407.20** (pg. 349) 10-8-18; B. 5., Add the sentence as the next to last sentences of the 1<sup>st</sup> paragraph:

**“Acceptance for Mix Density on the Roadway.** The Department will apply a deduction in payment, not as a penalty but as liquidated damages, for failure to meet the density requirements specified in **407.15**. As soon as practicable after the final rolling is completed on each lot, the Department will perform 5 density tests at locations determined by the Engineer, and will compute an average of all such tests. Deductions for failure to meet density requirements will be computed to the nearest 0.1% as a percentage of the total payment otherwise due for each lot. The percent of total payment to be deducted will be 5 times the percent the average in-place density for each lot that fails to meet **407.15**. The Department will make deductions in monies due the Contractor for failure to meet the density requirements under the item for Density Deduction. The Department will conduct acceptance testing for density in accordance with ASTM D2950 unless otherwise specified. [For projects with total project tonnage per mix type](#)

less than 2,000 tons (not including small quantity jobs as defined in 407.20.B.1) the department may alternatively calculate in place density by cores (AASHTO T-166), in this case no cores will be taken for gauge correlation on the test strip. The Department inspector will be a certified Asphalt Roadway Technician.”

**Subsection 407.20** (pg. 350) 10-7-19; B. 5. Acceptance for Mix Density on the Roadway, Revise the last sentence in the 1<sup>st</sup> paragraph:

“**Acceptance for Mix Density on the Roadway.** The Department will apply a deduction in payment, not as a penalty but as liquidated damages, for failure to meet the density requirements specified in **407.15**. As soon as practicable after the final rolling is completed on each lot, the Department will perform 5 density tests at locations determined by the Engineer, and will compute an average of all such tests. Deductions for failure to meet density requirements will be computed to the nearest 0.1% as a percentage of the total payment otherwise due for each lot. The percent of total payment to be deducted will be 5 times the percent the average in-place density for each lot that fails to meet **407.15**. The Department will make deductions in monies due the Contractor for failure to meet the density requirements under the item for Density Deduction. The Department will conduct acceptance testing for density in accordance with ASTM D2950 unless otherwise specified. The Department inspector conducting the density tests shall -will be a certified Nuclear Gauge Field-Asphalt Roadway Technician.”

**Subsection 407.20** (pg. 350) 11-16-15; B. 5. Acceptance for Mix Density on the Roadway, Replace the entire 2<sup>nd</sup> paragraph with the following:

“For density testing purposes, the Department will divide the pavement into lots of 1,000 tons. Five density tests will be performed in each lot and the average results compared with the requirements specified in Tables 407.15-1 to 407.15-4. At the beginning of a project or at any time it is deemed advisable, the Department may consider smaller lots to evaluate compaction methods or for other reasons as approved or directed by the Engineer.”

**Subsection 411.03** (pg. 357) 10-8-18; B. Proportioning, modify table 411.03-1 to add TLE requirements:

“Table 411.03-1: Proportions of Total Mixture, Percent by Weight

Surface Course	Effective Combined Mineral Aggregate	Asphalt Cement
Grading D	93.0 - 94.3	5.7 - 7.0 <sup>(1)</sup>
Grading E <sup>(2)</sup>	93.0 - 94.3	5.7 - 7.0 <sup>(1)</sup>
Grading E (shoulders)	92.0 - 94.7	6.0 - 6.5 <sup>(1)</sup>
Grading TL	92.5 - 94.3	5.7 - 7.5 <sup>(1)</sup>
Grading TLD	93.0 - 94.3	5.7 - 7.0 <sup>(1)</sup>
<u>Grading TLE</u>	<u>93.0 - 94.3</u>	<u>5.7 - 7.0<sup>(1)</sup></u>
Grading OGFC	92.0 - 94.0	6.0 - 8.0 <sup>(1)</sup>

<sup>(1)</sup> If the effective combined specific gravity of the aggregate exceeds 2.80, the above proportions may be adjusted as directed by the Engineer. The upper limit for flow values shall not apply to mixes with modified asphalt liquids.

<sup>(2)</sup> The minimum allowable asphalt cement content for 411E low volume

mixtures is 5.3%.

**Subsection 411.03** (pg. 358-359) 10-8-18; B. Proportioning: 2. Grading E, modify subsection and Table 411.03-3 to add TLE requirements, remove riding surface phrase:

2. **Grading E and TLE.** In addition to the other requirements of these Specifications, ~~if using Grading E for the riding surface,~~ the composition of the mineral aggregate shall be such that, when combined with the required amount of bitumen, the resultant mixture will meet Table 411.03-3.

**Table 411.03-3: Mixture Properties (High vs. Low Volume Roads)**

Mix	Traffic Volume	Stability Minimum lb-ft <sup>(1,3)</sup>	Flow 0.01 inch <sup>(2)</sup>	Design Void Content % <sup>(1)</sup>	Production Void Content % <sup>(1)</sup>	VMA, Min % <sup>(1)</sup>
411E <a href="#">411TLE</a>	High Volume (ADT > 1,000)	2,000	8 - 16	4.0 ± 0.2	3 - 5.5	14
411E <a href="#">411TLE</a>	Low Volume (ADT ≤ 1,000)	1,500	8 - 16	3.5 ± 0.5	2 - 5	n/a

- <sup>(1)</sup> Tested according to AASHTO T 245 with 75 blows of the hammer on each side of the test specimen, using a Marshall Mechanical Compactor.
- <sup>(2)</sup> Flow will only be required when using a non-modified binder (PG 64-22 or 67-22)
- <sup>(3)</sup> Minimum stability for shoulder mixes will be 1,500 lb-ft and optimum asphalt cement content for shoulder mixes shall be as directed by the Regional Materials Supervisor.

**Subsection 411.03** (pg. 358-359) 10-8-18; C. Recycled Asphalt Pavement and Recycled Asphalt Shingles: modify Table 411.03-6 to add TLE requirements:

**Table 411.03-6: Use of Recycled Asphalt Pavement**

Mix Type	% RAP (Non-processed) <sup>(1)</sup>	Maximum % RAP (Processed) <sup>(2)</sup>	Maximum % RAP Processed and Fractionated <sup>(3)</sup>	Maximum Particle Size (inch)
411D (PG64-22, PG67-22)	0	15	20	1/2
411D (PG70-22, PG76-22, PG82-22)	0	10	15	1/2

Mix Type	% RAP (Non-processed) (1)	Maximum % RAP (Processed) (2)	Maximum % RAP Processed and Fractionated (3)	Maximum Particle Size (inch)
411E & 411TLE (Roadway)	0	15	20	1/2
411E & 411TLE (Shoulder)	15	30	35	1/2
411TL (PG64-22, PG67-22)	0	15	15	5/16
411TL (PG70-22, PG76-22, PG82-22)	0	10	10	5/16
411TLD (PG64-22, PG67-22)	0	15	15	5/16
411TLD (PG70-22, PG76-22, PG82-22)	0	10	10	5/16

(1) “Non-processed” refers to RAP that has not been crushed and screened or otherwise sized such that the maximum recycled material particle size is less than that listed above prior to entering the dryer drum.

(2) “Processed” refers to RAP that has been crushed and screened or otherwise sized such that the maximum recycled material particle size is less than that above prior to entering the dryer drum.

(3) “Fractionated” refers to RAP that has been processed over more than one screen, producing sources of various maximum particle sizes (e.g., 3/4 to 1/2 inch, 1/2 inch to #4, etc.). The Contractor may use the larger percentages of fractionated RAP specified only if individual fractions of two different maximum particle size are introduced into the plant as separate material sources for increased control.

**Subsection 411.03** (pg. 363) 11-16-15; 2. Recycled Asphalt Shingles (RAS), change 5% to 3% in the 1<sup>st</sup> sentence of the 1<sup>st</sup> paragraph.

“Recycled Asphalt Shingles (RAS) may be included to a maximum of 3% of the total weight of mixture.”

**Subsection 411.03 B. Anti-strip Additive** (pg. 365) 6-27-16; revise the 2<sup>nd</sup> paragraph:

“Mix an approved anti-strip agent with the asphalt cement at the dosage as specified in **921.06.B.**”

**Subsection 414.02** (pg. 369) 11-16-15; Materials, add the following paragraph to the end of the subsection:

“Ensure that no deleterious material is introduced into aggregate stockpiled at project site.”

**Subsection 414.02** (pg. 369) 11-6-17; Revise the last sentence:

“For a slurry seal, use a Type CQS-1h emulsified asphalt. For micro-surfacing use a type CQS-1hp or CSS-1hp emulsified asphalt.”

**Subsection 414.06** (pg. 379-382) 5-14-18; Remove B. 3. a., update b. to a. and revise as follows:

“B. Quality Control

**3. Documentation.** Maintain a lot sheet as follows:

**a. Lot Sheet.** Divide the Project into lots of each day’s production. For each lot, maintain a lot sheet, providing the following information:

- (1) Contract Number, Route,
- (2) Date, Air Temperature, Pavement Surface Temperature
- (3) Control Settings, Calibration Values, Unit Weight of Emulsion (pounds per gallon), Percent Residue in Emulsion
- (4) Beginning and Ending Log Miles
- (5) Computer display readings for material usage (Beginning, Ending, and Total)
- (6) Length, Width, Total Area (square yards) of the construction completed for the day
- (7) Aggregate used (dry ton)Asphalt Emulsion used (ton), additives (gallon), water (gallon), and/or Portland Cement (ton)
- (8) Application Rate of asphalt emulsion, Combined Application Rate (pounds per square yard)
- (9) Mix Design (Percent Portland cement, Percent Emulsion, Percent Asphalt Cement)
- (10) Calibration Forms
- (11) Contractor’s Authorized Signature”

**Subsection 414.12** (pg. 384) 10-8-18, Basis of Payment, add the following as the last sentence of the paragraph:

“The Department will pay for accepted quantities, determined in accordance with 414.11, at the contract prices, complete in place, which payment shall be full compensation for all equipment, materials, labor and incidentals necessary to complete the work. [A price adjustment for Loss on Ignition \(LOI\) shall be applied on a project basis per 407.20.C.3.](#)”



STATE

OF

TENNESSEE

(Rev. 5-18-15)  
(Rev. 11-16-15)  
(Rev. 5-15-17)  
(Rev. 11-6-17)  
(Rev. 5-14-18)  
(Rev. 10-8-18)

January 1, 2015

**Supplemental Specifications - Section 500**

**of the**

**Standard Specifications for Road and Bridge Construction**

**January 1, 2015**

**Subsection 501.03** (pg. 395), 5-18-15; 3. Mix Design Submittal; Replace the first paragraph with the following:

“Instead of the above mix design submittal, a request to use an existing design may be submitted for approval provided the design has been used on a state funded project within the last six (6) months. The approval of this concrete design submittal will not relieve the Contractor of the responsibility of providing concrete meeting the requirements of these Specifications. A temporary mix design may be issued if the 7-day or 14-day compressive strengths exceed the required 28-day strengths.”

**Subsection 501.03 A. Proportioning** (pg. 395) 5-15-17; Add water as 22. on the list of Design Submittal requirements, update the paragraph below the list to add water requirements:

**“A. Proportioning**

**3. Design Submittal.** Include the following information as a minimum in the proposed concrete design submittal:

1. Source of all aggregate
2. Brand and type of cement
3. Source and class of fly ash (if used)
4. Source and grade of ground granulated blast furnace slag (if used)
5. Specific gravity of cement
6. Specific gravity of fly ash (if used)
7. Specific gravity of ground granulated blast furnace slag (if used)
8. Admixtures (if used)
9. Gradation of aggregates
10. Specific gravities of aggregates (saturated surface dry)
11. Air content (if air entrainment is used)
12. Percentage of fine aggregate of the total aggregate (by volume)
13. Slump
14. Weight per cubic yard
15. Yield
16. Temperature of plastic concrete

17. Water/cement ratio (pound/pound)
18. 7-day compressive strength [minimum of two 4-inch x 8-inch cylinders]
19. 14-day compressive strength [minimum of two 4-inch x 8-inch cylinders]
20. 28-day compressive strength [minimum of two 4-inch x 8-inch cylinders]
21. Weight of each material required to produce a cubic yard of concrete
22. Water – submit testing results per Tables 921.01-1 & 921.01-2

Instead of the above mix design submittal, a request to use an existing design may be submitted for approval provided the design has been used on a state funded project within the last six (6) months. When submitting for the use of an existing mix design, the most current water testing results per 921.01 shall accompany the submittal. The approval of this concrete design submittal will not relieve the Contractor of the responsibility of providing concrete meeting the requirements of these Specifications. A temporary mix design may be issued if the 7-day or 14-day compressive strengths exceed the required 28-day strengths.”

**Subsection 501.03** (pg. 399-402) 11-16-15; B. Quality Control and Acceptance of Concrete, adjust the following:

“1. Test to determine aggregate gradations (AASHTO T 27 with AASHTO T 11 when required). Conduct a combined belt gradation before work starts and at least daily to verify consistency if using a dynamic, multi-aggregate feed system.

3. Calibrate the weighing systems, aggregate feed flow rate and weigh bridges, water meters, and admixture dispensing systems before starting production.

4. Ensure accurate weighing or flow rate of the aggregates and cement, the proper metering of water and admixtures, and the quality of water.

6. Adjust mix proportions due to actual moisture content of both coarse and fine aggregates, with moisture content determined according to AASHTO T 255. If using a dynamic aggregate weighing system, multi-aggregate proportioning adjustments are to be made by using an in-bin moisture sensor.”

7. Conduct slump (AASHTO T119) or slump flow (ASTM C1611) and air tests (AASHTO T152).

Page 401- “Make, cure, and transport all early break cylinders (7-14 day, etc.) according to AASHTO T 23, and deliver to the Regional laboratory or other established satellite laboratories for testing. Make all early break cylinders (7-14 day, etc.) for self-consolidating concrete according to ASTM C1758, and deliver to the Regional laboratory or other established satellite laboratories for testing.”

Page 402 - “Correct batch weights or aggregate feed flow rates to compensate for surface moisture on the aggregate at the time of use. The Contractor...”

**Subsection 501.03** (pg. 401) 5-14-18; B. Quality Control and Acceptance of Concrete, remove AASHTO T23 and replace with specification 604.15 C.”

“Make, cure, and transport all early break cylinders (7-14 day, etc.) in accordance with 604.15.C, and deliver to the Regional Laboratory or other established satellite laboratories for testing.”

**Subsection 501.04** (pg. 402) 11-16-15; replace the following:

**“A. Batching Plant, Multi-Aggregate Feed System, and Equipment,**

1. General. The batching plant shall include bins, weighing hoppers or belt feeds with weigh bridges and load cells, and scales. If using cement in bulk,...

2. Bins and Hoppers- Add the following new paragraph under the existing paragraph

For multi-aggregate feed systems, provide bins as noted with variable size openings and variable speed belts. Each bin must have a calibrated moisture sensor to adjust aggregate feed flow rates. Assure consistent, uninterrupted aggregate flow and consistent belt speeds once aggregate feed system is calibrated.

3. Scales- Add the following new paragraph under the last paragraph in the section.

For multi-aggregate feed systems, provide a dual idler weight bridge with load cells to accurately weigh the actual aggregate flow rate.”

**Subsection 501.04 A. 1.** (pg. 402), 11-6-17; General, Add the following after the first paragraph:

“All producers of concrete shall be on the Department’s approved producer list and be actively certified by the National Ready Mixed Concrete Association (NRMCA) Plant Certification Program.”

**Subsection 501.04 B. 3.** (pg. 403), 11-6-17; Truck Mixers and Truck Agitators, Add the following to the beginning of the first paragraph:

“Truck mixers shall be certified by the National Ready Mix Concrete Association (NRMCA) Delivery Vehicle Certification Program Option A or Option B.”

**Subsection 501.04** (pg. 404) 11-16-15; B. Mixers, remove the complete 4th paragraph.

**Subsection 501.09** (pg. 410) 10-8-18; Revise course to coarse in the 3<sup>rd</sup> paragraph of the subsection:

“Separately weigh the fine aggregate and each size of coarse aggregate into the hopper or hoppers in the respective amounts set by the Engineer. The ~~coarse~~ aggregates shall meet the gradation requirements for Size No. 467, as specified in **903.22**, or a blend of Size No. 4 and Size No. 67 that meets the required gradation for Size No. 467, specified in **903.22**.”

**Subsection 501.12 – Placing Concrete** (pg. 413-415) 5-15-17; replace the subsection:

#### **“501.12 Placing Concrete**

Either unload the concrete into an approved spreading device, or deposit it directly on the base, and mechanically spread the concrete in a manner that prevents segregation of the materials. When using central or transit mixed concrete, deposit it in an approved spreader. Place the mixture so as to minimize rehandling and relocation from point of placement. The mechanical spreader will not be required on areas too small to accommodate the paving equipment, projects that contain 10,000 square yards or less of concrete paving, and on variable width sections and ramps. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Do not place concrete on frozen grade.

Perform any necessary hand spreading with shovels or other approved tools. Do not allow workmen to walk in the freshly mixed concrete with boots or shoes coated with earth or other foreign substances.

If placing concrete adjacent to a previously constructed lane of pavement and mechanical equipment is to be operated on this existing lane of pavement, that lane shall meet the requirements for opening to traffic specified in **501.22**. If the existing lane is to only carry finishing equipment, the Contractor may begin paving the adjoining lanes after 7 days.

Deposit concrete as near to expansion and contraction joints as possible without disturbing them; do not dump concrete from the discharge bucket or hopper onto a joint assembly unless the hopper is well centered on the joint assembly.

Immediately remove all concrete materials that may fall on or be worked into the surface of a completed slab using approved methods.

When using the slip-form method of concrete paving, place the concrete with an approved slip-form paver meeting the requirements of **501.04.D.11**.

Ensure that the sliding forms are rigidly held together laterally to prevent spreading of the forms. The forms shall trail behind the paver for such a distance that no appreciable slumping of the concrete will occur and so that necessary finishing can be accomplished while the concrete is still within the forms. Before the concrete has hardened, correct any edge slump of the pavement, exclusive of edge rounding, in excess of 1/4 inch.

Operate the slip-form paver with as nearly a continuous forward movement as possible, and coordinate all operations of mixing, delivering, and spreading of concrete so as to provide uniform progress while minimizing the stopping and starting of the paver. If, for any reason, it is necessary to stop the forward movement of the paver, also immediately stop the vibratory and tamping elements. Apply no tractive force to the machine, other than that which is controlled from the machine. Replace slabs with random cracks before completion of paving operations.

Contractor may choose to utilize a single lift or two lift paving process according to the following requirements.

**A. Single Lift Pavement**

Use vibrators to thoroughly consolidate the concrete against and along the faces of all forms and along the full length and on both sides of all joint assemblies. Do not allow vibrators to come in contact with a joint assembly, the grade, or a side form. Do not operate the vibrator for longer than 5 seconds in any one location.

The Contractor may only use hand-operated vibrators on projects containing 10,000 square yards or less of concrete paving and on variable width sections. Only operate vibrators mounted on a machine while the machine is in motion.

Equip the slip-form paver with vibrators meeting the applicable requirements of **501.04.D.1** to vibrate the concrete for the full width and depth of the strip of pavement being placed.

**B. Two Lift Composite Pavement**

When placing two lift composite pavements, the upper lift shall be of a lesser thickness as designated by contract design. It shall be placed such that the result is a wet-on-wet application. The lower lift will be one foot less in width than the upper lift.

Paving operations shall be adjusted and approved by the Engineer as necessary to assure a wet-on-wet monolithic pavement section. If the bonding between lifts or the consolidation of concrete is determined to be unsuitable by the Engineer, the lower lift shall be removed and replaced prior to the upper lift placement.

**1. Lower Lift.** Uniformly spread concrete with a spreader or slipform machine. Internal vibration will be required for the lower lift. Tie bars and dowel bars (with the use of dowel baskets) shall be placed in the lower lift at mid-depth of the finished concrete pavement thickness. The lower lift shall not require curing, texturing, or sawing before the upper lift is placed. The lower lift shall be struck off to provide a nominal lower lift thickness that complies with the pavement design. The upper lift shall be struck off to allow for the finished total pavement to conform to the cross section shown in the contract plans.

**2. Upper Lift.** Place the upper lift within 45 minutes following the placement of the lower lift. Placement of the upper lift shall be such that intermingling of the two concrete mixtures is minimal. External vibration for the upper lift will be allowed if proper consolidation and finishing can be demonstrated in accordance with **501.16**. Dowel bars can be inserted during the placement of the upper lift. Cure the upper lift only in accordance with **501.18**. At no time shall the total thickness be less than shown on the pavement design and the cross section shown in the contract plans.

Frequency of the vibrators shall be established based on the workability of the concrete mixture and past experiences. Electronic, internal, T-shaped, poker vibrators shall be used. Other types of vibrating equipment may be approved by the Engineer. Vibrator impulses shall be delivered directly to the concrete and the intensity of vibration shall be sufficient to consolidate the concrete thoroughly and uniformly throughout the depth and width of the lift. Increase in the speed of the vibrators will be allowed with the permission of the Engineer.

A paving plan shall be supplied to the Engineer for review and approval prior to pouring. The plan shall document procedures to ensure consistency of material properties during concrete placement and finishing, identify and eliminate potential for load misidentification, and maintain speed of production and paving. Concrete for each lift shall be produced from the same ready-mix facility.”

**Subsection 501.17** (pg. 424) 11-16-15; A. Surface Testing, modify the following:

- “3. Ramps where the design speed is greater than 40 miles per hour
  - (a) Test sections shall terminate 100 feet from a stop or slow speed yield condition
  - (b) Superelevated sections greater than 40 miles per hour design speed must be ground in accordance with **Table 501.17-1**
- 4. Ramps where the design speed is 40 miles per hour or less
  - (a) Test sections shall terminate 100 feet from a stop or slow speed yield condition
  - (b) Superelevated sections with a design speed of 40 miles per hour or less must be ground in accordance with **Table 501.17-2**

**Subsection 501.17** (pg. 425) 11-16-15; B. Pay Factors and Required Corrective Action, modify the following:

“Payment factors and required corrective actions relative to profile indexes for ramps with design speeds of 40 MPH or less shall conform to Table 501.17-2.

Table 501.17-2: Pay Factors & Corrective Action for Ramps with Design Speeds of 40 mph or less

<b>Profile Indexes</b>	<b>Pay Factor</b>	<b>Corrective Action</b>
<10 inches per mile	105%	None
10 to < 20 inches per mile	100%	None
20 to < 23 inches per mile	98%	Grind to 20 inches per mile
23 plus inches per mile	95%	Grind to 20 inches per mile

**Subsection 501.26 – Basis of Payment** (pg. 434) 5-15-17; add the following sentence to the 7<sup>th</sup> paragraph of the subsection:

“The Department will pay for additional concrete, measured in accordance with **501.25**, at the purchase price, F.O.B. the unloading point, as verified by invoices, with no compensation allowed for further handling. The State will be reimbursed from monies due the Contractor for a decrease in concrete measured in accordance with **501.25** in an amount equal to the purchase price of the cement, F.O.B. the unloading point. No payment will be allowed for any changes in the proportions of the aggregates. No additional payment will be made if two-lift composite pavement alternate is selected.”

**STATE****OF****TENNESSEE**

(Rev. 5-18-15)

(Rev. 11-16-15)

(Rev. 6-27-16)

(Rev. 12-2-16)

(Rev. 5-15-17)

(Rev. 11-6-17)

(Rev. 5-14-18)

(Rev. 10-8-18)

January 1, 2015

**Supplemental Specifications - Section 600****of the****Standard Specifications for Road and Bridge Construction****January 1, 2015**

**Subsection 602.17** (pg.459-477), 12-2-16; Entire Subsection: Replace all references to AASHTO M164 and AASHTO M253 with ASTM F3125, Grade A325 and A490

**Subsection 602.17** (pg. 459) 12-2-16; modify the first paragraph of A.:

“All high strength bolts, or equivalent fasteners, tightened to a high tension shall be coated with permitted coatings in accordance with ASTM F3125 for their respective grade. Use the bolts in holes conforming to 602.06, 602.07, and 602.08. All Grade A325 and A490 bolts, except Type 3 bolts used in weathering steel, shall be coated. Permitted coatings for Grade A325 and Grade A490 bolts are listed in ASTM F3125, Annex A1.”

**Subsection 602.17** (pg. 465–469), 12-2-16; Update Tables:

Bolt Diameter (inches)	Bolt Tension (pounds)	
	(GradeA325)	GradeA490 Bolts
½	12,000	15,000
5/8	19,000	24,000
¾	28,000	35,000
7/8	39,000	49,000
1	51,000	64,000
1-1/8	64,000	80,000
1-1/4	81,000	102,000
1-3/8	97,000	121,000
1-1/2	118,000	148,000

<sup>(1)</sup> Equal to 70% of the specified minimum tensile strength of bolts.

Table 602.17-1: Minimum Bolt Tension <sup>(1)</sup>

Bolt Diameter (inches)	Grade A325 Snug Tension (kips)	Grade A490 Snug Tension (kips)
1/2	1	1
5/8	2	2
3/4	3	4
7/8	4	5
1	5	6
1-1/8	6	8
1-1/4	8	10
1-3/8	10	12
1-1/2	12	15

Table 602.17-3: Minimum Installation Tension

Bolt Diameter (inches)	Grade A325 Tension (kips)	Grade A490 Tension (kips)
1/2	12	15
5/8	19	24
3/4	28	35
7/8	39	49
1	51	64
1-1/8	64	80
1-1/4	81	102
1-3/8	97	121
1-1/2	118	148

Table 602.17-4: Rotation from Snug Condition

Bolt Length (measured in Step 1)	Grade A325 Required Rotation	Grade A490 Required Rotation
Up to and including 4 diameters	2/3	2/3
Over 4 diameters, but not exceeding 8 diameters	1	5/6
Over 8 diameters to 12 diameters	1-1/6	1



Table 602.17-5: Turn Test Tension

<b>Bolt Diameter (inches)</b>	<b>Grade A325 Tension (kips)</b>	<b>Grade A490 Tension (kips)</b>
1/2	14	17
5/8	22	28
3/4	32	40
7/8	45	56
1	59	74
1-1/8	74	92
1-1/4	94	117
1-3/8	112	139
1-1/2	136	170

Table 602.17-6

<b>Bolt Length (measured in Step 1)</b>	<b>Required Rotation (All Grades)</b>
Up to and including 4 diameters	1/3
Over 4 diameters, but not exceeding 8 diameters	1/2

Table 602.17-7

<b>Bolt Diameter (inches)</b>	<b>Grade A325 Torque (ft-lbs)</b>	<b>Grade A490 Torque (ft-lbs)</b>
1/2	150	180
5/8	290	370
3/4	500	630
7/8	820	1020
1	1,230	1540
1-1/8	1,730	2160
1-1/4	2,450	3050
1-3/8	3,210	3980
1-1/2	4,250	5310

Table 602.17-8

<b>Bolt Length (measured in Step 1)</b>	<b>Additional Required Rotation Grade A325</b>	<b>Additional Required Rotation Grade A490</b>
Up to and including 4 diameters	1/3	¼
Over 4 diameters, but not exceeding 8 diameters	1/2	1/3

Table 602.17-9: DTI Requirements for A325 Bolts

<b>Bolt Diameter (inches)</b>	<b>Verification Tension (kips)</b>	<b>Maximum Verification Refusals</b>	<b>DTI Spaces</b>	<b>Minimum Installation Refusals</b>
½	13	1	4	2
5/8	20	1	4	2
¾	29	2	5	3
7/8	41	2	5	3
1	54	2	6	3
1-1/8	67	2	6	3
1-1/4	85	3	7	4
1-3/8	102	3	7	4
1-1/2	124	3	8	4

Table 602.17-11

Bolt Diameter (inches)	Bolt Tension (kips)	
	AASHTO M 164 Bolts (ASTM A325)	ASTM A490 Bolts
1/2	13	16
5/8	20	25
3/4	29	37
7/8	41	51
1	54	67
1-1/8	67	84
1-1/4	85	107
1-3/8	102	127
1-1/2	124	155

Table 602.17-12

Bolt Diameter (inches)	Number of Spaces	
	Bolts (GradeA325)	Grade A490 Bolts
1/2	4	N/A
5/8	4	N/A
3/4	5	6
7/8	5	6
1	6	7
1-1/8	6	7
1-1/4	7	8
1-3/8	7	8
1-1/2	8	N/A

**Subsection 602.19** (pg. 478), 6-27-16; add the following as the 2<sup>nd</sup> paragraph:

“All welders shall be qualified in accordance with the AASHTO/AWS D1.5, Bridge Welding Code, current edition. Welders shall be certified for each weld process and position which they will be using.”

**Subsection 602.39** (pg.488), 6-27-16; revise the title as follows:

“CONSTRUCTION REQUIREMENTS – ERECTION – REMOVAL”

**Subsection 602.42** (pg.489), 6-27-16; revise as follows:

“All contractors and subcontractors directly engaged in the erection or removal of structural steel, precast prestressed or mild steel reinforced concrete bridge beams or girders over active highway traffic lanes, on any route, railroad or any stream deemed navigable to commercial or pleasure water craft, shall submit an erection or removal plan prepared and stamped by a Professional Engineer licensed in the State of Tennessee. Include the following in these plans: the sequences of erection or removal, the generalized location of all pick points, and the plan to adequately stabilize the structure throughout the erection or removal process. Submit this plan to the Engineer at least 30 days before starting erection. At each stopping point in the erection or removal sequence, have a competent contractor’s representative inspect the beams to ensure adequate stability.

Do not begin any erection or removal work without the Engineer’s approval. The Engineer’s approval does not relieve the Contractor of the responsibility for the safety of its method or equipment or from carrying out the work in accordance with the Plans and Specifications.”

**Subsection 604.02** (pg. 519), 11-16-15; C. 2<sup>nd</sup> paragraph, 1<sup>st</sup> sentence:

“Prior to construction, submit for approval shop drawings of the proposed precast structure and design calculations for any details which deviate from the standard box culvert drawings.”

**Subsection 604.02** (pg. 517-518), 5-15-17; A. General, add Class DS Concrete to the index:

**604.02 Materials**

**A. General**

Provide materials as specified in:

Hydraulic cement <sup>1</sup> .....	<b>901.01</b>
Fine Aggregate, (all Classes of concrete).....	<b>903.01</b>
Coarse Aggregate	
For Class A Concrete: Size No. 57 .....	<b>903.03</b>
For Class D Concrete: Size No. 57 .....	<b>903.03</b>

<sup>1</sup>Use Type I, Type IL, or Type IS unless otherwise specified or permitted, or Type I or Type IL cement with either fly ash and/or ground granulated blast furnace slag as a partial cement replacement unless otherwise specified or permitted. When using Type I or Type IL cement with either fly ash and/or ground granulated blast furnace slag as a partial cement replacement, comply with the requirements of **604.03**.

**Subsection 604.02 C.** (pg. 519), 11-6-17; Precast Box Sections, remove mylar reference in second paragraph:

“Submit shop drawings of the proposed precast box section and design calculations for approval before construction. As a minimum, the shop drawings shall include a plan and elevation view of the box culvert showing all precast sections, a typical precast box section showing dimensions and reinforcing, and notes and details required for construction. After obtaining the necessary approval, furnish the Structures Division a reproducible design file. . The Department will pay the Contractor for the precast box based on the price bid for the quantity of the items in the cast-in-place structure it replaces. Manufacture the precast reinforced box sections in accordance with Departmental procedures.”

For Class DS Concrete: Size No. 57 .....	<b>903.03</b>
For Class L Concrete.....	<b>903.19</b>
Joint Filler, Preformed Type .....	<b>905.01</b>
Steel Bar Reinforcement .....	<b>907.01</b>
Welded Steel Wire Fabric .....	<b>907.03</b>
Structural Steel.....	<b>908.01</b>
Permanent Steel Bridge Deck Forms .....	<b>908.03</b>
Steel Castings.....	<b>908.05</b>
Gray Iron Castings .....	<b>908.07</b>
Bronze Bearing Plates, Plain.....	<b>908.09</b>
Bronze Bearing Plates, Self-Lubricating.....	<b>908.10</b>

**Subsection 604.03** (pg. 520-521), 5-15-17; Table 604.03-1: Composition of Various Classes of Concrete and Table 604.03-2: Use of Chemical Admixtures, Add class DS to the Tables, revise footnotes 2 and 3 of Table 604.03-1 and the note below Table 604.03-3; Update Table 604.03-4: Composition of Self-Consolidating Concrete and Table 604.03-5: Use of Chemical Admixtures to add SH-SCC, update :

**Table 604.03-1: Composition of Various Classes of Concrete**

<b>Class of Concrete</b>	<b>Min 28-Day Compressive Strength (psi)</b>	<b>Min Cement Content (pound per cubic yard)</b>	<b>Maximum Water/Cement Ratio (pound/pound)</b>	<b>Air Content % (Design <math>\pm</math> production tolerance)</b>	<b>Slump (inches)</b>
A	3,000	564	0.45	6 $\pm$ 2	3 $\pm$ 1 <sup>(1)</sup>
D, DS <sup>(2,3)</sup>	4,000	620	0.40	7 <sup>(3)</sup>	8 max <sup>(4)</sup>
L <sup>(3,5)</sup>	4,000	620	0.40	7 <sup>(3)</sup>	8 max <sup>(4)</sup>
S (Seal) <sup>(6)</sup>	3,000	682	0.47	6 $\pm$ 2	6 $\pm$ 2
X <sup>(7)</sup>					

<sup>(1)</sup> For slip forming, the slump shall range from 0 to 3 inches.

<sup>(2)</sup> Use Class DS concrete in riding surfaces as described in 903.03 and in accordance to Specification 903.24 requirements. Use Class D concrete in all other bridge decks except box and slab type structures unless otherwise shown on the Plans.

<sup>(3)</sup> Design Class D, Class DS, and Class L concrete at 7% air content. Acceptance range for pumping and other methods of placement is 4.5-7.5%. Sampling will be at the truck chute.

<sup>(4)</sup> Water reducing admixtures are acceptable; however, do not exceed the maximum water/cement ratio in order to achieve the required slump.

<sup>(5)</sup> The unit weight of air dried Class L concrete (lightweight concrete) shall not exceed 115 pounds per cubic foot as determined according to ASTM C567.

<sup>(6)</sup> The use of fly ash as a cement replacement will be allowed in Class S (Seal) concrete.

<sup>(7)</sup> Plan specific requirements.

Include chemical admixtures in the concrete mixture as specified in Table 604.03-2 based on the ambient air temperature and expected weather conditions.

Table 604.03-2: Use of Chemical Admixtures

Class of Concrete	Temperature less than 85 °F and falling	Temperature 85 °F or greater and rising
A	Type A or F	Type D or G or A and B
D, DS	Type A or F	Type A or F and B or G
L	Type F	Type F and B or G
S	Type D or G or A and B	Type D or G or A and B

Table 604.03-3: Type I or Type IL Cement Modified by Fly Ash or Ground Granulated Blast Furnace Slag (GGBFS)

Modifier	Maximum Cement Replacement Rate % (by weight)	Minimum Modifier Cement Substitution Rates (by weight)
GGBFS (grade 100 or 120)	35.0	1:1
Class "F" Fly Ash	25.0	1:1
Class "C" Fly Ash	25.0	1:1

The Contractor may use ternary cementitious mixtures (mixtures with Portland cement, ground granulated blast furnace slag, and fly ash) for Class A, Class D, and Class DS concrete provided that the minimum Portland cement content is 50%. The maximum amount of fly ash substitution in a ternary cementitious mixture shall be 20%. The Department will allow Type IS cement with ternary cementitious mixtures. When using a Type IS cement, do not use any additional slag as a partial replacement for the hydraulic cement.

Table 604.03-4: Composition of Self-Consolidating Concrete

Class of Concrete	Min 28-Day Compressive Strength (psi)	Min Cement Content (pound per cubic yard)	Maximum Water/Cement Ratio (pound/pound)	Air Content % (Design $\pm$ production tolerance)	Slump Flow (inches)
SCC (2,3,4,5)	3,000 <sup>(1)</sup>	564	0.45	6 $\pm$ 1	25 $\pm$ 4
SH-SCC (2,3,4,5,6)	4,500	620	0.45	6 $\pm$ 1	25 $\pm$ 4

(1) Or as shown on the Plans or approved shop drawings.

- (2) Acceptance range for the T50 test in accordance with ASTM C1611 shall be between 2-7 seconds.
- (3) Passing ability in accordance with ASTM C1621 shall be less than 2 inches for acceptance.
- (4) Visual Stability Index (VSI) shall not exceed 1.0 as per ASTM C1611 for acceptance.
- (5) Static segregation as measured by ASTM C 1610 shall not exceed 20%.
- (6) Air Content may be reduced if placed under water or underground if approved by the Engineer

**Table 604.03-5: Use of Chemical Admixtures**

Class of Concrete	Temperature less than 85 °F and falling	Temperature 85 °F or greater and rising
SCC, SH-SCC	Type A or F Type S (Viscosity Modifying)	Type D or G or A and B Type S (Viscosity Modifying)

**Subsection 604.03** (pg. 520-521), 5-14-18; Table 604.03-4: Composition of Self-Consolidating Concrete and Table, update the Air Content %, Slump Flow:

**Table 604.03-4: Composition of Self-Consolidating Concrete**

Class of Concrete	Min 28-Day Compressive Strength (psi)	Min Cement Content (pound per cubic yard)	Maximum Water/Cement Ratio (pound/pound)	Air Content % (Design $\pm$ production tolerance)	Slump Flow (inches)
SCC (2,3,4,5)	3,000 <sup>(1)</sup>	564	0.45	6 $\pm$ 2	26 $\pm$ 5
SH-SCC (2,3,4,5,6)	4,500	620	0.45	6 $\pm$ 2	26 $\pm$ 5

- (1) Or as shown on the Plans or approved shop drawings.
- (2) Acceptance range for the T50 test in accordance with ASTM C1611 shall be between 2-7 seconds.
- (3) Passing ability in accordance with ASTM C1621 shall be equal to or less than 2 inches for acceptance.
- (4) Visual Stability Index (VSI) shall not exceed 1.0 as per ASTM C1611 for acceptance.
- (5) Static segregation as measured by ASTM C 1610 shall not exceed 20%.
- (6) Air Content may be reduced if placed under water or underground if approved by the Engineer

**Subsection 604.03** (pg. 522-523) 5-15-17; A. Classification and Proportioning and Quality Assurance: Add 22.-28, add sentence to 5<sup>th</sup> paragraph:

2. **“Mix Design Submittal.** Submit the proposed concrete design to the Engineer for approval. Develop the design using saturated surface dry aggregate weights and trial batches meeting the requirements of these Specifications. The concrete design shall be prepared by a TDOT certified Class 3 concrete technician or approved independent testing laboratory under the direction of a registered civil engineer licensed by the State of Tennessee. The concrete plant technician or the civil engineer shall certify that the information contained on the design is correct and is the result of information gained from the trial batches. The concrete design shall produce an average compressive strength to indicate that the specified 28-day strength can be obtained in the field. Make all strength determinations using equipment meeting the requirements of, and in the manner prescribed by, AASHTO T 22. Provide concrete of the design strength specified in all applicable Special Provisions, Plans, and Standard Specifications. Build trial batches for design no more than 90 days before submitting the concrete design. The approved mix design will expire after 6 months if it is not used on a Department funded project and meet the minimum 28-day strength requirements. Assume responsibility for all costs of concrete design, preparation, and submittal.

As a minimum, include the following information in the proposed concrete design submittal:

1. Source of all aggregates
2. Brand and type of cement
3. Source and class of fly ash (if used)
4. Source and grade of ground granulated blast furnace slag (if used)
5. Specific gravity of cement
6. Specific gravity of the fly ash (if used)
7. Specific gravity of the ground granulated blast furnace slag (if used)
8. Admixtures (if used)
9. Gradations of aggregates
10. Specific gravity of aggregates (saturated surface dry)
11. Air content (if air entrainment is used)
12. Percentage of fine aggregate of the total aggregate (by volume)
13. Slump
14. Weight per cubic yard
15. Yield
16. Temperature of plastic concrete
17. Water/cement ratio (pound/pound)
18. 7-day compressive strength (minimum of two 4-inch x 8-inch cylinders)
19. 14-day compressive strength (minimum of two 4-inch x 8-inch cylinders)
20. 28-day compressive strength (minimum of two 4-inch x 8-inch cylinders)
21. Weight of each material required to produce a cubic yard of concrete
22. Water – submit testing results per Tables 921.01-1 & 921.01-2

In addition to the above mentioned items, for self-consolidating concrete include as a minimum the following information in the proposed SCC design submittal:

23. Slump flow, VSI, and T50, in accordance with ASTM C1611, shall be required in place of the slump test.
24. Passing ability in accordance with ASTM C1621.
25. Static segregation in accordance with ASTM C1610.
- 26. 7-day compressive strength (minimum of two 4-inch x 8-inch cylinders), in accordance with ASTM C1758.
27. 14-day compressive strength (minimum of two 4-inch x 8-inch cylinders), in accordance with ASTM C1758.
28. 28-day compressive strength (minimum of two 4-inch x 8-inch cylinders), in accordance with ASTM C1758.



Self-consolidating concrete (Classes SCC, SH-SCC and P-SCC) shall be verified prior to placement either at the ready mix facility or prestressed plant. The submitted mix design shall be reviewed by Headquarters Materials and Tests for specification compliance. The concrete producer shall then perform a trial batch verification of the submitted mix design in the presence of Regional Materials and Tests. The trial batch will ensure that all batch quantities and target admixture dosage rates are acceptable and meet TDOT specification prior to full mix design approval. If using a previously approved SCC design additional verification of the trial batch is not required. All quantities and identified admixture target dosage rates shall meet the tolerances specified in **501.09**

Instead of the above mix design submittal, an existing design may be submitted for approval provided the design has been used on a state funded project within the last six (6) months. When submitting for the use of an existing mix design, the most current water testing results per 921.01 shall accompany the submittal. The approval of this concrete design submittal will not relieve the Contractor of the responsibility of providing concrete meeting the requirements of these Specifications. A temporary mix design may be issued if the 7-day or 14-day compressive strengths exceed the required 28-day strengths.”

**Subsection 604.03** (pg. 522 and 523), 5-18-15; 2. Mix Design Submittal; Replace the first sentence of the last paragraph on page 522 with the following:

“Instead of the above mix design submittal, an existing design may be submitted for approval provided the design has been used on a state funded project within the last six (6) months.”

**Subsection 604.03** (pg. 519-522), 11-16-15; A. Classification and Proportioning and Quality Assurance, modify the following:

**1a. Design and Production Parameters.** Proportion the concrete based on a pre-determined minimum cement content, and a water-cement ratio that does not exceed the maximum shown in **Table 604.03-1**. Below this limit, adjust the quantity of water to meet the slump requirements. The fine aggregate shall not exceed 44% by volume calculation of the total aggregate, with the exception of slip formed Class A concrete incorporated into parapets and median barriers. For slip formed parapet and median barriers exclusively, the percentages of fine and coarse aggregate in an approved concrete mix design may be adjusted plus or minus 2%, such that the...

**1b. Self-Consolidating Concrete (SCC) Design and Production Parameters.** Proportion the concrete based on a pre-determined minimum cement content, and a water-cement ratio that does not exceed the maximum shown in **Table 604.03-4**. The fine aggregate shall not exceed 50% by volume calculation of the total aggregate volume. Maximum size of coarse aggregate shall not exceed a No. 67 stone. The Contractor may elect to use SCC as an alternate/option in replacement of Class A concrete.

Document mixture adjustments in the field book and daily concrete report. Ensure that the adjusted mix complies with all of the performance criteria specified in **Table 604.03-4**.

**Table 604.03-4: Composition of Self-Consolidating Concrete**

Class of Concrete	Min 28-Day Compressive Strength (psi)	Min Cement Content (pound per cubic yard)	Maximum Water/Cement Ratio (pound/pound)	Air Content % (Design $\pm$ production tolerance)	Slump Flow (inches)
SCC (2,3,4,5)	3,000 <sup>(1)</sup>	564	0.45	6 $\pm$ 1	25 $\pm$ 4

(1) Or as shown on the Plans or approved shop drawings.

(2) Acceptance range for the T50 test in accordance with ASTM C1611 shall be between 2-7 seconds.

(3) Passing ability in accordance with ASTM C1621 shall be less than 2 inches for acceptance.

(4) Visual Stability Index (VSI) shall not exceed 1.0 as per ASTM C1611 for acceptance.

(5) Static segregation as measured by ASTM C 1610 shall not exceed 20%.

Include chemical admixtures in the self-consolidating concrete mixture as specified in Table 604.03-5 based on the ambient air temperature and expected weather conditions. Approved viscosity modifying admixtures (VMA) may be used as part of the chemical admixtures if they are shown in the approved mixture design.

**Table 604.03-5: Use of Chemical Admixtures**

Class of Concrete	Temperature less than 85 °F and falling	Temperature 85 °F or greater and rising
SCC	Type A or F Type S (Viscosity Modifying)	Type D or G or A and B Type S (Viscosity Modifying)

Dosage rates for any admixtures incorporated into the concrete shall be stated during the mix design submittal process. All admixtures shall be compatible and from the same manufacturer.

2.Mix Design Submittal. Submit the proposed concrete design to the Engineer for approval. Develop the design using saturated surface dry aggregate weights and trial batches meeting the requirements of these Specifications....

As a minimum, include the following information in the proposed concrete design submittal:

1. Source of all aggregates
2. Brand and type of cement
3. Source and class of fly ash (if used)
4. Source and grade of ground granulated blast furnace slag (if used)
5. Specific gravity of cement

6. Specific gravity of the fly ash (if used)
7. Specific gravity of the ground granulated blast furnace slag (if used)
8. Admixtures (if used)
9. Gradations of aggregates
10. Specific gravity of aggregates (saturated surface dry)
11. Air content (if air entrainment is used)
12. Percentage of fine aggregate of the total aggregate (by volume)
13. Slump
14. Weight per cubic yard
15. Yield
16. Temperature of plastic concrete
17. Water/cement ratio (pound/pound)
18. 7-day compressive strength (minimum of three 4-inch x 8-inch cylinders)
19. 14-day compressive strength (minimum of three 4-inch x 8-inch cylinders)
20. 28-day compressive strength (minimum of three 4-inch x 8-inch cylinders)
21. Weight of each material required to produce a cubic yard of concrete

In addition to the above mentioned items, for self-consolidating concrete include as a minimum the following information in the proposed SCC design submittal:

22. Slump flow, VSI, and T50, in accordance with ASTM C1611, shall be required in place of the slump test.
23. Passing ability in accordance with ASTM C1621.
24. Static segregation in accordance with ASTM C1610.
25. 7-day compressive strength (minimum of three 4-inch x 8-inch cylinders), in accordance with ASTM C1758.
26. 14-day compressive strength (minimum of three 4-inch x 8-inch cylinders), in accordance with ASTM C1758.
27. 28-day compressive strength (minimum of three 4-inch x 8-inch cylinders), in accordance with ASTM C1758.

Self-consolidating concrete (Classes SCC and P-SCC) shall be verified prior to placement either at the ready mix facility or prestressed plant. The submitted mix design shall be reviewed by Headquarters Materials and Tests for specification compliance. The concrete producer shall then perform a trial batch verification of the submitted mix design in the presence of Regional Materials and Tests. The trial batch will ensure that all batch quantities and target admixture dosage rates are acceptable and meet TDOT specification prior to full mix design approval. If using a previously approved SCC design additional verification of the trial batch is not required. All quantities and identified admixture target dosage rates shall meet the tolerances specified in **501.09**.

**Subsection 604.03** (pg. 522), 12-2-16; Mix Design Submittal, modify the following:

- “18. 7-day compressive strength (minimum of two 4-inch x 8-inch cylinders)  
 19. 14-day compressive strength (minimum of two 4-inch x 8-inch cylinders)  
 20. 28-day compressive strength (minimum of two 4-inch x 8-inch cylinders)”

**Subsection 604.03 B.** (pg.524), 11-6-17; B. Quality Control and Acceptance of Concrete, Add the following as the last sentence of the 1<sup>st</sup> paragraph:

“If the quantity exceeds 2 cubic yards, prior approval must be obtained from the Engineer prior to

placement.”

**Subsection 604.04** (pg. 525-527). 5-14-18; Remove the last 3 paragraphs from page 527 and insert the paragraphs as the 6<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup> paragraph of the subsection:

**“604.04 Equipment**

Obtain the Engineer’s approval as to the design, capacity, and mechanical condition of equipment and tools used to handle materials and perform the work. Have the equipment on the jobsite sufficiently ahead of the start of construction operations to be examined and approved by the Engineer. Use equipment and construction processes that have sufficient capacity to accomplish the maximum continuous concrete placement, as governed by the construction joints shown on the Plans or as directed by the Engineer.

Meet the requirements for batching plants specified in **501.04.A**, except that when approved by the Engineer, the requirement for storage compartments in addition to weigh bins for fine and coarse aggregates may be waived, provided the batching tolerances specified in **501.09** are maintained.

Meet the requirements for mixers specified in **501.04.B**, except that the requirement for the boom-and-bucket attachment to the mixer will be waived.

Provide ample and satisfactory equipment for conveying concrete from the mixer to final position in the forms. Use closed chutes or pipes when concrete is to be dumped or dropped for a distance greater than 5 feet. Where steep slopes are required, equip the chutes with baffle boards, or use chutes in short lengths that will allow the direction of movement to be reversed.

Use vibrators of an approved type and design, and operate them under load at the rate recommended by the manufacturer and approved by the Engineer.

When placing concrete by pumping, do not use aluminum conduit.

Do not pour any concrete for bridge decks or slabs above grade before verifying the availability and operability of all necessary equipment, including finishing machines, continuous water source or portable tanks, water distribution equipment, two work bridges, vibrators, sprayers, a 12-foot straightedge, and appropriate backup items.

Provide at every concrete deck pour a portable, cold fogger capable of changing humidity and cooling air above fresh concrete. The fogger shall be designed to provide a maximum VMD (volume mean diameter) of 15 microns, and a throw distance of 60 feet.

The Contractor may mix concrete for minor structures, as identified in **604.11.B**, in a mobile volumetric continuous mixing plant.

Use a mobile mixing plant that is:

1. Designed to accurately batch aggregates and cement by volume based on weight.
2. Equipped to perform mixing by a continuous auger and/or paddles.
3. Capable of producing a uniform concrete mix meeting all requirements of the Specifications.
4. Capable of carrying in separate compartments all the necessary ingredients needed for the concrete mix.
5. Equipped with calibrated proportional devices for each material.
6. Equipped with proportioning controls that they may be set and secured for different materials and mixes.

7. Equipped with separate bins and gate openings for each type of material, including a watertight storage bin for cement. Cover the aggregate bins with tarpaulins or by other approved methods when required.

Ensure that a metal plate identifying the discharge speed and weight-calibrated constant of the machine is attached to each unit.

Make adequate standard volume measures, scales, and weights available for checking the accuracy of the proportioning mechanism.

Furnish a calibrated chart for the individual unit when required by the Engineer.

In the Engineer's presence, the producer or factory representative shall perform the calibration and gate settings according to the manufacturer's recommendations for the design to be used.

Provide a satisfactory method of setting the dosage for admixtures. If using admixtures other than air-entraining agents, add them in the manner and in the dosage recommended by the manufacturer.

”

**Subsection 604.13** (pg. 541), 5-15-17; Mixing Concrete, add Class DS concrete to the 2<sup>nd</sup> paragraph, 3<sup>rd</sup> sentence:

- A. “Do not retemper concrete by adding water or by other means. However, the Contractor may withhold a portion of the mixing water or chemical admixtures from transit mixers and add at the work site if all requirements of the approved mix design are met. Water added at the placement site for Class A, Class D, Class DS and Class L concrete shall not exceed 1 gallon per cubic yard. The total amount of water in the mix shall not exceed the maximum in the approved mix design. To achieve additional slump, use a water reducing admixture. If water, air entrainers, or chemical admixtures are added at the placement site, mix the concrete a minimum of 30 revolutions at mixing speed after making the additions. Do not use concrete that is not within the specified slump limits, air content limits, temperature limits, or time limits at the time of placement.”

**Subsection 604.13** (pg. 541), 5-14-18; Mixing Concrete, revise the 2<sup>nd</sup> and 3<sup>rd</sup> sentence of the 2<sup>nd</sup> paragraph:

“Do not retemper concrete by adding water or by other means. However, the Contractor may withhold a portion of the mixing water or chemical admixtures from transit mixers and add at the work site if all requirements of the approved mix design are met, provided the delivery ticket indicates the amount of water withheld. The total amount of water in the mix shall not exceed the maximum in the approved mix design. To achieve additional slump, use a water reducing admixture. If water, air entrainers, or chemical admixtures are added at the placement site, mix the concrete a minimum of 30 revolutions at mixing speed after making the additions. Do not use concrete that is not within the specified slump limits, air content limits, temperature limits, or time limits at the time of placement.”

**Subsection 604.14** (pg. 542), 11-16-15; Consistency of Concrete, modify the following:

“The slump of the concrete when measured according to AASHTO T 119 shall meet 604.03 - **1A**. The slump flow of self-consolidating concrete when measured according to ASTM C1611 shall meet **604.03 1B**.”

**Subsection 604.15** (pg. 542-543), 11-16-15; B. Concrete Acceptance Cylinders, modify the following:

“The Department will test the specimens for compressive strength according to AASHTO T 22. Provide the necessary concrete for making test specimens and adequate curing and storage facilities at no additional cost to the Department.

Concrete cylinders submitted for testing beyond 28 days shall comply with the strength requirements specified in Table 604.15-1.

**Table 604.15-1: Strength Requirements**

Class of Concrete	Compressive Strength (psi) at:			
	Less than 31 days	31 to 42 days	42 to 43 days	43 to 56 days
A, S, CP, SCC	3,000	3,300		3,500
D, L	4,000	4,400		4,600
X	Plans Requirement (Req)	Req. * (10%)	+	Req. * (15%)

If the acceptance cylinders fail to meet the specified strengths, the Contractor may drill core samples from the hardened concrete as verification of concrete strength instead of using the concrete cylinders. The Contractor must provide QC data from companion cylinders that meet or exceed the required strength, and TDOT Materials and Test shall perform a nondestructive test using a Swiss Hammer on the concrete to prove required strength is achieved. If the above mentioned requirements are met, the Contractor may then elect to drill a maximum of three core samples per set of cylinders from the hardened concrete. The Contractor shall obtain the cores in accordance with the Department’s Standard Operating Procedure 4-2, and bear all costs of obtaining the cores and repairing the core holes.”

**Subsection 604.15** (pg. 543), 5-15-17; Table 604.15-1: Strength Requirements, Add Class DS to Table, update 2<sup>nd</sup> paragraph 3<sup>rd</sup> sentence to remove “cylinders and”:

**Table 604.15-1: Strength Requirements**

Class of Concrete	Compressive Strength (psi) at:		
	Less than 31 days	31 to 42 days	43 days to 56 days
A, S, CP, SCC	3,000	3,300	3,500
D, DS, L	4,000	4,400	4,600
SH-SCC	4,500	4,950	5,175
X	Plans Requirement (Req)	Req. + Req. * (10%)	Req. + Req. * (15%)

If the acceptance cylinders fail to meet the specified strengths, the Contractor may drill core samples from the hardened concrete as verification of concrete strength instead of using the concrete cylinders. The Contractor must provide QC data from companion cylinders that meet or exceed the required strength, and TDOT Materials and Test shall perform a nondestructive test using a Swiss Hammer on the concrete to prove required strength is achieved. If the above mentioned requirements are met, the Contractor may then elect to drill a maximum of three core samples per set of cylinders from the hardened concrete. The Contractor shall obtain the cores in accordance with the Department's Standard Operating Procedure 4-2, and bear all costs of obtaining the cores and repairing the core holes.

Acceptance for payment may be based on cores provided by the Contractor at its expense. These cores shall meet the strength requirements specified in Table 604.15-1. The Engineer will not accept concrete cores submitted for testing beyond 56 days.

**Subsection 604.15** (pg. 542-544) 5-14-18, Compressive Strength Tests of Concrete; revise the last sentence of A. and add subsection 604.15.C.:

#### **“604.15 Compressive Strength Tests of Concrete**

##### **A. General**

The Engineer will determine concrete strength by tests performed during the progress of the work, and will use these tests to determine the strength of the concrete for acceptance and pay purposes. The frequency of testing will be as specified in the sampling and testing schedule of the Department's Standard Operating Procedures.

The frequency of testing for compressive strength to determine when forms may be removed, or when a structure may be put into service, shall be as requested by the Contractor or as deemed necessary by the Engineer in accordance with 604.15.C.

**B. Concrete Acceptance Cylinders**

The Department will test the specimens for compressive strength according to AASHTO T 22. Provide the necessary concrete for making test specimens and adequate curing and storage facilities at no additional charge to the Department.

Concrete cylinders submitted for testing beyond 28 days shall comply with the strength requirements specified in Table 604.15-1.

**Table 604.15-1: Strength Requirements**

Class of Concrete	Compressive Strength (psi) at:		
	Less than 31 days	31 to 42 days	43 days to 56 days
A, S, CP, SCC	3,000	3,300	3,500
D, DS, L	4,000	4,400	4,600
SH-SCC	4,500	4,950	5,175
X	Plans Requirement (Req)	Req. + Req. * (10%)	Req. + Req. * (15%)

If the acceptance cylinders fail to meet the specified strengths, the Contractor may drill core samples from the hardened concrete as verification of concrete strength instead of using concrete cylinders. The Contractor must provide QC data from companion cylinders that meet or exceed the required strength, and TDOT Materials and Tests shall perform a nondestructive test using a Swiss Hammer on the concrete to prove required strength is achieved. If the above mentioned requirements are met, the Contractor may then elect to drill a maximum of three core samples per set of cylinders from the hardened concrete. The Contractor shall obtain the cores in accordance with the Departments Standard Operating Procedure 4-2, and bear all costs of obtaining the cores and repairing the core holes.

Acceptance for payment may be based on cores provided by the Contractor its expense. These cores shall meet the strength requirements specified in Table 604.15-1. The Engineer will not accept concrete cylinders and cores submitted for testing beyond 56 days.

The average compressive strength of the two cores taken to represent the low test cylinders will be considered to be the acceptance strength of the in-place concrete, provided that the cores are obtained and tested within 56 days after concrete placement. In accordance with 603.31, the Engineer will accept at a reduced pay concrete that meets the required strengths specified in 604.03 for the respective class, but fails to meet the requirements in Table 604.15-1.

All concrete used shall undergo acceptance testing. The Department will determine the method to formally accept in-place concrete that is represented by acceptance cylinders that have been lost, damaged, or destroyed. These methods may include coring or non-destructive testing.



**C. Early Break Cylinders**

Make and cure all test specimens according to AASHTO T 23, and the applicable procedures therein defined for *Field Cured Specimens*, unless otherwise specified by the Engineer. The Department will test the specimens for compressive strength according to AASHTO T 22. Provide the necessary concrete for making test specimens at no additional charge to the Department.

Field Cured Specimens, as defined in AASHTO T 23, shall be cured in accordance with AASHTO T23- *Section 10.2. - Field Curing*. Cylinders shall be representative of the concrete placed and shall be cured in the same manner and method as the placed concrete. Specimens shall be protected from the elements in the same manner as the formed work. If specimens are to be used for determining when a structure is capable of being put into service the specimens should be removed from the molds at the time of removal of the form work.

**Subsection 604.16** (pg. 545) 5-15-17; Placing Concrete, A. General – revise the 1<sup>st</sup> paragraph to add Class DS in the first sentence:

“Unless otherwise specified, before placing a bridge deck overlay of Class D , Class DS, or Class L concrete, machine scarify the surface to be covered to a minimum depth of 1 inch. In areas inaccessible to machine scarifying, and in areas of spalling where steel reinforcement is exposed, remove deteriorated concrete using hand tools or other methods approved by the Engineer. After scarifying, clean the deck of all deleterious material. Do not allow traffic on the scarified deck.”

**Subsection 604.19** (pg. 551-552), 5-14-18; Removal of Forms and Falsework, Revise the 3<sup>rd</sup> paragraph and 1. to incorporate references to subsection 604.15:

“The Contractor may release and remove falsework and supports under concrete structures when the following conditions are met:

1. Representative specimens of the concrete, made and cured in accordance with 604.15.C, attain a compressive strength of 3000 pounds per square inch.”

**Subsection 604.27** (pg. 560), 11-16-15; Rideability of New or Resurfaced Bridge Decks and Roadway Approaches, A. General, revise the 1<sup>st</sup> paragraph to the following:

“On all highway sections with a posted speed greater than 40 miles per hour, the following rideability provisions shall apply to new or resurfaced bridge decks and roadway approaches.”

**Subsection 604.31** (pg. 567-568) 5-15-17; Basis of Payment, add Class DS to item and pay unit list:

**604.31 Basis of Payment**

The Department will pay for accepted quantities at the contract prices as follows:

<i>Item</i>	<i>Pay Unit</i>
Class A Concrete (Description)	Cubic Yard
Class D Concrete (Description)	Cubic Yard
Class DS Concrete (Description)	Cubic Yard
Class L Concrete (Description)	Cubic Yard
Class S Concrete (Description)	Cubic Yard
Steel Bar Reinforcement	Pound
Epoxy Coated Reinforcing	Pound
Scarifying	Square Yard
Applied Texture Finish	Square Yard
Hydro-demolition	Square Yard

**Subsection 606.04.B.1(b)** (pg. 578), 6-27-16; replace 1.b. with the following:

“(b) Except as provided in paragraph 2(b) below, develop an energy per blow in foot-pounds not less than 250 multiplied by R, where R is the required minimum bearing resistance of the pile in tons.”

**Subsection 606.07.A.** (pg. 581), 6-27-16; revise the 1<sup>st</sup> paragraph:

“Construct cast-in-place concrete piles of the design shown on the Plans and that consist of concrete cast in drilled holes or in steel shells or pipes driven to the required bearing. Use Class A concrete meeting **604**, or use Class X concrete, as required by design, meeting **604**. Provide and place suitable casing when required to prevent caving of the hole before concrete is placed.

**Subsection 611.02** (pg. 620), 11-6-17; Materials, revise the last sentence of the last paragraph to remove the mylar reference:

“After obtaining the necessary approval, furnish the Engineer an electronic reproducible design file..”

**Subsection 613.02** (pg. 633), 6-27-16; add the following section:

“Brick Paving Units .....912.05”

**Subsection 615.09** (pg. 644), 10-8-18; Table 615.09-1: Class P Concrete, Revise Table and footnote (4):  
**Table 615.09-1: Class P Concrete, Revise Table 615.09-1 and footnote (3).**

**Table 615.09-1: Class P Concrete**

Class of Concrete	Min 28-Day Compressive Strength (psi)	Min Cement Content (pound per cubic yard)	Maximum Water/Cement Ratio (pound/pound)	Air Content % (Design $\pm$ production tolerance)	Slump or Slump Flow (inches)
P	5,000 <sup>(1)</sup>	658	0.45	0-8 <sup>(2)</sup>	2 $\pm$ 1 <sup>(3)</sup>
P-SCC <sup>(4)</sup>	5,000 <sup>(1)</sup>	658	0.45	0-6 <sup>(2)</sup>	<u>26 + 5</u>

(1) Or as shown on the Plans or approved shop drawings.

(2) Air entraining is optional with the Contractor, unless otherwise shown on the Plans or shop drawings.

(3) Not to exceed 3 inches before the addition of high range admixtures, and not to exceed 10 inches after the addition of high range admixtures. If water-cement ratio is equal to or less than 0.35 then the maximum slump is 10 inches. If the water-cement ratio is 0.36 – 0.45, the maximum slump is 8 inches.

(4) Maximum coarse aggregate size of a No. 67 stone.

**Subsection 615.09** (pg. 644), 11-16-15; Proportioning and Mixing of Concrete, update Table 615.09-1 and add the 3<sup>rd</sup> paragraph below the table, modify the last paragraph:

**Table 615.09-1: Composition of Prestress Concrete Classes**

Class of Concrete	Minimum 28-Day Compressive Strength (psi)	Minimum Pounds Cement per Cubic Yard	Maximum Water/Cement Ratio (pound/pound)	Air Content %	Slump or Slump Flow (inches)
P	5,000 <sup>(1)</sup>	658	0.45	0-8 <sup>(2)</sup>	2 $\pm$ 1 <sup>(3)</sup>
P-SCC <sup>(4)</sup>	5,000 <sup>(1)</sup>	658	0.45	0-6 <sup>(2)</sup>	25 $\pm$ 4

(1) Or as shown on the Plans or approved shop drawings.

(2) Air entraining is optional with the Contractor, unless otherwise shown on the Plans or shop drawings.

(3) Not to exceed 3 inches before the addition of high range admixtures, and not to exceed 10 inches after the addition of high range admixtures. If water-cement ratio is equal to or less than 0.35 then the maximum slump is 10 inches. If the water-cement ratio is 0.36 – 0.45, the maximum slump is 8 inches.

(4) Maximum coarse aggregate size of a No. 67 stone.

Comply with all applicable provisions of **604.03** except as modified herein.

Submit a concrete design to the Department for review and approval. In addition to the proportions, identify in the design submittal the source or brand of all materials and the type of cement to be used. The Contractor may use Type I or Type III cement, unless otherwise specified. Do not use calcium chloride. Use a retardant admixture when the ambient temperature is 75 °F or higher. The slump of the concrete shall be 2 inches with a tolerance of  $\pm 1$  inch at the time of placement. When an approved superplasticizer is to be used, the slump of the concrete shall be the same as above before the superplasticizer is added to the mix. After the addition of the superplasticizer, the slump may be increased to a maximum of 8 inches at the time of placement.

The slump flow of self-consolidating concrete shall be determined and within the design and production tolerances stated in **Table 615.09-1**. Include chemical admixtures in the self-consolidating concrete mixture as specified in **Table 604.03-5** based on the ambient air temperature and expected weather conditions. Approved viscosity modifying admixtures (VMA) may be used as part of the chemical admixtures if they are shown in the approved mixture design.

Handle, measure, and batch materials; mix concrete; and comply with the limitations of mixing as specified in **501.09**, **501.10**, and **501.11**, respectively.

Make concrete test specimens for Class P and Class P-SCC, in accordance with AASHTO T 23 and ASTM C1758 respectively, to determine the adequacy of the concrete design and the minimum time at which the stress may be applied to the concrete. Cure the test specimens used to determine the time at which stress may be applied in the same manner and under the same conditions as the bridge members. The initial curing of specimens to determine the design strength of the concrete shall be as specified above with additional curing water, as provided in AASHTO...

**Subsection 615.17** (pg. 652), 5-18-15; Table 615.17-1: Manufacturing Tolerances in Standard Sections, Update Table 615.17-1:

Table 615.17-1: Manufacturing Tolerances in Standard Sections

Description	Tolerance	
	I-Sections	Box Sections
Nominal Depth	± 1/2 inch	± 1/2 inch
Nominal Width	± 1/2 inch	± 1/2 inch
Nominal Length	Computed Elastic Shortening ±1/2 inch	Computed Elastic Shortening ±1/2 inch
Variation in Straightness, inches	1/4 inch x (Total Length in feet)/10	1/4 inch x (Total Length in feet)/10
Variation in Camber, inches	Beams in any 1 span not more than: 1/8 inch x (Total Length in feet )/10	Beams in any 1 span not more than: 1/8 inch x (Total Length in feet )/10
Location of Voids	-----	Length ± 1/2 in Wall Thickness ± 1/2 in
Bearing	Full Bearing - Full Width of Beam	Full Bearing on at Least 2/3 of Width of Beam
Tendon Placement	± 1/2 inch	± 1/2 inch
Reinforcing Steel Placement	± 1/2 inch	± 1/2 inch
Reinforcing Steel Concrete Cover	± 1/2 inch	± 1/2 inch
Reinforcing Steel Splice Lengths	Minus 1-1/2 inches	Minus 1-1/2 inches

**Subsection 622.03** (pg. 686) 12-2-16; Add the following paragraph at the beginning of the section:

“Same-as designs shall not be submitted for Shotcrete.”

**Subsection 622.03** (pg, 686-688) 5-14-18; Add subsection C: Placement of Shotcrete:

**“C. Placement of Shotcrete**

An ACI-certified Shotcrete Nozzleman shall be utilized to properly place shotcrete.”

**Subsection 622.03** (pg. 687) 10-8-18; Proportioning and Quality Assurance of Shotcrete, Modify Table 622.03-2, add a sentence to the end of the paragraph between tables 622.03-1 and 622.03-2:

**Table 622.03-1: Shotcrete Performance Requirements**

Parameter	Value
3-Day Compressive Strength (psi)	2000
28-Day Compressive Strength (psi)	4000
Minimum Cementitious per cubic yard	660
Maximum Water/Cement (pound/pound)	0.45
Air Content (%)	7-10 <sup>(1)</sup>
7-Day Maximum Absorption (%)	8

<sup>(1)</sup> Air content acceptance range shall be between 7-10%, with sampling at the truck chute. Air entrainment is required for wet-mix shotcrete but not for dry-mix shotcrete.

Aggregate for shotcrete shall meet the strength and durability requirements of AASHTO M6/M80 and the gradation requirements specified in Table 622.03-2. An intermediate size aggregate may also be used as an additional component if needed to meet gradation. Aggregates failing to comply with Table 622.03-2 may be used if preconstruction testing as specified in 622.04 proves satisfactory results.

**Table 622.03-2: Gradation Requirements**

Sieve Size	Percent Passing by Weight
<u>3/4 inch</u>	<u>100</u>
1/2 inch	<u>98</u> -100
3/8 inch	90-100
No. 4	70-85
No. 8	50-70
No. 16	35- <del>55</del> <u>60</u>
No. 30	20- <del>35</del> <u>50</u>
No. 50	8-20
No. 100	<u>20</u> -10

S T A T E

O F

T E N N E S S E E

(Rev. 6-27-16)

(Rev. 12-2-16)

(Rev. 5-15-17)

(Rev. 11-6-17)

(Rev. 10-8-18)

January 1, 2015

**Supplemental Specifications - Section 700**

**of the**

**Standard Specifications for Road and Bridge Construction**

**January 1, 2015**

**Subsection 712.04** (pg. 759), 12-2-16; A. Flaggers, add ABET Accredited University Programs to the list of flagger training:

- “1. American Traffic Safety Services Association (ATSSA)
- 2. National Safety Council (NSC)
- 3. Tennessee Transportation Assistance Program (TTAP)
- 4. ABET Accredited University Programs”

**Subsection 712.04** (pg. 759). 11-6-17; A. Flaggers, replace the last paragraph with the following:

“The Department will review and determine if an alternative training program is acceptable prior to use. Alternative training programs shall meet all MUTCD requirements and follow FHWA guidance.

The Department will consider flaggers to be a general requirement of traffic control and will not make direct payment for such.

Coordinate flagging operations in a manner that causes as little delay to the traveling public as possible. Delays shall be kept within 2 minutes or ¼ mile, but shall not exceed 5 minutes or a 1 mile maximum, unless prior authorization is granted by the Department.”

**Subsection 712.04.B** (pg.759-760) 12-2-16; revise the second paragraph of B. THP Troopers and Uniformed Law Enforcement Officers:

“B. THP Troopers and Uniformed Law Enforcement Officers  
When a THP Trooper is not available, the Contractor may provide a Uniformed Law Enforcement Officer if approved by the Engineer and the Regional Safety Coordinator or Regional Operations Office. All Uniformed Law Enforcement Officers shall provide marked law enforcement vehicle equipped with blue lights and have the authority to write traffic tickets and make arrests within the project site. The Uniformed Law Enforcement Officer shall maintain a detailed written log of enforcement activities and shall submit the log to the Engineer for verification each month.”

**Subsection 712.04 G.** (pg. 762), 11-6-17; G. Lane Closures, add the Type of Facility and Requirement table to the end of the subsection, revise the last sentence:

“G. Lane Closures  
Hold the length of a lane closure to the minimum length required to accomplish the Work. Locate advanced warning signs for the Project so as to not overlap with the advanced warning signs for lane shifts and lane closures.

Use drums in all transition tapers for lane closures on multi-lane roads.

Contractor’s Staff performing lane closure shall have the following certifications to close lanes on TDOT facilities and shall be onsite during each lane closure performed.

Type of Facility	Requirement
Two Lane	Flagging Operations Certification (Shall comply with Subsection 712.04 A)
Multi-Lane	*ATSSA Traffic Control Technician Training or equivalent
Controlled Access Freeways & Expressways	*ATSSA Traffic Control Technician Training or equivalent

\*Proof of certification shall be provided to the Engineer at the Pre-Construction Meeting.”

**Subsection 712.09** (pg. 769), 12-2-16; change Uniformed Police Officer to Uniformed Law Enforcement in the last paragraph:

“The Department will pay for Uniformed Law Enforcement Officers provided by the Contractor at the invoice price of the work plus 5%, not to exceed \$50 per hour for the hours present on the Project. No compensation will be made for drive time.”

**Subsection 713.04** (pg. 772) 5-15-17; Construction Methods and Requirements; add steel requirement as the last paragraph:

“Ensure steel meets all specifications in **602.04**.”

**Subsection 713.04.C.6** (pg. 774), 6-27-16; replace C.6. with the following:

“6. Concrete. Use either (1) Class A concrete meeting 604.03 or (2) Class X concrete with a f’c as identified in the plans or required by the design. If Class X concrete is required, use a mix meeting the minimum requirements of **604.03** for Class A concrete, but with a cementitious material quantity necessary to produce the specified strength.”

**Subsection 713.04.C.8** (pg. 774), 6-27-16; add sentence to the end of 8.:

“8. Setting Anchor Bolts and Stubs. Set anchor bolts and stubs for sign supports to proper locations and elevations with templates, and carefully check them after constructing the sign foundation and before the concrete has set. Anchor rods shall conform to the requirements of section **730.11**”

**Subsection 714** (pg. 779-800), 11-6-17; Revise the subsection as follows:

**“MATERIALS**

**714.02 Materials**

Provide materials as specified in **917** and as follows:

Portland Cement Concrete, Class A .....	<b>604</b>
Crushed Stone Grading D.....	<b>903.05</b>
Steel Bar Reinforcement for Concrete Structures.....	<b>907.01</b>
Welded Steel Wire Fabric .....	<b>907.03</b>



Gray Iron Castings..... **908.07**  
 Inorganic Zinc Paint ..... **910.03**  
 Cement Concrete Curing Materials ..... **913**  
 Conduit ..... **917.05** or **917.07**

Within 30 days after the issuance of the work order, submit to the Engineer, four collated sets of the manufacturer’s descriptive literature and technical data, fully describing the types of lighting equipment proposed for use. In the descriptive literature, identify the manufacturer and model, and include sufficient information for the Engineer to determine if the equipment or material meets the requirements of the Plans and these Specifications. Include with these sets of submittal data a list of the materials submitted along with descriptive material for, but not limited to, the following items when applicable:

1. Complete photometric data of luminaires as published by the manufacturer with independent testing laboratory results.
2. Computer printouts showing illumination levels throughout each interchange area where high mast luminaires are to be installed.
3. General details of light standards, breakaway bases, and bracket arms. For light standards taller than 30 feet, submit one set of design calculations and six prints of “Design” or “Shop” drawings to the Division of Structures for approval purposes. The Department will review these drawings at the earliest possible date, and will return two prints marked “Approved for Fabrication,” or “Returned for Revisions as Noted.” Respond by taking appropriate action to ensure the earliest possible correction of these items so as not to delay the installation.
4. Highmast tower details with a set of design calculations for each height including access hole, base, anchorage, head frame, and lowering device. Include specification references for materials and location, type, size, and extent of welds. In addition to the set of design calculations, submit six prints of “Design” or “Shop” drawings for each highmast tower height to the Division of Structures for approval purposes, in a manner similar to that specified in Item 3 above for light standards taller than 30 feet.
5. Dimension sheets and performance data on all related equipment.

The Engineer will retain one copy and forward one copy each to the the local entity (city or county engineer) and the Traffic Operations Division for their review.

Also include with the submittal sets detailed scale drawings of all non-standard or special equipment and of all proposed deviations from the Plans. Deviations from the Plans or Specifications require approval from the Traffic Operations Division. Include a letter requesting deviations or alternate materials in the submittal for Traffic Operations Division approval. Upon request, submit for approval sample articles of materials proposed for use. The Department will not be liable for any materials purchased, labor performed, or delay to the Work prior to such approval.

In addition to the above, include with each submittal a notarized letter certifying that all lighting system materials listed in the submittal conform to the Plans and Specifications. Also submit to the Engineer a statement from the Maintaining Agency that the system is acceptable to the Agency.

**714.03 Codes**

Furnish material and perform all work in strict accordance with the latest revision of the National Electrical Code, the National Electrical Safety Code, the Illuminating Engineering Society (IES) publications, ANSI standards, and the codes, regulations, and rules prevailing in the area in which the Work is being performed, as applicable.

**714.04 Reserved****CONSTRUCTION REQUIREMENTS****714.05 Conduit**

Install conduit of the type and size specified at the locations shown on the Plans, or as directed by the Engineer. Install pull or drag wires of the type and size specified in conduit at the locations shown on the Plans.

**A. Underground Conduit**

- 1. General.** Underground conduit shall consist of encased or direct burial conduit. Install conduit in a trench excavated to the dimensions and lines specified.

Before beginning any excavation, determine the location of all electrical, drainage, and utility lines in the vicinity, and perform work so as to avoid damaging these facilities. Ensure that the conduit will be located so as to avoid conflict with proposed guardrail, sign posts, and other features.

Build conduit runs in straight lines where possible. Where sweeps are necessary, use standard long sweep conduit bends when feasible, and meet the minimum radius required by the National Electric Code. Install pull boxes at intervals so that the tensile strength of the conductors will not be exceeded.

Obstructions encountered when excavating trenches for underground conduit may require minor changes, such as in locations of conduit runs and pull boxes. Obtain the Engineer's approval before making such changes. Where possible, provide a minimum of 12 inches between the finished lines of conduit runs and utility facilities, such as gas lines, water mains, and other underground facilities not associated with the electrical system. Where the conduit run is adjacent to concrete walls, piers, footings, and similar structures, maintain a minimum of 4 inches of undisturbed earth or firmly compacted soil between the conduit and the adjacent concrete or, when the conduit is encased, between the encasement and the adjacent concrete.

Unless shown on the Plans, do not excavate trenches in existing pavement or surfaced shoulders to install conduit. If it is necessary to place a conduit under an existing pavement, install the conduit by jacking or other approved means with galvanized rigid steel conduit or schedule 80 PVC conduit.

Keep jacking and drilling pits at least 10 feet from the edge of the paved shoulder or sidewalk unless otherwise directed by the Engineer. When the Plans specifically allow excavation of a trench through an existing pavement or surfaced shoulder, restore the pavement and/or surface and base to their original condition. Do not leave boring pits open for extended periods of time.

Unless otherwise specified, cut trenches for conduit on a slight grade for drainage, and make the walls of the trench essentially vertical. Tamp the bottom of the trench as necessary to produce a firm foundation for the conduit.

Excavate trenches for rigid metallic conduit, with or without encasement, to a minimum depth of 18 inches, plus conduit diameter, measured from the finished subgrade.

Sheet and brace the trenches as required, and adequately support all pipe and other structures exposed in trenches as necessary to prevent damage.

Ream metallic conduit after threads are cut. Ream other conduit as necessary. Cut all ends square and to butt solidly in the joints to form a smooth raceway for cables.

Ensure that conduit joints form a water-tight seal. Coat metallic conduit threads with pipe compound and then securely connect. Make conduit joints with the materials and in the manner recommended by the conduit manufacturer and as approved by the Engineer.

Install conduit bushings in conduit where necessary and required for protection of the conductors. When the conduit is installed for future use, ensure that the ends of metallic conduit runs are properly threaded and capped, and that the ends of non-metallic conduit runs are satisfactorily plugged or capped to prevent water or other foreign matter from entering the conduit system.

**a. Encased Conduit.** Place encased conduit under roadway and paved shoulders unless trenching is required for installation at the locations shown on the Plans. Unless otherwise specified, construct encasement as follows:

- (1) Construct the encasement of Class A concrete meeting the requirements of **604**.
- (2) Extend the encasement of conduit under roadway pavements or surfaces to the outer edges of the surfaced or paved shoulders, or 1 foot beyond the outer edge of the sidewalk, or 1 foot beyond the outer edge of the curb when no shoulder or sidewalk is indicated.
- (3) Extend the conduit at least 6 inches beyond the encasement.
- (4) Encase the pipe with a minimum of 3 inches of concrete.
- (5) Plug the ends of the conduit temporarily to prevent the entrance of concrete or other foreign material.
- (6) Do not encase any conduit with concrete until inspected and approved by the Engineer.
- (7) Cure concrete encasement as specified in **604.23**, except that the curing period may be reduced to 24 hours if backfilling is to proceed at the time specified in **714.05.A.2**.

**b. Direct Burial Conduit.** When rock is encountered in the bottom of the trench, install the conduit on a bed of well compacted fine grain soil at least 4 inches thick.

**2. Backfilling Conduit.** Do not backfill encased conduit until the concrete encasement has cured a minimum of 24 hours. After the Engineer has inspected and approved the installation of direct burial conduit, promptly backfill to the required grade with approved material in layers not exceeding 6 inches in loose depth, and compact each layer as directed by the Engineer.

#### **B. Conduit on Structures**

Install conduits, conduit fittings, hangers, expansion fittings, and accessories on as shown on the Plans and, unless otherwise specified, in accordance with the following:

1. Run conduit parallel to beams, trusses, supports, pier caps, and similar features in the most direct manner.
2. Install horizontal runs on a slight grade, without forming low spots, to ensure proper drainage.

3. Run conduits with smooth, easy bends.
4. Hold conduits in boxes with locknuts and provide bushings for protection of the conductors.

### **C. Testing Conduit**

After completing the installation of conduit, test it with a metallic mandrel in the presence of the Engineer. Use a mandrel having a diameter 1/4 inch smaller than the conduit, and a length of 2 inches. Repair, to the Engineer's satisfaction, all conduits that will not allow passage of the mandrel. If repairs cannot be accomplished, remove and replace the conduit at no additional cost to the Department.

After the mandrel test, scour all conduits with a stiff wire brush having a slightly larger diameter than the conduit.

Test conduits that have been installed under a previous contract with a mandrel and clean as described above before installing the cables.

### **714.06 Pull Boxes**

Construct pull boxes in accordance with the design, dimensions, and at the locations shown on the Plans. Construct concrete pull boxes of Class A concrete meeting the requirements of **604**. Place non-metallic pull boxes only in non-traffic bearing locations and not in paved areas.

Provide a cast iron frame and cover or reinforced concrete cover, as shown on the Plans, with each pull box.

Plug unused conduit entrance holes and openings for conduit to be extended by others with suitable plugs of plastic, bituminous fiber, or other approved material to prevent the entrance of foreign matter.

### **714.07 Underground Cable for Lighting Circuits**

Underground cable for lighting circuits shall consist of direct burial cable, preassembled cable in duct, or cable in conduit, as shown on the Plans.

If it is necessary to install a cable under an existing pavement or surfaced shoulder, install conduit, when specified, in accordance with the applicable provisions of **714.05**, and place the cable within the conduit.

Construct walls of trenches for cables to be essentially vertical. Unless otherwise specified, install underground cable as follows:

1. Excavate trenches for direct burial cable to a minimum depth of 24 inches plus the cable diameter as measured from finished subgrade.
2. In general, locate the trenches to avoid conflict with proposed guardrail, sign posts, and other features.
3. Protect direct burial cable, and preassembled cable in duct, in trenches by cushioning with sand or earth that passes a 1/4-inch screen. Place the cable, or preassembled cable in duct, and sand or earth in the trench so that a minimum 3-inch thickness of the cushion material will completely surround each cable.

**A. Direct Burial Cable**

Do not unreel cables and pull into the trench from one end. Unreel the cables, lay them alongside the trench, and then lay in the trench. Allow the cables to “snake” slightly in the trench to provide adequate slack for settling of earth. Ensure that there are no crossovers of cable in the trench. Where cable is brought up into the base of the lighting standard, leave sufficient slack for making the connections inside the standard.

**B. Preassembled Cable in Duct**

When installing in the trench, do not pull preassembled cable in duct taut, but allow it to “snake” in the ditch to provide not less than 18 inches slack per 100 feet of trench. The minimum bending radius on the cable duct shall be 18 inches. Where the duct is brought into the base of the lighting standard or into a pull box, leave sufficient length for trimming the duct to expose enough cable to allow for the connections to be made inside the standard or pull box.

**C. Cable in Conduit**

Carefully pull cables in conduits into place using approved methods so that the cable will be installed without electrical or mechanical damage. Pull all cables within a single conduit at the same time. If necessary to ease the pulling, use a lubricant of the type recommended by the cable manufacturer. When cables are pulled through hand holes in pole shafts, place a pad of firm rubber or other suitable material between the cable and the edges of the opening to prevent cable damage.

After the cable has been installed in the conduit, seal the ends of buried conduit with approved pliable and non-hardening material to prevent the entrance of dirt, moisture, or other foreign material.

**D. Splices**

Splice conductors as shown on the Plans. Only make splices at accessible points, such as handholes and pull boxes, unless otherwise shown on the Plans. After making a conductor splice, insulate it with heat-shrinkable tubing, supplied by the manufacturer, with an adhesive coating on the inner wall.

**E. Ground Wire**

Install ground conductors of the type and size shown on the Plans, and to be continuous in trenches with direct burial cable, and continuous inside preassembled cable in duct, and in conduit. Connect the ground conductors to the ground rod at all control points, to the ground lug in pole foundations, and to all metallic conduit runs using a grounding bushing, except that the connections to conduit in pole foundations may be omitted. Make all connections as shown on the Plans.

**F. Backfilling Underground Cable**

Backfill cable as specified in **714.05**.

**G. Cable Identification**

To assist in the identification of circuits at the pull boxes, mark the phase conductors with colored rubber-based, or equivalent, paint. When final connections are made, provide permanent tape wire markers to identify the branch circuit conductors (X1A, X1B, etc.), neutral (X1N, etc.), and the ground (g).

**714.08 Light Standards**

Install light standards of the designated design, kind, size, and class in accordance with and at the locations shown on the Plans. Ensure that the installed standards, complete with the bracket arm(s) and luminaire(s) as specified, provide the mounting height shown on the Plans. Determine the pole height as required by bracket arm upsweep, slope conditions, and similar characteristics.

**A. Foundations for Light Standards**

Consider transformer bases to be an integral part of the lighting standard unless otherwise specified.

**1. Bolt-Down Base Pole Foundations**

- a. **Concrete Foundations.** Excavate a hole of the size and depth shown on the Plans. Remove and dispose of all excavated material as directed by the Engineer. Place anchor bolts of the type and size specified according to the pole manufacturer's recommendations, and securely hold to ensure proper position in the completed foundation. Ensure that no realignment of anchor bolts will occur after the foundation is poured. Accurately place reinforcing steel and securely hold to avoid displacement.

Accurately place conduits in foundations, orient them in the proper direction to accommodate service cables, and securely hold to avoid displacement.

Place Class A concrete in the excavated area against undisturbed earth to an elevation 4 inches below the finished ground line, and in an approved form from 4 inches below said ground line to the finished top of foundation elevation, as specified. Construct the foundation with a continuous concrete pour. Chamfer the edges of the top and formed portion of the foundation. Apply a Class 2 finish, as specified in **604.21.B**, to the portion of the foundation above grade and within 4 inches of grade.

- b. **Metal Foundations.** Install metal foundations where shown on the Plans and, if desired, at locations where installation is possible without predrilling the hole.
2. **Prestressed Concrete Butt Base Pole Foundations.** Excavate prestressed concrete butt base lighting standard foundations using manual or mechanical methods. Dig or drill the holes to the depth and the diameter shown on the Plans. Place and compact in the bottom of the hole 6 inches of crushed stone, meeting the requirements of **903.05**, Grading D.
  3. **Wood Poles.** Excavate for wood poles as specified for prestressed concrete butt base pole foundations in **714.08.A.2**. Dig or drill the holes to the depth shown on the Plans and in such diameter to allow satisfactory use of mechanical tamping equipment.

**B. Light Standard Installation**

Handle the standards or poles as recommended by the manufacturer and approved by the Engineer. Accomplish erection without marring the finish or otherwise damaging the standard. Ground the light standards as shown on the Plans. When installing lighting on a bridge, review the proposed bridge plans or the completed structure before ordering the standards.

1. **Bolt-Down Base Poles.** Set standards with bolt-down bases on foundations constructed as specified in **714.08.A.1**. Use metal shims supplied with the poles to plumb the pole, if the twin bracket arm type is

used; and, unless otherwise specified, to rake or lean the pole backward 4 inches, if the single bracket arm type is used.

2. **Prestressed Concrete Butt Base Poles.** Place prestressed concrete butt base lighting standards in the hole and on the layer of crushed stone prepared as specified in **714.08.A.2**. Position the pole in the center of the hole at grade and hold in place. Rake the lighting standards with single bracket arms as specified for poles with bolt-down bases in **714.08.B.1**. Set lighting standards with two bracket arms plumb. Fill the space surrounding the pole butt-base with crushed stone, applied in 6-inch layers. The crushed stone shall meet the same requirements specified for the stone foundation in **714.08.A.2**. Moisten the stone backfill material as necessary, and thoroughly compact each layer with mechanical tamping equipment. Continue the backfill with crushed stone to the depth of the bottom edge of the cable entrance in the butt-base. After completing the installation of the electrical cable, continue placing the crushed stone backfill in 6-inch layers, and compact to a depth of 1 foot below grade. Backfill the remaining 12 inches with soil in two equal layers, and thoroughly compact each layer.
3. **Wood Poles.** Place wood poles in holes excavated as specified in **714.08.A.2**. Set the pole in the center of the hole, with any vertical curvature of the pole located in the plane of the lines, and rake in a direction opposite that of the unbalanced stress where a guy or underbrace is specified. Backfill the hole with approved material applied in 6-inch layers, and thoroughly compact each layer with mechanical tamping equipment. Install cross arms and guying components, when specified, as shown on the Plans.

#### C. **Highmast Tower Installation**

Install standards with lowering devices on foundations constructed as shown on the Plans. Ensure that the standards are plumb. Assemble the shaft in the Engineer's presence. Do not perform any field welding between sections of the shaft. Erect the tower according to the manufacturer's recommended procedures and under the manufacturer's supervision. Make adjustments to align all parts and ensure operation. Arrange for the manufacturer or its representative to instruct the local utility in the proper operation of the lowering device.

#### **714.09 Bracket Arms**

Install, on the lighting standards, bracket arms of the specified type, design, kind, dimensions, and number as shown on the Plans.

#### **714.10 Luminaires**

Use the following luminaire types on the roads and bridges: High Intensity Discharge (HID) which includes High Pressure Sodium (HPS) and Metal Halide (MH); Fluorescent and Induction lamps; and Light Emitting Diode (LED).

Install luminaires of the design and size shown on the Plans, and level according to the manufacturer's recommendations, as shown on the Plans and as approved by the Engineer. Provide glare shields on luminaires when shown on the Plans.

Clamp the pole and bracket cable in the proper terminals on the terminal board in the luminaire, and then splice the cable to the proper phase and neutral conductors outside of the handhole in the pole base. After other required circuit splices are made outside of the handhole, place all of the wire inside the handhole.

Leave slack in all cables for future maintenance. Attach a suitable identification tag to each of the phase cables.

Clean luminaire reflector surfaces and glassware after installation. Perform cleaning, if required, according to the luminaire manufacturer's recommendations.

Ensure that luminaires for sign lighting are adjustable both horizontally and vertically.

### **High Intensity Discharge (HID)**

High Intensity Discharge (HID) luminaires shall meet IES standards from LM-51-00 to LM-35-02. The HID luminaire shall be covered by a one-year written warranty starting from the system acceptance date. All of the other electrical and mechanical component parts of the HID shall be covered by a five-year written warranty starting from the system acceptance date. The signed warranty certificate shall be submitted prior to final payment.

### **Light Emitting Diode (LED)**

Light Emitting Diode (LED) luminaires shall be manufactured in accordance with ANSI C136.37-2011 (or recent version). All testing and data sheets for proposed LEDs shall be included in the submittal package and shall include, but not limited to, the following: Illuminating Engineering Society of North America (IESNA): LM-79-08, LM-80-08, RP-8-14, TM-3-95 and TM-15-07 (all should be up-to-date versions). In addition to these requirements, the LEDs shall meet the following requirements:

1. Finished surface: Furnish luminaires with the color mentioned in the plans. The surface of luminaire housing shall meet UL-1598 listed for wet locations, ASTM B117 for salt chamber exposure, and ASTM D1654 for rust creepage.
2. Thermal Management: the luminaire shall start and operate in the ambient temperature range of -25C to +25C.
3. Optical Assembly: The LED optical assembly package shall have a minimum Ingress Protection rating of IP 66 according to ANSI/IEC 60529. The luminaire shall have a standardized refractor/reflector to meet the required optical distribution as required by the plans. The optical assembly shall utilize high brightness, long life, minimum 70 color rendering index (CRI), (3000 K-5700 K) color temperature (+/-300 K) LEDs binned according to ANSI C78.377. Lenses shall be UV-stabilized acrylic or glass. Provisions for house-side shielding shall be provided when specified.
4. Prevent the entrance of wildlife by limiting openings around the pipe tenon mounting area.
5. Electrical Parts (including Safety Testing) shall comply with an ANSI C136.41 with 7-pin receptacle that is fully pre-wire for LED driver's control.
6. Documents for the materials submitted need a certification from a National Voluntary Laboratory Accreditation Program (NVLAP) and that lab must be recognized by the U.S. Department of Energy.

### **LED Luminaire Warranty**

The entire LED luminaire and all of its component parts shall be covered by a 10 year written warranty covering materials, fixture finish, and workmanship. Failure is when one or more of the following occur:



1. Negligible light output from more than 10 percent of the LED packages.
2. Condensed moisture inside the optical assembly.
3. Driver that continues to operate at a reduced output below 15 percent of the rated nominal output. The warranty period shall start from the system acceptance date. The signed warranty certificate shall be submitted prior to final payment.

**714.11 Lamps**

Install lamps of the design, type, and size, and at the locations shown on the Plans.

**714.12 Installation of Overhead Wires**

Install overhead wiring, when specified, as shown on the Plans.

**714.13 Cable Markers**

When shown on the Plans, place precast or cast-in-place concrete cable markers, of the dimensions indicated, at all locations where lighting cables make an abrupt change in direction. Construct the markers of Class A concrete meeting **604**. Imprint an arrow on each marker to indicate the direction of the cable run as it approaches and leaves the marker. Also imprint the circuit number on the marker.

Recess the markers into the ground approximately 3 inches, unless otherwise specified.

**714.14 Control Center**

Furnish and install a service pole or poles of the design, type, size, and class, and at the locations shown on the Plans. Install the service pole(s) as specified in **714.08** and as shown on the Plans. Set the service pole(s) plumb.

Notify the power company, at least 30 days before connection, of the need to furnish power to operate the lighting system.

Unless otherwise specified, furnish and install all the control center equipment and electrical supply facilities. The electrical supply facilities shall include the necessary service conduit from the control cabinet to the delivery point designated on the Plans.

Construct a concrete slab, of the dimensions and thickness indicated, around the service pole foundation. Construct the slab of Class A concrete meeting the requirements of **604**, and reinforce the slab, if specified, as shown on the Plans.

Construct a 6-foot chain-link fence and gate of the size specified around the control center as shown on the Plans and as specified in **707**.

**714.15 Field Painting**

After erection is completed, thoroughly clean steel standards that are not galvanized, and then apply two coats of inorganic zinc paint meeting the requirements of **910.03**. Perform painting as specified in **603**.

If the shop coat of prime paint is damaged, cover the damaged areas with a coat of the same type of paint as used for the original primer coat, and allow it to completely dry before applying the first coat of aluminum paint.

If the finish on galvanized steel materials is scratched, chipped, or otherwise damaged, the Engineer will reject the material, or may allow it to be repaired as specified in **713.04.B**.

#### **714.16 Testing After Installation**

Install all materials and equipment to form a complete installation ready for operation, unless otherwise specified.

After the installation is completed, test the lighting system in the presence of a Department representative and the Maintaining Agency. Tests shall include insulation resistance, voltage, current, and performance tests. Unless otherwise specified, perform the tests in accordance with the following:

##### **D. Voltage Tests**

Take a voltage reading at the control center at the load side of the circuit protection device and the last lighting standard served in each branch circuit. In cases where the circuit feeds in two or more directions, take the voltage reading at the light most remote from the control point or as directed by the Engineer. Unless otherwise specified, with the complete lighting system energized and all lamps operating, the voltage of this last standard shall not be less than 90% of the nominal rated voltage of the luminaire supply circuit, and the voltage at the last underpass luminaire in each branch circuit shall not be less than the minimum operating voltage recommended by the manufacturer of the luminaire ballast.

##### **E. Current Test**

Conduct current tests at each control center at the load side of each circuit protection device, using a clamp-on type ammeter. Current, in amperes, in each supply conductor shall not be greater than the rated current of a luminaire times the number of luminaires in the circuit.

##### **F. Grounding Resistance Test**

Conduct ground resistance tests with a "megger," manufactured by the James H. Biddle Company, or a "vibraground" manufactured by Associated Research Incorporated or approved equal.

Adhere to the following when conducting this test:

1. Ensure that no equipment, such as ballast or oil switches, is connected at the time of the test.
2. Test only one conductor at a time.
3. Isolate the conductor being tested from ground.
4. Ensure that the other phase conductor and the neutral are grounded during each test.

##### **G. Performance Tests**

Prior to acceptance and after all faults have been corrected, operate the lighting system, including automatic control equipment and other specified apparatus, for a continuous 48-hour period without interruption or failure attributable to poor workmanship or defective material. After the 48 hours of continuous operation,

the Engineer will inspect all lights and equipment for normal operation. Make all necessary repairs or replacements to the Engineer's satisfaction.

Make arrangements with the Servicing Agency to purchase the electric power necessary to conduct all tests.

Furnish the Engineer five copies of the test results, together with five copies of a statement from the Maintaining Agency that the system is acceptable to the Agency.

**714.17 Repair of Seeded and Sodded Areas**

If areas previously seeded or sodded are disturbed during the performance of the work described in this Section, reseed (with mulch) or re-sod such areas as specified in **801** or **803**, respectively. Perform these repairs as the work progresses to minimize erosion of disturbed areas.

**H. 714.18 Disposal of Excess or Unsuitable Material**

Dispose of excess or unsuitable material as specified in **203.07**.

**714.19 Final Cleanup**

Perform final cleanup as specified in **104.10**. Remove existing foundations, designated for removal, to a minimum of 6 inches below grade. Before final inspection, touch-up finishes, clean surfaces including signs that are lighted, and perform such other work as directed by the Engineer to ensure the effectiveness and neat appearance of the work.

**COMPENSATION**

**714.20 Method of Measurement**

When the bid schedule contains an item for Roadway and Structure Lighting on a lump sum basis, measurement will be for the sum total of all items to be furnished and installed.

When the bid schedule contains items for various elements of Roadway and Structure Lighting, the Department will make measurement for payment as follows:

**A. Conduit**

The Department will measure:

1. Encased Conduit and Direct Burial Conduit by the linear foot of conduit for each kind, number, and size installed as indicated, and
2. Conduit (Structures) of the kind and size specified by the linear foot of each individual kind and size of conduit placed.

**B. Pull Boxes**

The Department will measure Pull Boxes by the unit, per each.

**C. Cable**

The Department will measure Cable of the type, and number and size of conductors specified, by the linear foot from the center to center of pull boxes, light standards, and similar features, for each type and number and size of conductors. No additional allowance will be made for slack length, length inside equipment or standards, and similar instances requiring additional length of wire.

**D. Preassembled Cable in Duct**

The Department will measure Preassembled Cable in Duct by the linear foot from the center to center of pull boxes, light standards, and similar features. No additional allowance will be made for slack length.

**E. Light Standards**

The Department will measure Light Standards of the kind and design specified by the unit, per each.

**F. Luminaires**

The Department will measure Luminaires of the size, type, and design specified by the unit, per each, regardless of their classifications (i.e. LED, HID).

**G. Overhead Conductors**

The Department will measure Overhead Conductors of the gauge, type, and kind specified by the linear foot between supports. No allowance will be made for slack length.

**H. Cable Markers**

The Department will measure Cable Markers by the unit, per each.

**I. Control Center**

The Department will measure the Control Center on a lump sum basis. Such measurement will be for the sum total of all items to be furnished and installed at the control center, except as specified in **714.20.J** and **714.20.K**.

**J. Class A Concrete**

The Department will measure Class A Concrete used to construct the concrete slab around the service pole at the control center by the volume in cubic yards, as determined from the specified thickness shown on the Plans and surface measurements for width and length. The Department will not measure reinforcement for the concrete slab for payment, but will consider the costs thereof as incidental to the item for Class A Concrete.

**K. Chain-Link Fence and Gate**

The Department will measure and pay for Fence and Gates in accordance with **707.08** and **707.09**, respectively.

**L. Navigational Lighting and Overhead Sign Lighting**

The Department will measure Navigational Lighting and Overhead Sign Lighting furnished and installed in accordance with the Plans on a lump sum basis.

**M. Incidental Items**

The Department will consider incidental, and will not directly measure, the following:

1. Excavation and backfilling performed in connection with this construction.
2. The removal and satisfactory disposal of existing pavement, surface, and base required to install conduit, and for restoring the base, pavement, and surface to their original condition.
3. Furnishing, installing, and subsequently removing sheeting, bracing, and supports needed to install conduit.
4. Labor, materials, equipment, electrical energy, and incidentals required to conduct the performance tests specified in **714.16.D**.
5. Reseeding, resodding, and otherwise restoring to their original condition areas that were disturbed during the performance of the work described in this Section.

**714.21 Basis of Payment**

When the bid schedule indicates payment will be made for Roadway and Structure Lighting on a lump sum basis, such payment is full compensation for all materials, labor, equipment, and incidentals necessary to produce a completely integrated, operative, and finished installation of a Roadway and Structure Lighting System, as shown on the Plans.

When the bid schedule contains items for various elements of Roadway and Structure Lighting, the Department will make payment as follows:

**A. Conduit**

1. **Encased Conduit.** The Department will pay for Encased Conduit at the contract unit price per linear foot, complete in place, for each kind, number, and size installed as indicated. Such payment is full compensation for all excavation, sheeting when required, backfilling, disposal of excess or unsuitable material, furnishing and placing or installing all materials and accessories, including grounding materials, concrete, and reinforcement when specified, all bends, joints, fittings and appurtenances, and installing the encased conduit complete.
2. **Direct Burial Conduit.** The Department will pay for Direct Burial Conduit of the kind, number, and size specified at the contract unit price per linear foot, complete in place. Such payment is full compensation for all excavation, sheeting when required, backfilling, jacking of conduit, disposal of excess or unsuitable material, furnishing and placing or installing all materials and accessories, including grounding materials, bedding materials when required, all bends, joints, fittings and appurtenances, and installing the conduit complete.
3. **Conduit (Structures).** The Department will pay for Conduit (Structures) of the kind and size specified at the contract unit price per linear foot, complete in place. Such payment is full compensation for furnishing

and installing all materials, including conduits, hangers, expansion fittings, grounding materials, and associated hardware and accessories, and installing the conduit complete.

**B. Pull Boxes**

The Department will pay for Pull Boxes at the unit price per each, complete in place. Such payment is full compensation for furnishing and installing or constructing pull boxes and for all excavation, backfilling, and other work connected therewith.

**C. Cable**

The Department will pay for Cable of the type, and number and size of conductors, as specified, at the contract unit price per linear foot, complete in place. Such payment is full compensation for furnishing and installing the cable and grounding materials, making splices, joints and connections, and for trenching, furnishing, and placing cushion and backfill material, and disposing of excess or unsuitable excavated material.

**D. Preassembled Cable in Duct**

Preassembled Cable in Duct of the kind and size specified will be paid for at the contract unit price per linear foot, complete in place. Such payment is full compensation for furnishing and installing the cable duct, grounding materials, making splices and connections, and for trenching, furnishing, and placing cushion and backfill material, and disposing of excess or unsuitable excavated material.

**E. Light Standards**

The Department will pay for Light Standards of the type specified at the contract unit price per each, complete in place. Such payment is full compensation for furnishing and installing the complete light standards, including the foundation, standard, bracket arm or arms, associated hardware and wiring, grounding materials, excavation, backfilling materials, and backfilling. The Department will measure foundations for high mast towers separately.

**F. Luminaires**

The Department will pay for Luminaires of the size and type specified at the contract unit price per each, regardless of their classifications (i.e. LED, HID), complete in place. Such payment is full compensation for furnishing and installing the complete luminaire, including the ballast(s), lamp(s), glare shields where required, and associated hardware and wiring.

**G. Overhead Conductors**

The Department will pay for Overhead Conductors of the gauge, type, and kind specified at the contract unit price per linear foot, complete in place.

**H. Cable Markers**

The Department will pay for Cable Markers of the design specified at the contract unit price per each, complete in place. Such payment is full compensation for furnishing and installing the marker complete, including the excavation, backfilling, and removal and disposal of excess or unsuitable excavated materials.

**I. Control Center**

The Department will pay for the Control Center at the contract unit price per lump sum, complete in place. Such payment is full compensation for furnishing and installing all equipment and materials, including service pole(s) when specified, and photoelectric relays, relay cabinets, multiple relays, lightning arrestors, fuse cutouts, and all other equipment, materials, associated hardware, and accessories, as shown on the Plans. Payment for the Control Center is full compensation for furnishing and installing all electrical supply facilities from the delivery point for electrical energy, as shown on the Plans, to the control center.

**J. Class A Concrete**

The Department will pay for Class A Concrete, measured as specified in **714.20.J**, at the contract unit price per cubic yard, complete in place.

**K. Navigational Lighting and Overhead Structure Lighting**

The Department will pay for Navigational Lighting and Overhead Structure Lighting by the lump sum complete in place including all materials and labor.”

**Subsection 716.05** (pg. 813), 10-8-18, Snowplowable Reflective Pavement Marker, Add the following as the third sentence:

“Contour the pavement at each snowplowable marker location to match the bottom of the marker casting. Install markers according to the manufacturer’s recommendations. For asphalt surfaces, only use the dry saw method to apply snowplowable reflective pavement markers. When using the dry saw method, provide a vacuum system to contain the dust. For other surfaces, —rRegardless of the saw method used, ensure that the saw cut is clean, dry, and free of all dust or residue before applying the adhesive. Accompany each shipment of adhesive with a written statement from the adhesive manufacturer certifying that the material furnished conforms to the recommendations of the marker manufacturer, and stating the minimum temperature at which the adhesive can be satisfactorily mixed and applied.”

**Subsection 730.11** (pg. 835), 6-27-16; Revise the title:

“AnchorRods”

**Subsection 730.11** (pg. 835), 6-27-16; revise the first paragraph:

“Furnish, with anchor-base type poles, anchor rods meeting the requirements of ASTM F1554, Grade as required by design. Fit each anchor bolt with two heavy hex nuts. Hot-dip galvanize all nuts and not less than 10 inches of the threaded ends of anchor bolts according to ASTM A153. The anchor bolts shall be capable of resisting at yield strength stress the bending moment of the shaft at its yield strength stress.”

**Subsection 730** (pg. 828-880), 11-6-17; replace section with the following:

**SECTION 730 – TRAFFIC SIGNALS**

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**DESCRIPTION****730.01 Description of Work**

This work consists of furnishing and installing all necessary materials and equipment to complete in-place traffic signal systems, modify existing systems, or both, all as shown on the Plans or the Standard or Special Details, and as specified in these Specifications. Unless otherwise shown on the Plans or specified in the Special Provisions, all materials shall be new.

Where existing systems are to be modified, incorporate the existing material into the revised system, salvage it, or abandon it as specified or as directed by the Engineer.

Furnish and install all incidental parts that are not shown on the Plans or specified herein, but that are necessary to complete the traffic signal or other electrical systems, or that are required for modifying existing systems, as though such parts were shown on the Plans or specified herein. Include the costs of such incidentals in bid price for other items. All systems shall be complete and in operation to the Engineer's satisfaction at the time of completion of the work.

**GENERAL REQUIREMENTS****730.02 Regulations and Code**

Ensure that all equipment provided conforms to NEMA Standards Publication, Traffic Control Systems, latest revision, or the Radio Manufacturers Association, whichever is applicable. In addition to the requirements of these Specifications, the Plans, and the Special Provisions, all material and work shall conform to the requirements of the NEC and the NESC; the Standards of ASTM, ANSI, ITE, and IMSA; the MUTCD; and other applicable local ordinances.

Wherever reference is made to the NEC, or the Standards mentioned above, consider the reference to mean the code or standard that is in effect on the date of advertising the bids or authorization for force account.

**730.03 Submittal Data Requirements**

Within 30 days after the issuance of the work order, submit to the Engineer, the Traffic Operations Division, and the local entity (city or county engineer), one collated set of the manufacturer's descriptive literature and technical data that fully describes the types of signal equipment proposed for use. In the descriptive literature, identify the manufacturer and models and include sufficient information for the Engineer to determine if the equipment or material meets the requirements of the Plans and these Specifications. Include with these sets of submittal data a list of the materials submitted along with descriptive material for, but not limited to, the following items:

1. Controller
2. Cabinet and Exhaust Fan
3. Detectors
4. Signal Heads including Lamp Information and Mounting Hardware
5. Loop Wire and Loop Sealant
6. Shielded Detector Cable
7. Signal Cable
8. Cable for Span Wire, Guys, and similar features
9. Pull Boxes
10. Conduit
11. Coordination Equipment

Also include in the submittal sets detailed scale drawings of all non-standard or special equipment and of all proposed deviations from the Plans. Upon request, submit for approval sample articles of materials proposed for

use. The Department will not be liable for any materials purchased, labor performed, or delay to the Work prior to such approval.

In addition to the above, submit to the Engineer a notarized letter certifying that all traffic signal materials listed in the submittal conform to the Plans and Specifications along with a copy of a statement from the maintaining agency that the system is acceptable to the agency. Any material substitutions requested by the maintaining agency shall meet minimum Department standards and shall be approved by the Department in writing prior to purchase or installation. The Department will not be liable for any materials purchased; labor performed, or delay to the Work regarding such approval.

Submit an electronic copy in PDF format of “Design” or “Shop” drawings, indicating the proposed dimensions and material specification for each of the supports and mast arms involved, to the Division of Structures for approval purposes within 30 days after the work order is issued. The Department will review these drawings at the earliest possible date, and will return the electronic copy marked “Approved for Fabrication,” or “Returned for Revisions as Noted.” Respond by taking appropriate action to ensure the earliest possible correction of these items so as not to delay the installation.

**730.04 Mill Test Reports and Certification**

Provide Mill Test Reports (MTR) or Certifications of Conformance to the Specifications for Materials and Design for all materials incorporated into the Work. Supply the following prior to acceptance of the structures:

1. MTRs for MAJOR structural items only, as identified in Table 730.04-1, shall include both physical and chemical descriptions of the material as supplied to the fabricator. When physical properties are altered during the fabrication, supplement the MTR covering chemical composition with certified test reports indicating the physical properties of this material after fabrication.
2. Certifications of Conformance to the Specifications for all remaining material not covered by MTR as identified in Table 730.04-1.
3. Certification that all welding was performed by operators qualified as follows: Steel welders to AWS and aluminum welders to ASME.
4. Certification of Conformance to the Specification for the Design of all components not completely dimensioned and detailed on the Standard Drawing.

**Table 730.04-1: Required Mill Test Reports and Certifications**

<b>Component Materials</b>	<b>MTR</b>	<b>Certification</b>
Tubes for arms and poles	X	
Base Castings	X	
Anchor Bolts	X	
Pole tops, misc. fittings, and hardware		X
Fabricated or cast-type arm connections		X
Galvanizing		X

**730.05 Working Drawings**

Provide within the controller cabinet and to the local maintaining agency an electrical schematic diagram of the cabinet and system wiring. Submit manufacturer’s instructions for installation, maintenance, and operation of all equipment to the local maintaining agency and also place a copy within the controller cabinet. Place all such materials inside a plastic envelope mounted in the cabinet.

**730.06 Guarantee**

Guarantee the Traffic Signal System(s) installed under these Specifications, including all equipment, parts, and appurtenances in connection therewith, to the City or County and State against defective workmanship and materials for a period of not less than 1 year following the date the signal system is installed and made operational, except in no case shall this guarantee expire prior to 3 months after the final acceptance of the Project. Upon completion of the Project, turn over to the government agency responsible for maintaining the signal installation all warranties or guarantees on equipment and materials that are offered by the manufacturers as normal trade practice.

**730.07 Training**

Provide to the maintaining agency and/or the Department a training session on the controller and associated cabinet equipment to be supplied on the Project. The training session shall last for a minimum 4 hours unless the maintaining agency and/or the Department determines a lesser time is adequate. Train the user in the complete operation and programming features of all controllers. Provide this training prior to the acceptance of the Project at a facility agreed upon by the maintaining agency.

After the required training, certify to the Engineer that training has been completed.

This training requirement shall not apply if a training program meeting these criteria has been provided to the maintaining agency by this vendor and/or manufacturer on the equipment being bid within 18 months prior to the date of the invitation to bid. This requirement shall apply if the bidder is proposing new, upgraded, or modified equipment not covered in the previous training program.

**MATERIALS AND INSTALLATION****730.08 Excavating and Backfilling**

Perform excavation needed to install conduit, foundations, and other equipment, so as to cause the least possible damage to the streets, sidewalks, and other improvements. Excavate trenches no wider than necessary to properly install the electrical equipment and foundations. Do not begin excavating until immediately before installing conduit and other equipment. Place the material from the excavation where it will cause the least disruption and obstruction to vehicular and pedestrian traffic and the least interference with the surface drainage.

Backfill the excavations and compact to at least the density of the surrounding material. Remove all surplus excavation material and dispose of outside the highway right-of-way, in accordance with **203.07**, or as directed by the Engineer.

After backfilling, keep excavations well-filled, and maintain in a smooth and well-drained condition until permanent repairs can be made.

At the end of each day's work, and at all other times when construction operations are suspended, remove all equipment and other obstructions from that portion of the roadway used by public traffic, and park a minimum of 30 feet from the edge of pavement unless otherwise protected by guardrail, bridge rail, or barriers installed for other purposes.

Perform excavation in the street or highway so as to restrict no more than one traffic lane in either direction at any time. Do not obstruct traffic during hours of peak flow unless otherwise approved by the Engineer. Incorporate construction signing in accordance with the MUTCD.

**730.09 Removing and Replacing Improvements**

Replace or reconstruct, with the same kind of materials as found on the Work, improvements, such as sidewalks, curbs, gutters, Portland cement concrete and asphalt concrete pavement, bituminous surfacing, base material, and all other improvements removed, broken, or damaged by the Contractor.

Before removing the sidewalk and pavement material, use an abrasive type saw to cut, to a minimum depth of 2 inches, the outline of all areas to be removed in Portland cement concrete sidewalks and in all pavements. Use any method satisfactory to the Engineer to cut the remainder of the required depth. Make cuts neat and true with no shatter outside the removal area.

Whenever a part of a square or slab of existing concrete sidewalk or driveway is broken or damaged, remove the entire square or slab and reconstruct the concrete as specified above.

Perform all work in accordance with these Specifications, or the applicable local ordinance, whichever is of a higher standard. Consider this removal and replacement work to be incidental to other items.

**730.10 Foundations**

Construct foundations for posts, standards, and cabinets of Class A Portland cement concrete.

Pour foundations for posts, standards, and pedestals after the post, standard, pedestal, or anchor bolts or reinforcing steel is in proper position. Form the exposed portions to present a neat appearance. Rest the bottom of concrete foundations on firm undisturbed ground.

Construct forms to be true to line and grade. Finish tops of footings for posts and standards, except special foundations, to curb or sidewalk grade or as ordered by the Engineer. Use rigid forms, securely braced in place. Place conduit ends and anchor bolts by means of a template until the concrete sets. Moisten both the forms and the ground that will be in contact with the concrete before placing concrete. Do not remove forms until the concrete has cured for at least 12 hours and hardened sufficiently to allow form removal without causing damage to the concrete.

Apply an ordinary surface finish to exposed surfaces of concrete. Wherever the edge of a concrete foundation or sidewalk section is within 18 inches of any existing concrete improvement, extend the sidewalk section to meet the existing improvement.

Where obstructions prevent the construction of planned foundations, construct a foundation satisfactory to the Engineer.

**730.11 Anchor Rods**

Furnish, with anchor-base type rods, anchor bolts meeting the requirements of ASTM F1554, grade as required by design. Fit each anchor bolt with two heavy hex nuts. Hot-dip galvanize all nuts and not less than 10 inches of the threaded ends of anchor bolts according to ASTM A153. The anchor bolts shall be capable of resisting at yield strength stress the bending moment of the shaft at its yield strength stress.

Set standards, posts, and pedestals plumb by adjusting the nuts before the foundation is finished to final grade. Do not use shims or similar devices for plumbing or raking. After plumbing or raking has been completed, cut off anchor bolts 1/4 inch above the top nut, and paint the exposed surface with rust protective paint.

Furnish all anchor bolts and nuts required for relocating existing standards and posts.

**730.12 Pull Boxes**

Construct and install pull boxes as shown on the Plans and the Standard Drawings or as directed by the Engineer. Additional pull boxes may be required where conduit runs are more than 150 feet long. The maximum spacing

between pull boxes shall be 150 feet, unless otherwise directed by the Engineer. Install pull boxes wherever practicable out of the line of traffic. Set covers level with the pavement, or with the curb or sidewalk grade, or with the surrounding ground as required.

Place electrical conductors within pull boxes so as to be clear of the metal frame and cover.

Rest the bottom of the pull box firmly on a bed of crushed stone with a minimum depth of 12 inches below the bottom, and extending 6 inches beyond the outside edge of the pull box, unless otherwise directed by the Engineer.

#### **A. Concrete Pull Boxes**

Construct concrete pull boxes of a mixture of one part cement, two parts sand, and four parts gravel or 1-inch crushed stone with reinforcement placed as shown on the Standard Drawings. Reinforcement shall consist of welded wire reinforcement, 4 x 4 inches - No. 4/4 at 85 pounds per 100 square feet, meeting the requirements of **907.03**. Pull boxes may be poured in place or precast. The color of the pull box concrete material shall match the surrounding concrete color.

Install a cast iron frame and cover of the dimensions shown on the Drawings in each pull box. Provide castings of Class 30, meeting the requirements of **908.07**. The covers shall have a roughened top surface of 1/8 inch in relief. Provide notches for removing the cover. Inscribe the words "TRAFFIC SIGNALS" on top of the covers with letters 1-1/2 inches high and 1/8 inch in relief as shown on the Drawings.

The frame shall have a minimum weight of 42 pounds. The cover shall be of the "Extra Heavy" type with a minimum weight of 54 pounds.

#### **B. Reinforced Plastic or Epoxy Mortar Pull Boxes**

Ensure that pull boxes composed of reinforced plastic or epoxy mortar are designed and tested to temperatures of -50 °F and meet the requirements of the following: ASTM D543, ASTM D570, ASTM D790, and ASTM D635, and are based on a 30,000-pound single axle load over a 10 x 20 inch area. The top of the pull box shall consist of a concrete frame (ring) and cover. The color of the pull box concrete material shall match the surrounding concrete color. Inscribe the words "TRAFFIC SIGNALS" on top of the covers.

### **730.13 Transformer Base**

Fabricate the transformer base from steel plate and sheet, and design it to harmonize with the shaft. Provide each transformer base with:

1. One 7-1/2 x 9 inch minimum handhole, with a cover secured with stainless steel fastening screws;
2. Four galvanized steel bearing plates to fasten the base to the anchor bolts;
3. Four galvanized steel bolts, nuts, and washers to fasten base and standard; and
4. One 1/2-inch, 13 UNC grounding nut welded to the inside of the base opposite the handhole opening.

Ensure that the strength of the transformer base is comparable with that of the shaft.

When a transformer base is required, no handhole will be required in the shaft.

### **730.14 Conduit**

Furnish and install plastic and steel conduit in accordance with these Specifications and close conformity with the lines shown on the Plans or as established by the Engineer.

Threads shall be clean cut, straight, and true and of sufficient length to allow proper coupling. Do not use long running threads on any part of the Work. Protect threads in transit and during installation, and provide conduit with proper supports and protection during construction to prevent damage. Properly thread, ream, and cap all ends of pipe installed for future connections to prevent water and foreign matter from entering the conduit system. Provide threaded ends with approved conduit bushings.

Signal conduit shall be a minimum 2 inches in diameter, and detector conduit a minimum 1 inch in diameter, unless otherwise specified or directed by the Engineer. Conduit for service connections shall be 1 inch in diameter. Do not use conduits smaller than 1 inch in diameter unless otherwise specified, except grounding conductors at service points shall be enclosed in 3/4-inch diameter conduit. Larger-sized conduit may be used, at no additional cost to the Department, in which case it shall be for the entire length of the run with no reducing couplings allowed.

#### **A. Materials**

Provide conduits and fittings of the type as shown in the construction plans or as directed by the Engineer and as follows:

##### **1. Steel Conduit**

- a. Rigid conduit and fittings shall be heavy-wall, hot dipped galvanized steel conforming to Federal Specification WW-C-581-d(3) and ANSI C80.1. It shall be galvanized inside and out and shall meet the requirements of ASTM A53. Each length shall bear the label of Underwriters Laboratories, Inc.
- b. Flexible conduit shall be galvanized flexible steel meeting Federal Specification WW-C-581-d(3), ANSI C80.1 and UL Standard 6 with a minimum 40-mil thickness of polyvinyl chloride (PVC) coating conforming to ASTM D746.

**2. Plastic Conduit.** For plastic conduit, provide high impact PVC, Schedule 40 or Schedule 80.

**3. High-Density Polyethylene (HDPE).** Materials used for the manufacture of HDPE conduit and fittings shall be per ASTM F2160 and consist of a Standard Dimension Ratio (SDR) 9-11. No other substitutions shall be allowed unless directed by the Engineer. HDPE conduit can be used with preassembled cable and rope-in-conduit.

#### **B. Installation**

All bends shall be in strict compliance with the NEC.

Lay conduits to a minimum depth of 6 inches below subgrade but not less than 24 inches below pavement grade except when approved by the Engineer; conduit may be laid at a depth of not less than 24 inches below top of curb when placed in back of the curb. Place conduit runs for detectors parallel to existing or proposed curbs and not more than 18 inches behind the curb face unless otherwise specified. Place steel conduit or Schedule 80 PVC conduit under existing pavements by approved jacking or drilling methods. Do not disturb pavements without the Engineer's approval. Where trenching is allowed in a traffic bearing area, use PVC conduit (Schedule 40) encased in concrete.

Conduits shall be continuous and extend from end point (i.e. pull box, foundation signal pole, pedestal pole, etc.) to another end point, or as directed by the Engineer. Conduit splicing shall not be permitted between end points.

After completing the installation of the conduit, test all conduits installed under the Contract with a mandrel having a diameter 1/4-inch smaller than the conduit and a length of 2 inches. Repair, to the Engineer's satisfaction, all conduits that will not allow passage of the mandrel; if repairs cannot be accomplished, remove

and replace the conduit at no additional cost to the Department. After the mandrel test, scour all conduits with a stiff wire brush slightly larger in diameter than the conduit. Clear all conduits in the Engineer's presence.

Extend conduits terminating in anchor base standards and pedestals approximately 2 inches above the foundation and slope them toward the hand-hole opening. Conduits shall enter concrete pull boxes from the bottom and shall terminate not less than 2 inches nor more than 4 inches above the bottom of the box and near the box walls to leave the major portion of the box clear.

Clean existing underground conduit to be incorporated into a new system by blowing with compressed air, or by other means approved by the Engineer.

**730.15 Conductors**

Furnish and install conductors in accordance with these Specifications and close conformity as shown on the Plans, or as directed by the Engineer.

Traffic Control Conductors shall be rated at 600 volts. Run all conductors, except loop conductors and cables run along messengers, in conduit, except where run inside poles. Where signal conductors are run in lighting standards containing high voltage street lighting conductors, encase the signal conductors in flexible or rigid metal conduit. Where telephone circuits are introduced into controller foundations, encase the telephone conductors in flexible metal conduit and in conformance with the NEC.

Conductors for traffic loops shall be continuous AWG No. 14 XLP stranded wire to the detector terminals or spliced with shielded detector cable within a pull box, conduit, or pole base.

Detector cable shall be two conductor twisted pair shielded AWG No. 14 stranded meeting IMSA Specification No. 50-2.

**730.16 Cable**

All signal cable shall conform to applicable IMSA Specification No. 19-1 or 20-1. Use stranded cable color coded AWG No. 14 for all signal and accessory circuits. Retain the same color identification for the entire length of a circuit run.

**730.17 Wiring**

1. Terminate all wiring to screw terminals using lugs.
2. Make all splices with solderless connectors, and insulate splices with weatherproof tape applied to a thickness equal to the original insulation.
3. Attach cables to messenger with non-corrosive lashing rods or stainless steel wire lashings.
4. All wiring within enclosed cabinets shall be neatly formed and harnessed and shall have sufficient length for access and servicing.

**730.18 Service Connection**

Coordinate service connection details and metering with the local utility as directed by the Engineer and in conformance with the City and County requirements. Obtain the necessary service for each installation.

**730.19 Sealant**

Provide sealant material selected from the Qualified Products List maintained by the Department's Material and Test Division for sealing saw-cuts. The sealant material shall resist the upward movement of loop and lead-in and shall

exhibit stable dielectric characteristics, including a low permittivity and high dielectric strength. It shall bond to the roadway paving material, preventing entry of moisture, and shall remain flexible without melting through the anticipated temperature and weather conditions.

**730.20 Strand Cable**

Span cable for suspending signal heads between pole supports shall be 7-strand, Class A, copper-covered steel wire strand or greater, meeting the requirements of ASTM A460, with a minimum breaking strength as noted on the Plans. An acceptable alternate is 7-strand steel wire with a Class A zinc coating meeting the requirements of ASTM A475, with a minimum breaking strength as shown on the Plans.

Strand cable for messenger wire (other than span wire as specified above) and pole guy cable use shall be of the diameter(s) shown on the Plans and shall meet the requirements of ASTM A475 for zinc-coated steel wire strand, 7-strand Siemens-Martin Grade with a Class A zinc coating or greater.

A Figure 8 cable combining the messenger cable and conductor cable in an insulated jacket is an acceptable alternate to conductor cable lashed to a messenger cable.

**730.21 Bonding and Grounding**

Make metallic cable sheaths, conduit, transformer bases, anchor bolts, and metal poles and pedestals mechanically and electrically secure to form a continuous system, and ensure they are effectively grounded. Bonding and grounding jumpers shall be copper wire or copper strap of not less than the same cross-sectional area as No. 6 AWG.

Furnish and install a ground electrode at each service point. Ground electrodes shall be one-piece lengths of copperweld ground rod not less than 8 feet in length and 1/2 inch in diameter, installed in accordance with the NEC. Ground the conduit and neutral as required under the NEC, except that grounding conductors shall be No. 6 AWG or approved equal, as a minimum. Enclose exposed ground conductors in 1/2-inch diameter conduit, and bond to the electrode with a copperweld ground clamp.

**730.22 Field Test**

Prior to completing the work, conduct the following tests on all traffic signal and lighting circuits in the Engineer's presence:

1. Test for ground in circuit.
2. Conduct a megger test on each circuit between the circuit and ground. The insulation resistance shall be not less than the values specified in Section 119 of the NEC.
3. Conduct a functional test to demonstrate that each part of the system functions as specified or intended herein.
4. Test all detector loops and leads before and after they are sealed in the pavement to ensure there are no shorts to ground in the system and to ensure that the loop plus lead-in inductance is within the operating range of the detector.

Replace or repair, in a manner approved by the Engineer, all faults in material or in the installation revealed by these tests. Repeat the applicable testing until no fault appears.

**730.23 Inspection**

After completion of the installation and before final acceptance of the Project, conduct a full operational check of the system under actual traffic conditions in the presence of the Engineer. The operational check shall cover a



minimum time period of 30 calendar days. During this period, perform all necessary adjustments and replace all malfunctioning parts of the equipment required to place the system in an acceptable operational condition at no additional cost to the Department. Perform all work and furnish all materials required under these Specifications subject to the direct supervision, inspection, and approval of the Engineer. Provide the Engineer and authorized representatives free access to the work, and to all plants, yards, shops, mills, and factories where, or in which, articles or materials to be used or furnished in connection with such work are being prepared, fabricated, or manufactured. Provide full and sufficient information to determine that the performance of the work, the character of materials, and the quality of workmanship and materials meets the intent of these Specifications.

Only perform work in the presence of the Engineer or the Inspector appointed by the Engineer, unless permission to do otherwise has first been obtained. The Engineer may reject any work that is performed or constructed in the absence of the Engineer or Inspector, without such permission having been granted, either expressly or by implication.

The inspection of the work shall not relieve the obligation to properly fulfill the Contract as specified. If the Engineer finds a part of the work, or the materials used in the work, to be defective or unsuitable at any time prior to final acceptance, repair or replace such defective or unsuitable work or material.

Request the presence of an Engineer or Inspector in connection with the work under these Specifications at least 24 hours before such services will be required.

## **SIGNAL HEADS**

### **730.24 Signal Heads**

Signal heads shall meet the latest requirements published in the Equipment and Materials Standards of the Institute of Transportation Engineers (ITE) for Adjustable Face Vehicle Traffic Control Signal Heads” and the National Electrical Code. The arrangement of traffic signal heads shall be mounted as shown on the Plans or as specified by the Engineer and be in accordance with the latest versions of the MUTCD and the TDOT Traffic Design Manual.

All circular indications shall use 12-inch lenses unless otherwise shown on the Plans. All arrow indications shall use 12-inch lenses. All new vehicle signal heads installed at any one intersection shall be of the same style and from the same manufacturer. All exposed metal signal housings, doors, visors, backplates and framework parts shall be painted with a powder coated finish and be in accordance to the MUTCD specifications. Suspensions for span wire mounting of multi-faced signal heads and signal head clusters (such as a 5-section signal head) shall include an approved swivel type balance adjuster for proper vertical alignment.

Signal head housings shall be cast aluminum and all associated parts/hardware shall be of non-corrosive material. In addition to these requirements, comply with the following:

#### **A. Optical Units**

Traffic signal indications shall be LED type and meet the Institute for Transportation Engineers (ITE) latest LED specifications. All LED indications shall have a five year warranty.

#### **B. Signal Head Mounting and Mounting Brackets**

Furnish signal heads that either have integral serrations or are equipped with positive lock rings and fittings designed to prevent heads from turning due to external forces. Lock ring and connecting fittings shall have serrated contacts. Provide signals with water-tight fittings.

Support bracket-mounted signal heads, as shown on the Plans, by mounting brackets consisting of assemblies of 1-1/2 inch standard pipe size. Ensure that all members are either plumb or level, symmetrically arranged, and securely assembled. Conceal all conductors within poles and mounting assembly. Secure each slip fitter to the pole.

**C. Directional Louvers**

Where shown on the Plans, furnish and install louvers in the hoods of the signal head sections designated.

Directional louvers shall have a snug fit in the signal hoods. Construct the outside cylinder and vanes from a non-ferrous metal or galvanized sheet steel. Louvers shall be painted with a powder coated finish.

**D. Back Plates**

Where shown on the Plans, furnish and attach back plates to the signal heads. All back plates shall be louvered and constructed of 3,003, half-hard, 0.051-inch minimum thickness aluminum sheet. Other materials such as plastic or fiberglass may be used where approved. In fabricating back plates, bend back the inside vertical edges, adjacent to the signal head, to form mounting brackets for attaching to the signal. Form back plates in two or more sections and bolt together, thus allowing for installation after signal heads are in place. Back plates shall have a dull black appearance in the front and back.

**E. Wiring**

Signal head leads shall be No. 18 AWG stranded with 221 °F thermoplastic insulation. Wire a separate white (common) lead to each socket shell; and wire a colored lead, corresponding to the color code shown on the Plans, to each socket terminal. Provide leads of sufficient length to allow connection to the terminal block specified. Provide each complete signal head with a minimum 4-point terminal block, properly mounted in a signal section. Stud type terminal blocks shall have not less than 1/4-inch edge clearance to any portion of the stud. Exterior wiring shall have a 360-degree drip loop in advance of entering the head.

**F. Pedestrian Signals**

Pedestrian signal heads shall meet the latest requirements published in the Equipment and Materials Standards of the Institute of Transportation Engineers (ITE) for Adjustable Face Pedestrian Signal Heads”, the National Electrical Code and be compatible with NEMA standards. The arrangement of pedestrian signal heads shall be mounted as shown on the Plans or as specified by the Engineer and be in accordance with the latest versions of the MUTCD and the TDOT Traffic Design Manual. The pedestrian indications shall be LED symbols and in conformance with the Institute for Transportation Engineers (ITE) latest LED specifications. All LED indications shall have a five year warranty.

In addition, where pedestrian signal heads are provided, they shall:

1. include a pedestrian change interval countdown display where the calculated pedestrian change interval is more than 7 seconds;
2. include Accessible Pedestrian Signals and pedestrian pushbuttons complying with MUTCD Accessible Pedestrian Signals section;
3. incorporate a locator tone meeting the requirements of the MUTCD Accessible Pedestrian Signals;
4. include a pedestrian pushbutton with tactile vibrating arrow button and audible sound.

The pedestrian countdown display shall conform to the latest FCC regulation on Emission of Electronic Noise.

The manufacturer must supply certification, which includes a copy of the test report by an independent technical laboratory as to the compliance with ITE specifications (where it applies). The report shall also indicate that the tests were performed only after the modules received a thirty (30) minute operational warm-up period immediately preceding the tests.

The housing door, door latch, and hinges shall be of aluminum, or polycarbonate or approved equal. Hinge pins shall be stainless steel. Provide the door with a neoprene gasket capable of making a weather resistant, dust-proof seal when closed.

All pedestrian signal heads, mountings, outside of hoods, and pedestrian push button housings shall have a powder coated finish (if aluminum) or colored resin (if polycarbonate) in accordance to MUTCD specifications.

**G. Signal Head Installation**

Install signal heads and pedestrian signal heads with the faces completely covered until the entire installation is ready for operation.

**CONTROLLERS – GENERAL**

**730.25 Controllers**

Controller equipment shall be permanently marked with the manufacturer’s name or trademark, part number, and serial number.

Controllers must meet the following applicable industry standards and amendments:

- NEMA TS2 Controller ..... NEMA TS-2-2016
- ATC Controller ..... AASHTO/ITE/NEMA ATC 5.2b

All NEMA TS2 and ATC controllers must provide functionality that meets or exceeds operational characteristics, including NTCIP support, as described in NEMA TS-2-2016.

NEMA TS2 Type 2 controllers shall be used when downward compatibility to existing TS1 cabinets is desired.

Except for replacing controllers in existing systems, all new installations must include controllers that capture high resolution event-based data elements to provide the automated traffic signal performance measures.

The manufacturer must supply certification of the conformance to the above requirements at the time of the bid.

In addition to the above requirements, the controller shall:

5. have all timing values entered via a front panel mounted keyboard. This keyboard shall be an integral part of the controller unit;
6. have an English language menu for programming or reading all controller features;
7. continue to operate the intersection as values are inspected or altered;
8. include the ability to upload and/or download the controller software operating system and user programmed database to or from external media (datakey, usb, sd card etc).
9. support Flashing Yellow Arrow for Permissive Left-turn Movements applications.

**Surge Protection Devices**The cabinet shall have Surge Protective Devices (SPDs) for the main AC power input, all signal head field wiring terminals, interconnect cable terminals and loop lead-in cable terminals which are located in the cabinet. Furnish SPDs to provide effective defense against high transient voltages caused by lightning discharges or other sources. SPDs must be unobstructed and accessible from the front side of any panel used in the cabinet. The SPD for the main AC power input of the cabinet must be connected on the load side of the cabinet circuit breaker. SPDs must meet the following minimum requirements:

1. AC power SPD:
  - a. Must be UL 1449 4<sup>th</sup> Edition Listed
  - b. Parallel connected device
  - c. UL Nominal Surge Rating (In): 20kA
  - d. UL Short Circuit Current Rating (SCCR): 150kA minimum
  - e. Surge current rating: 50kA per phase minimum

- f. Visual status indication
  - g. Remote signalization contacts for monitoring purposes
  - h. 10 year manufacturer's warranty minimum
2. DC power SPD:
- a. Must be UL 1449 4<sup>th</sup> Edition recognized
  - b. Parallel connected device
  - c. UL Nominal Surge Rating (In): 10kA minimum
  - d. Must provide protection between all +/-Gnd connections
  - e. Surge current rating: 20kA per phase minimum
  - f. Visual status indication
  - g. Remote signalization contacts for monitoring purposes
  - h. 10 year manufacturer's warranty minimum
3. Data and communication SPD:
- a. Must be UL 497B listed
  - b. 10 year manufacturer's warranty minimum
4. Signal and interconnect cable field wiring terminal SPD:
- a. Clamp the surge voltage to a level no greater than twice the peak operating voltage of the circuit being protected
  - b. Withstand a surge current of 1000A with an 8 by 20  $\mu$ s waveform six times (at 1 second intervals between surges) without damage to the suppressor
  - c. 10 year manufacturer's warranty minimum
5. Loop lead-in cable field wiring terminal SPD:
- a. Protect the detector unit loop inputs against differential (between the loop lead) surges, and against common mode (between loop leads and ground) surges
  - b. Clamp the surge voltage to 25 V or less when subjected to repetitive 300A surges
  - c. Withstand repetitive 400A surges with an 8 by 20  $\mu$ s waveform without damage
  - d. 10 year manufacturer's warranty minimum

All SPDs must be installed according to the SPD manufacturer's instructions and not affect the operation of equipment. SPD leads must be kept as short and straight as possible.

## CABINETS – GENERAL

### 730.26 Cabinets

Cabinets must be permanently marked with a label including the manufacturer's name or trademark, model/part number, and the year and month of manufacture. The label should be placed on the inside of the main door using a water resistant method. The label must be visible after installation.

Cabinets shall be provided as a complete unit and have all terminals and facilities necessary for traffic signal control as shown on the plans and shall meet at a minimum, the following requirement:

NEMA TS2 Controller Cabinet ..... NEMA TS 2 2016

The manufacturer must supply certification of the conformance to the above requirements at the time of the bid. Cabinets shall also be in accordance with the latest version of the TDOT Traffic Design Manual.

Two paper copies of the cabinet wiring diagram shall be provided with each cabinet. The nomenclature of signal heads, vehicular movements and pedestrian movements on the wiring diagram must be in accordance with the signal

operating plan. Documentation must include a list identifying the termination points of cables used for vehicular and pedestrian signal heads, detector loop lead-ins, and pedestrian pushbutton wires. A heavy duty, resealable plastic bag must be mounted on the backside of main cabinet door for storing cabinet documentation.

House the controller in a rigid, weatherproof cabinet, constructed, finished, and equipped as follows, and as shown on the Standard Details:

1. **Material.** Provide weather-tight cabinets fabricated from aluminum sheet or cast aluminum alloy with a minimum 0.125-inch thickness. All welds on fabricated cabinets shall be internal and continuous; spot welding is not acceptable. Painting of cabinets is only required if the final finish presents an unsightly appearance.
2. **Doors.** Type III, IV, and V cabinets shall have a hinged front opening door that shall include substantially the full area of the front of the cabinet. Equip the door with a positive hold fast device to secure the door in at least two open positions: one position at approximately 90 degrees and the other at 120 degrees or more. The holdfast device shall be easily secured and released without the use of tools. Equip doors for Type II, III, IV, and V cabinets with a switch compartment, and provide the manual switches, specified in **730.26.6.k**, with a hinged front opening auxiliary door. Each door shall have a gasket to provide a weatherproof seal when closed.

Provide the main door with a No. 2 pin-tumbler cylinder lock, and the auxiliary door with a standard police sub-treasury lock. Provide four keys for each lock.

Provide a switch which is to be tied to the cabinet light so that cabinet light will be on when the door is open and off when the door is closed.

3. **Cabinet Mounting.** Mount cabinets as shown on the Plans or Standard Details.
4. **Ventilation.** Unless otherwise specified, provide ventilation as follows:
  - a. On all cabinets housing controllers, mount a screened, rain-tight vent, 1-1/2 inches in diameter or larger, on the cabinet top.
  - b. Provide screened or filtered inlet ventilation openings, equal to or greater in area than top vents, located in the bottom or lower back side of Type I and II cabinets or around the lower 8 inches portion of Type III cabinets.
  - c. Construct the vents so as to project within the cabinet no more than necessary to provide for lock nuts and gaskets to retain the vent.
  - d. Locate vents so as to not interfere with the mounting of controller equipment.
5. **Cabinets with Exhaust Fans.** Exhaust fans shall consist of an electric fan with ball or roller bearings and a capacity of at least 100 cubic feet per minute. Mount the fan in a rain-tight housing attached to the top of the controller cabinet.

The fan shall be controlled by a thermostat having a temperature differential between turn-on and turn-off of 15 °F (-0, +5 °F), adjustable for turn-on through a minimum calibrated range of from 100 °F to 150 °F.

Whenever a fan is to be installed, provide the air inlet filter and filter holder shown in the Standard Details, or approved equal. Internally seal other air inlets. Provide exhaust fans in all cabinets that house controllers, with the exception of flasher controllers.

6. **Auxiliary Equipment.** With the exception of cabinets used in special applications (Type I and II), provide all cabinets with the following:

- a. Substantial shelves or brackets to support controller and auxiliary equipment.
- b. Panel for terminals arranged for adequate electrical clearance. Panels should be located in the cabinet as described below:

- Detectors	Lower left wall
- AC power	Lower right wall
- Auxiliary/police switches	Door
- Load switch bay	Back wall

c. The cabinet shall include an LED light and GFI duplex receptacle which can be used when the main circuit breaker is off.

d. Control panel assembly consisting of:

- 1. Power supply connections made to a 30-ampere circuit breaker mounted on the cabinet separate from the signal terminal panel. The circuit breaker shall be a magnetic trip type, having an interrupting capacity of at least 2,000 amperes at 125 volts AC. The circuit shall trip between 101% and 125% of rated load, with an inverse time delay characteristic provided. Instantaneous tripping shall occur at ten times the nominal rating. All controllers shall be internally fused.
  - 2. Service line surge protection.
  - 3. Electrical service termination point sized to accept No. 4 AWG copper wire.
  - 4. Ground fault receptacle.
  - 5. Porcelain lamp receptacle to accept a standard traffic signal lamp. If LED lenses are utilized, the shall be dimmable and switchable to reduce glare at night time.
  - 6. Circuit breakers in accordance to the National Electric Code for:
    - (a) Main power input to provide all power associated with normal operation.
    - (b) Flasher power input to provide all power associated with flash operation.
    - (c) Service power to provide power for the lamp and duplex receptacle and cabinet light.
  - 7. Copper ground bus (minimum of 12 positions).
- e. Flasher mechanism independent of controller. The cabinet shall be wired for and include a NEMA flasher mounted on the back panel. All cabinets shall have a two-circuit flasher. The flasher shall have output indicators mounted on the front of the flasher case and shall be rated at a minimum of 15 amperes.
- f. General purpose relays, where required to perform specified functions. All relays external to the controller or appurtenances shall meet NEMA standards. In addition:
- Flash transfer relays shall be of heavy-duty type and have a minimum contact rating of 10 amperes. Contacts shall be of silver material to reduce contact pitting.
  - Unless otherwise specified, each cabinet shall include six (6) flash transfer relays.

- Flash transfer relays shall support Flashing Yellow Arrow for Permissive Left-turn Movements applications.

- g. Type II, III, IV, and V cabinets, when specified as housing for traffic actuated controllers, with two or more insulated terminal blocks mounted within the housing, one or more for terminating each field wire.
- h. A minimum of 12 available bare ground positions tied to AC Common Return.
- i. Earth (driven) ground tie point to terminate a single No. 4 AWG copper ground.
- j. A tie point to tie all ground systems within the cabinet to a single reference point. All grounds (AC - return, Chassis, and Logic Ground) must be referenced to a single ground point at the electric service.
- k. A panel (police subpanel) shall contain the following:
  - 1. A main power switch, which shall be wired to remove all cabinet power when in the Off position
  - 2. An Automatic Flash switch, which shall be wired as follows:
    - (a) The Flash position shall cause the cabinet to provide Flash Operation. The controller shall continue to operate, and Stop Time shall be applied to the controller.
    - (b) Auto/Manual switch to activate Manual Control Enable.
    - (c) Manual control pushbutton switch with self-coiling cord. Cord shall attach to a 2 position terminal strip via fork type connector
    - (d) Upon return from Flashing to Automatic, the controller shall initialize in the Start-Up Display condition as programmed in the controller, typically major road phases.
  - 3. A panel mounted inside the main door shall contain the following switches:
    - (a) A technician Stop-Time switch to apply Stop Time to each controller ring.
    - (b) An Interval Advance switch, enabled only by the Stop Time switch, to be momentary pushbutton switch to apply Interval advance to the timer.
    - (c) A Signal On-Off switch, which shall remove the AC power applied to the signal heads for normal operation while the controller continues to operate.
    - (d) Individual phase vehicle and pedestrian detector test switches to be miniature toggle of the On-Off Momentary type to place:
      - i. No Call - Call provided by detectors
      - ii. Locked detector call
      - iii. Momentary detector call

Insulate or shield switch terminals on back of main cabinet door so that no live parts are exposed.

Leads from the terminal block to the auxiliary door switches shall be no less than No. 18 AWG stranded, with TW plasticized polyvinyl chloride or nylon insulation enclosed in

an insulating loom, and shall be of sufficient length to allow full opening of the main cabinet door.

l.

The cabinet shall be wired with the appropriate number of load switches to accommodate vehicular and pedestrian phasing according to plans. At a minimum cabinets shall include 16 load switch bases. The load switch wiring shall support Flashing Yellow Arrow for Permissive Left-turn Movement applications.

m. All cabinet wiring shall be neatly routed and labeled, laced and permanently secured. All cable shall be secured to the panel, where practical. There shall be no holes drilled through the cabinet walls to mount panels or secure cables.

n. All terminals in the cabinet shall be of the barrier type. The following field connector terminals shall be provided:

- Four (4) signal output positions per load switch bay (R-Y-G-FL).
- Ten (10) positions per phase for vehicle loop detector harness.
- One position per phase for pedestrian detector inputs.

o. Cabinets shall have SDLC communication between the controller, MMU, Detector Rack, Radar Detector (if applicable) and Video Detection (if applicable).

p. Cabinets should have an electrical outlet (Non GFI) that has 120 VAC from the OUTPUT side of the Main Power Surge unit.

q. Cabinets shall support Flashing Yellow Arrow for Permissive Left-turn Movements applications.

r. All cabinets shall be supplied with a Malfunction Management Unit (MMU) and shall meet at a minimum, the following requirement:

NEMA TS2 Malfunction Management Unit ..... NEMA TS 2 2016

The manufacturer must supply certification of the conformance to the above requirements at the time of the bid.

According to NEMA TS2 the MMU shall be able to detect the presence of voltage on conflicting on conflicting field connection terminals, the absence of proper voltages on all the signal field connection terminals of a channel, and shall be capable of monitoring for the presence of satisfactory operating voltages within the Controller Unit (CU) and the MMU itself. The MMU shall be able to operate as a Type 16 with sixteen channels or as a Type 12 with twelve channels (compatible with NEMA TS1 cabinets).

The MMU should have an Ethernet port.

**730.27 Auxiliary Equipment for Traffic Signal Controllers**

Furnish and install the following auxiliary equipment in each cabinet for traffic actuated controllers.

**A. Load Switches**

Provide each cabinet complete, with the necessary number of NEMA load switches and Flash Transfer relays necessary to effect the specified signal sequence and phasing. Load switches shall:

1. Meet NEMA standards.
2. Have front-face mounted LED indicators to indicate the “On” condition of both the Input and Output circuits.



3. Use replaceable “cube” type circuitry or encapsulated discrete component construction. No unencapsulated discrete component construction are acceptable.

#### **B. Time Clock Switches**

Where shown on the Plans, provide time clock switches of solid state circuitry, continuous duty, with a 7-day cycle clock operating from the 120-volt AC service line. Provide switching for a minimum of one independent output and ensure the time of day selection is adjustable to within 1 minute of the desired time. Provide a battery backup system that can maintain time keeping and memory a minimum of 24 hours after power interruption. Furnish an omitting device as an integral part of the time switch to allow the switching operation to be skipped for any preselected day or days of the week. The time clock shall automatically compensate for daylight savings time changes. When the time clock is supplied as an internal component of the controller, supply the clock feature to provide for the selection of Maximum Green II on time of day, day of week, week of year basis. Time clocks shall meet NEMA environmental specifications.

When required in the traffic signal plans, the auxiliary equipment listed below shall meet the following requirements:

- A. Uninterruptable Power Supply (UPS) – An UPS shall power the traffic signal cabinet in the event of a power failure for a minimum of 3 hours.

UPS assemblies should include off-the-shelf deepcycle AGM batteries.

Loss of utility power, transfer from utility power to battery power, and transfer back to utility power must not interfere with normal operation of connected equipment. In the event of UPS failure or battery depletion, connected equipment must be energized automatically upon restoration of utility power.

Removal and replacement of the UPS must not disrupt the operation of the equipment being protected.

All harnesses necessary to connect and operate the system must be included. All connectors must be keyed to prevent improper connection.

UPS assemblies shall be installed in accordance with the manufacturer’s recommendations.

An UPS operation and maintenance manual shall be provided in the cabinet where the UPS is installed with cabinet wiring schematics, electrical interconnection drawings, parts layout and parts lists.

The UPS shall include a manufacturer’s warranty covering defects for a minimum of three years (5 years for the external batteries) from the date of final equipment acceptance. The warranty must include provisions for providing a replacement UPS within 10 calendar days of notification for any UPS found to be defective during the warranty period at no cost to the maintaining agency.

B. Communications - Wireless - consist of installing a Wireless Network Communications Link with all necessary hardware in accordance with the plans and standard drawings to provide a data link between field devices (i.e. Traffic Signal Controllers).

Each link shall consist of Master ODU (Out Door Unit, Antenna) connected to a data switch within one of the signal cabinets and a Slave ODU connected to a data switch within the other signal cabinet. Each ODU is aligned to face the opposing ODU. The cable length between the ODU and its associated data switch may not exceed 300 feet.

The Wireless Network Communications Link components at each of the linked traffic signal cabinets shall include an ODU, a LPU (Lightning Protection Unit), power supply mounting hardware, and CAT 5e cabling. The ODU is pole mounted per manufacturer’s specifications. The LPU and power supply are mounted within the traffic signal cabinet. CAT 5e cable is installed between the ODU and LPU.

For the applicable frequency spectrum of the radios being deployed, perform a spectrum analysis to ensure no competing equipment in the area. Ensure the radio path site survey test is performed using the supplied brand of radio equipment to be deployed. Typically, if the ODUs can be mounted with clear line of sight between them, this is sufficient to ensure proper operation. If this is not possible, it may be determined that a repeater station is necessary to complete the intended link. Provide the test results to the ENGINEER for review and approval. Submit copies of the test results and colored copies of the frequency spectrum scan along with an electronic copy of this information. The ENGINEER will approve final locations of the ODUs and any necessary repeater stations.

Install each ODU in such a manner that avoids conflicts with other utilities (separation distances in accordance with the guidelines of the NESC) and as specified in the ODU manufacturer's recommendations. Secure the ODU mounting hardware to the pole and route the CAT 5E cable such that no strain is placed on the RJ-45 connectors. Align each antenna/radio to be perpendicular to the ground (using bubble level) and to face the opposing radio.

C. Fiber optic cables - Multi-mode type fiber optic cable shall be 50  $\mu\text{m}$  core diameter, with at least 12 fibers per cable unless otherwise specified in the plans. Single-mode type cable shall be between 8-9  $\mu\text{m}$  core diameter, with at least 12 fibers per cable unless otherwise specified. A fiber optic drop cable shall be a minimum of 6 fibers (each type) and be spliced into the trunkline in a splice enclosure either aurally or in a pull box. 50ft. of slack shall be provided, either lashed to a span aurally, or coiled in a pull box for underground installations. Termination panels shall be provided with sufficient size to provide for a neat installation, and enough panel space to accommodate the specified number of fibers for termination. ST connectors shall be used unless otherwise specified. Any necessary jumpers shall be provided for installed equipment.

### MISCELLANEOUS TRAFFIC SIGNALS

#### 730.28A Flashing School Signals

When shown on the Plans, provide flashing school signals that conform to the following:

1. The signal shall produce two alternate flashing lights within the marginal limits of a school speed limit sign. Details of the sign construction shall be as shown on the Plans. Sign colors shall conform to the MUTCD and be constructed of materials complying with these specifications.
2. The two LED lenses shall be yellow in color and a minimum of 8 inches in diameter. The LED lenses shall be part of a weather-proof and water-tight optical unit. The LED lenses shall meet the same requirements for vehicular signal head LED lenses. Mount the lenses in the sign using a molded endless rubber gasket with the sign being mounted to the signal case.
3. Provide a two circuit type flasher unit to provide alternating equal on-off operation. The flashing mechanism shall produce between 50 and 60 flashes per minute through two 120-volt, 60-cycle AC, 15-ampere circuits. The flasher shall be of solid state construction.
4. Wire the unit for external circuits.
5. The signal shall be actuated by time switch meeting **730.27**. Locate the timing device in a remote mounted control cabinet.
6. Where an illuminated speed limit indication is shown on the Plans, the numeral message shall be illuminated in Portland Orange in a rectangular lens and illuminated only during the period when the signal produces two alternately flashing amber lights.

In addition, the Time Clock Unit/Switch used for Flashing School Signals shall be a programmable module that allows a user to define the time and day that the school speed zone flasher assembly will initiate and terminate flashing operation. The module shall be installed within the pole-mounted signal cabinet provided as part of project. The time clock shall be compatible with the cabinet's wiring relays and termination panels and the battery power supply system. The time clock switch provided shall also have the following features/capabilities outlined below:

1. Daylight Savings Time shall be a user-programmable setting, in addition to having automated compensation per TDOT specifications.
2. The unit shall provide a minimum 12-character, multi-line alpha-numeric LCD back-lit display capable of displaying all programming parameters.
3. The unit shall be capable of being programmed manually (using an integral keyboard pad) or programmed externally using an optional software program via a laptop computer and cable connection (compatible software program is a separate and distinct item from the time switch unit, and if required, will be separately specified and noted in list of estimated project quantities).
4. Unit shall provide automatic Leap Year compensation.
5. The time clock switch shall be capable of up to minimum 24-hours of capacitive back-up operation, 48 hours desirable, in the event of power interruption.
6. Unit shall be compatible with the supplied solar powered power system / battery unit
7. Time clock switch shall be capable of being programmed for one (1) Normal / Main program, and an additional minimum of 12 Exception periods /programs allowing holiday, vacation and custom skip plans. The exception programs will allow for the Normal / Main program to be skipped or allow for flasher operation on alternative schedules (i.e. early release days, summer school, etc).
8. Unit shall conform to TDOT standard specification subsection 730.27 – Auxiliary Equipment for Traffic Actuated Controller – Time Clock Switches except as superseded herein.
9. Unit shall have non-volatile program memory to allow retention during power loss.

730.28B-Solar Power Flashers. When required, the solar power flasher equipment listed below shall meet the following requirements:

1. Solar panel and mounting equipment shall be installed on cantilever pole shaft as illustrated on layout detail sheet and as directed by manufacturer instructions.
2. Solar power unit assembly shall include all required mounting equipment, wiring/cables, battery supply, battery charging unit and other ancillary equipment necessary to operate the solar panel and properly charge the battery. The photovoltaic array shall include mounting bracket assembly to permit adjustment of the array to optimal sun exposure. The photovoltaic module shall be mounted and aligned per manufacturer recommendations to maximize solar exposure.
3. Battery unit shall meet manufacturer specifications required to operate and power L.E.D. signal displays and continuous time clock switch operation. Battery shall be compatible with cabinet equipment, including the time clock switch and the flasher signal displays. Battery unit shall meet minimum environmental and performance specifications required for system operation as recommended by solar panel and time clock switch manufacturers.
4. Solar panel and battery supply shall be of a size and power rating necessary to provide required power to time switch clock and flasher signal displays. Obtain the power load requirements from the solar power equipment manufacturer and provide as required. On a typical school day, it should be expected that the flasher system will operate up to four (4) hours per day with the time clock continuously operating to maintain its clock timer. Provide a solar system sizing report from the manufacturer indicating the power supply requirements of the proposed system required to meet the expected power demand.

5. The photovoltaic modules shall be warranted for a minimum of five (5) years from date of installation.
6. The battery system shall be a gelled-electrolyte type battery with capacity to provide a minimum of five (5) days continuous operation of the flasher assembly without charging. Batteries shall be field replaceable. Batteries shall have prorated warranty of a minimum of five (5) years from date of installation.

### **730.28C Portable Traffic Signals**

Portable Traffic Signals (PTS) consists of furnishing, installing and configuring a complete PTS system that may be used in construction zones or in other temporary signal locations. The work will be at various sites throughout the state of Tennessee and will consist of providing all labor, materials, equipment and incidentals necessary to make functional the PTS in accordance with these specifications.

The PTS shall be trailer or cart mounted units that provide for easy transportation and quick setup and deployment. There shall be 2 unit options and each unit shall be self-contained.

1. Type 1 units are typically used for long term projects (i.e. projects 5 days or longer in duration) and shall include 2 signal heads per trailer with an upper signal head mounted on an overhead mast arm that can be extended over the travel lane, and a lower signal head mounted on the vertical upright of the trailer.
2. Type 2 units are typically used for short term projects (i.e. projects 4 days or shorter in duration) and shall include 1 signal head that is mounted on the vertical upright of the trailer or cart. Cart-mounted units shall be successfully crash tested to NCHRP 350 TL-3, or equivalent MASH standards. If the project duration is extended beyond 4 days, then Type 1 units should be substituted in lieu of the Type 2 units for all PTS within the signal system.

The PTS shall be MUTCD Compliant and utilize standard ITE signal heads, and adhere to the ITE Specifications and Standards for Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) Circular Signal Supplement. The unit shall be solar powered and communicate via a wireless or hardwire connection. The unit shall include all the major components listed below or be able to perform the functions of these components. The major components of the unit shall include but are not limited to the trailer or cart, telescoping mast arm (on Type 1 units only), signal head(s) and back plates, traffic signal controller with operating software, solar charging system with batteries, input and output devices, flasher units, conflict monitor, relays, communications system and other equipment required for the safe operation and installation of the unit.

The PTS signal heads and all applicable components of the PTS shall meet the physical display and operational requirements of conventional traffic signals as specific in the MUTCD.

1. For Type 1 units, each unit shall contain 2 signal heads with an upper signal head mounted on an overhead mast arm that can be extended over the travel lane with a minimum clearance of 17 feet measured from the bottom of the signal head unit to the road surface. The lower signal head shall be mounted to the vertical upright of the trailer at a minimum height of 8 feet from the bottom of the signal head unit to the road surface. The signal heads shall also include black back plates that can be easily removed. The signal heads shall have the ability to be rotated 180 degrees to face in the opposite direction and shall have the ability to rotate and lock in approximately 10 degree increments to position the signal head for the optimum visibility to motorists.
2. For Type 2 units, the signal head of the unit shall be mounted to the vertical upright at a minimum height of 8 feet from the bottom of the signal head unit to the road surface. The signal head shall also include black back plate that can be easily removed. The PTS shall be easily rotated to position the signal head for optimum visibility to motorists.

The PTS shall include a solid-state controller with operating temperature range of -40°F to +180°F and compliance with NEMA TS-5 Performance Standard. The controller or programming module shall have an easy to read front panel indicator display. The display shall be backlit and have the capability to facilitate programming and display the currently operating program for each vehicular approach. The controller shall be capable of operating the PTS system in a fixed time, traffic actuated, or manual control mode. Each PTS in a connected system shall have the capability to serve as either the master or slave signal. Each PTS shall include a Conflict Monitor Unit (CMU), or Malfunction Management System (MMS) to ensure phase conflicts do not exist during operation.

1. A minimum of 5 automatic time-of-day timing plans within a 24-hour period should be available in fixed time mode. The operating system should have the ability to control a minimum of 4 traffic phases with programmable cycle time adjustments and user adjustable red, amber, minimum green and maximum green times. The operating system shall also have the capability of facilitating standby modes of red, red flash and yellow flash.
2. The system shall also have the ability to operate in vehicle actuation mode when vehicle detection detectors are used. The operating system shall have the capability to allow the PTS to be connected to and controlled by a standard NEMA controller.
3. The system shall have the capability to be configured and controlled remotely using a handheld wireless remote control with the capability of being operated at a distance up to ¼ mile from the master.
4. The system shall have the capability of remote monitoring for reporting, at a minimum, signal location and status, battery voltage and system defaults. The remote monitoring shall have capability to alert designated individuals if a fault condition occurs.
5. The operating system shall include password protection to prevent unauthorized programming.

The PTS shall communicate with all other PTS within the signal system via license-free wireless 900 MHZ radio link communications. The radio units shall maintain communications at a minimum distance of 1 mile. The radio system shall conform to the applicable Federal Communications Commission (FCC) requirements, including FCC 90.17, and all applicable state and local requirements. The PTS shall be in direct communication at all times either by wireless or hardwire connection to provide for the required conflict monitor.

The system shall also have the ability to operate in vehicle actuation mode when vehicle detection detectors are used. For Type 1 units, the PTS detector shall be a high-definition, multi-beam, microwave radar stop bar detector for each vehicular approach. The Type 1 radar detector shall have a minimum range of 140 feet and shall be mounted at a minimum height of 17 feet measured from the top of the road surface. For Type 2 units, the PTS detector shall be a radar detector for each vehicular approach. The Type 2 radar detector shall have a minimum range of 140 feet and shall be mounted and have complete radar detection functionality at a minimum height of 8 feet measured from the top of the road surface.

The PTS shall be equipped with a solar power array, charging unit and battery system. For Type 1 units, the number and size of batteries shall be sufficient to operate the signal for a minimum of 21 days at 70 degrees without additional charging or assist from the solar array. An on-board battery charger shall be compatible with both the solar array and with a 120V AC power source. The solar panel array shall provide for a minimum of 440 watts of solar collection capability. For Type 2 units, the PTS shall have batteries sufficient to operate the signal for a minimum of 5 days at 70 degrees without additional charging or assist from a solar array. All instrumentation for the electrical system and battery compartment shall be mounted in a lockable weatherproof enclosure. Solar panels shall be secured to the mounting brackets for theft prevention. All wiring for the unit shall be protected against weather and damage.

The trailer or cart, and all mounted components, shall conform to the wind loading requirements (90 mph minimum) as described in the AASHTO Standard Specifications for Highway Signs, Luminaries and Traffic Signals. The wind load calculations shall be completed by an independent third-party contractor, and stamped by a U.S. Registered Professional Engineer. The trailer or cart shall be made of structural steel and shall include 4 leveling/stabilizer

jacks capable of lifting the trailer or cart a minimum of 6 inches. The trailer or cart shall be equipped with a hydraulic or electric lift system sufficient for 1 person to be able to raise and lower the vertical upright and/or horizontal mast arm to and from the operating position. For Type 1 or 2 units, the trailer or cart shall be equipped to provide legal and safe transport on the public highway system at speeds up to 55 mph. All exterior metal surfaces, except signal heads and back plates, shall be powder-coat painted highway safety orange.

The PTS work shall meet the following general contractor requirements:

1. Be responsible for locating the PTS in the appropriate location based on MUTCD and ITE standards for visibility to motorists and for safe operation.
2. Be responsible for providing all hardware, software, communications equipment and licenses to operate a complete PTS system.
3. Be responsible that all PTS equipment is installed according to the manufacturer's recommendations including wireless or hardwire connections.
4. Be responsible for transport, setup, configuration, operation and monitoring of the PTS throughout the entire project. The Engineer shall approve all timing and settings that are used for operation of the signal.
5. As directed by the Engineer, it may be necessary to relocate the PTS during the project. The cost of the relocation shall be included in the PTS price bid.

**DETECTORS**

**730.29 Detectors**

Provide detectors, of the type shown on the Plans, to actuate signal phases of traffic actuated controllers. Provide ample lightning protection to provide effective defense against high transient voltages caused by lightning discharges or from other sources. The lightning protection unit must withstand repeated 400-ampere surges on a 9 x 20 microsecond waveform. Also, the unit must be a two-stage device capable of clamping a minimum of one hundred 300-ampere surges to 25 volts within 40 nanoseconds for surge applied across the two detector leads.

**A. Inductive Loop Detection System**

Inductive loop detector units (loop amplifiers) shall meet at a minimum, the following requirement:

NEMA TS2 Inductive Loop Detector Units ..... NEMA TS 2 2016

Loop amplifiers may be single or multi-channel and shall be of the totally self-contained type.

All loop amplifiers shall be of the type to provide both "Extended" and "Delayed" outputs.

The loop detector amplifier shall be full automatic, requiring no adjustments to effect operational ability other than setting of the operating frequency and sensitivity. The amplifier shall:

1. Sense any legal motor vehicle traveling at speeds up to 65 miles per hour.
2. Have both a "Pulse" and "Presence" Output:
  - a. Pulse output shall generate an output of 125 ±25 millisecond output for each vehicle entry.
  - b. Presence output shall provide a continuous output for up to 60 minutes as long as a vehicle is within the detection zone.
3. Provide at least four user selectable sensitivity ranges.

4. Be supplied with at least three frequency ranges for crosstalk minimization.
5. Have a front-face mounted indicator to indicate active output of the internal relay. This indicator shall indicate the presence of:
  - a. Normal Output
  - b. Delayed Output
  - c. Extended Output
6. Have a front-panel mounted “Reset” switch that when pressed shall cause the unit to completely re-tune itself.
7. Have Delayed or Extended timing features with the following ranges:
  - a. Delayed output of 0 to 30 seconds in 1-second increments.
  - b. Extended output of 0 to 10 seconds in 1/4-second increments.
8. Have internal diagnostics to determine the operational ability of the loop. These diagnostics shall determine if a loop is opened or shorted, and shall provide a visible indication of such condition. Additionally, if such a condition occurs, the amplifier unit shall default to a “constant” output.
9. Provide output by a mechanical relay, which shall be “off” to provide an output.
10. Have all delay functions wired to the associated plan phase green to inhibit that function during controller phase green.
11. Be able to operate with loop lead-in lengths of at least 2,000 feet.

Comply with the details of the detector loop installation as shown on the Plans or Standard Drawings.

B. Video Detection System (VDS)– when specified in the plans, the equipment shall consist of all items necessary to provide a complete functional video detection system that process images and provide detection outputs to the traffic signal controller.

VDS shall be capable of NEMA TS2 operation.

VDS shall be waterproof and weather resistant.

VDS shall provide user-defined detection zone programming via a graphical user interface (GUI) and any necessary equipment for future programming. The configuration database shall have the ability to be stored on a removable data storage external to the video card.

VDS shall display programmable detection zones and detection activations overlaid on live video inputs. It shall detect vehicles in real time as they travel across each detection zone.

VDS shall have a minimum of 24 programmable detection zones per camera.

VDS shall be capable of:

1. shadow rejection without special hardware;
2. non-impaired operation under light intensity changes;
3. maintained operation during various weather conditions (e.g. rain, fog, snow)
4. anti-vibration, 5% rejection based on image change;
5. ability to select direction of flow parameters;
6. ability to properly detect directionally;
7. ability to configure presence, pulse, extend and delay outputs;
8. ability to set up a minimum of six detection zones per camera view to count the number of vehicles detected and store the information for retrieval;
9. variable focus providing a minimum of 4 to at least 40 degree horizontal field of view;
10. store detection zones in non-volatile memory;

VDS shall have no splices between the processors and the cameras.

VDS shall provide LED indicators to show active detection.

VDS camera shall have an internal heater to assure proper operation of the equipment during low temperatures.

VDS shall have surge ratings as set forth in NEMA specifications.

VDS shall have a two-year warranty and updates of all software shall be available without charge during the warranty period.

C. Radar Vehicle Detection System (RVDS) – when specified in the plans, the equipment shall consist of all items necessary to provide a complete functional RVDS that process high-definition, multi-beam radar electromagnetic waves and provide detection outputs to the traffic signal controller.

RVDS shall be capable of NEMA TS2 operation.

An RVDS shall consist of the following components: Radar sensor (1), detector rack interface module (1) power and surge protection panel or module (1) (cabinet interface devices that combine one or more of the above components shall be acceptable as well), and all associated equipment required to setup and operate in a field environment including software, serial and ethernet communication ports, cabling, electrical connectors and mounting hardware.

The RVDS shall be able to operate in all types of weather conditions including: rain, snow, sleet, ice, fog and windblown dust.

Lightning and surge protection will be provided for power connections and communications links to the radar RVDS.

The RVDS shall provide a “fail safe” operation that triggers when communication between the radar vehicle sensor and the interface module is broken. Contact closure from the interface module will occur on all programmed detector channels associated with the affected radar sensor when the fail safe is triggered and will remain in this state until communication is re-established between the interface module and the radar vehicle sensor.

The RVDS shall comply with all applicable Federal Communications Commission (FCC) requirements. The manufacturer will provide documentation of compliance with FCC specifications.

The RVDS shall maintain frequency stability without the use of manual tuning elements by the user.

The RVDS as a minimum must provide a minimum of 4 separate RF channels selectable by the user to avoid interference with other devices working on the same frequency.

The communication port(s) shall support a communication speed that will not introduce excessive latency between when a vehicle is detected and the contact closure in the traffic signal cabinet.

RVDS interface modules that utilize the detector rack must operate at 12V or 24V DC. Shelf mounted interface modules must operate within a range of 89V to 135V AC, 60 Hz single phase. Power to the RVDS radar sensor must be from the transient protected side of the AC power distribution system in the traffic control cabinet in which the RVDS is installed.

RVDS documentation shall include a comprehensive user guide as well as quick reference guide(s).

RVDS shall have the ability to configure presence, pulse, extend and delay outputs.

D. Wireless Magnetometer Detection System (WMDS) - when specified in the plans, the equipment shall consist of all items necessary to provide a complete functional wireless magnetometer detection system that process changes to earth magnetic field and provide detection outputs to the traffic signal controller.

WMDS shall be capable of NEMA TS2 operation.

The WMDS shall consist of the following components: In-pavement sensors, all wireless communication equipment needed to establish communication links to the controller cabinet, interface modules compatible with NEMA TS-2 V2.06b cabinet detector rack, surge protection for the WMDS and system software for set-up and monitoring of the WMDS.

The WMDS must be capable of detecting a variety of vehicle types including motorcycles, automobiles and large trucks. The system must allow the user to select sensitivity levels that adjust the amount of hysteresis to the magnetic field needed to achieve contact closure to the assigned detector channel. Magnetometer sensitivity level adjustments must allow for different levels of vehicle detection.

WMDS shall have the ability to configure presence, pulse, extend and delay outputs.



WMDS equipment failure such as: the sensor, communications link, access point radio, repeater radio (if used) or interface module, shall result in constant vehicle call "fault state" on the affected detector channel to the traffic controller.

WMDS detection accuracy must be comparable to properly operating inductive loops.

The WMDS shall provide real-time vehicle detection (within 150 milliseconds (ms) of vehicle arrival). Once detection is achieved by the sensor, the traffic controller must receive contact closure to the assigned detector channel within the 150 ms time frame.

The WMDS in-pavement sensor must operate on batteries without the need for underground power or communication cable connections to the unit.

The average operating life span of the sensor under battery power must be a minimum of 10 years.

The interface module must provide 2 or 4 detector channels. Sensors must be assignable to the available detector channels on the interface module using software provided with the WMDS.

The front face of the module shall identify detector channel 1 and detector channel 2. Each must use an LED to indicate contact closure on the channel. When vehicle detection is achieved, the LED will be on and contact closure applied to the detector channel. During periods of no vehicle detection the LEDs will be in an off state and no contact closure will be applied to the detector channel.

The interface module will use an LED indication to indicate a "fault state" with the WMDS. When the fault state is active contact closure will be applied to the appropriate detector channel.

#### **E. Pedestrian Push Buttons**

Where shown on the Plans, furnish and install pedestrian push buttons of substantial tamper-proof construction. They shall consist of a direct push type button and single momentary contact switch in a cast metal housing. Operating voltage for pedestrian push buttons shall not exceed 24 volts.

Provide a weatherproof assembly, constructed to prevent electrical shocks under any weather condition.

Where a pedestrian push button is attached to a pole, the housing shall be shaped to fit the curvature of the standard or post to which it is attached to provide a rigid installation.

Unless otherwise specified, install the push button and sign on the crosswalk side of the pole.

Pedestrian push buttons shall have a transient protection that meets NEMA specifications.

730.30 (Reserved)

730.31 (Reserved)

### **TRAFFIC SIGNAL SUPPORTS**

#### **730.32 Cantilever Signal Supports**

This Subsection applies to the manufacture of steel poles and mast arms for the support of traffic signals. The height of poles, shaft dimensions and wall thickness shall meet the design requirements and mounting height of traffic signals as set forth in these Specifications and shown on the Plans. The Plans indicate bracket arm lengths.

Furnish poles consisting of a straight or uniformly tapered shaft, cylindrical or octagonal in cross-section, having a base welded to the lower end and complete with anchor bolts. All castings shall be clean and smooth with all details well defined and true to pattern. Steel castings shall conform to ASTM A27, Grade 65-35. Gray iron castings shall conform to ASTM A126, Class A.

All mast arms shall be compatible with the poles in material, strength, shape, and size.

**A. Anchor Base**

Secure an anchor base of one-piece cast steel or steel plate of adequate strength, shape, and size to the lower end of the shaft. Place the base so as to telescope the shaft, and weld at the top and bottom faces with continuous fillet welds so that the welded connection develops the full strength of the adjacent shaft section to resist bending action. Provide each base with a minimum of four holes to receive the anchor bolts. Provide cast steel bases with removable cast iron covers for anchor bolts and tapped holes for attaching covers with hex head cap screws.

Provide a welded frame handhole, 5 x 8 inches minimum and located with a clear distance above the base of no less than the pole diameter, "D". Weld a 1/2-inch 13 UNC grounding nut to the inside of the pole at a point readily accessible for wiring.

**B. Shaft**

Fabricate shafts from the best, hot-rolled basic open hearth steel. The shaft shall have only one longitudinal electrically welded joint and may have electrically welded intermediate transverse full penetration circumferential joints, at intervals of not less than 10 feet. The shaft shall be longitudinally cold-rolled to flatten the weld and increase the physical characteristics so that the metal will have a minimum yield strength of 48,000 pounds per square inch. Where transverse full penetration circumferential welds are used, the shaft fabricator shall furnish to the Engineer certification that: (1) all such welds have been radiographed and ultrasonically tested by an independent testing laboratory using a qualified Nondestructive Testing (NDT) technician and (2) the NDT equipment has been calibrated annually.

Fit the shaft with a removable pole cap, a J-hook wire support welded inside near the top, and a flange plate assembly to match that welded to the butt end of the mast arm.

**C. Mast Arms**

Provide mast arms fabricated and certified in the same manner as the upright shafts and that have the same physical characteristics.

The mast arms shall meet the design requirements necessary to support rigidly mounted traffic signals as shown on the Plans. All arms shall include a removable cap at the tip, grommeted wire outlets, and signal hanger assemblies of the type and number shown on the Plans, and a flange plate welded to the butt end to provide a rigid connection to the mast. The assembly shall be constructed so that all wiring can be concealed internally.

Connect mast arms to the upright pole at a height necessary to provide a minimum clearance of 16 feet 6 inches and a maximum clearance of 19 feet under the traffic signal heads. Install separate signal heads to provide the same clearance.

**D. Finish**

Galvanize steel poles, mast arms, and hardware in accordance with ASTM A123.

Galvanize all steel and cast iron components, hardware, and threaded fasteners, except anchor bolts, after fabrication in accordance with ASTM A123, or A153 or A385, as applicable.

**730.33 Steel Strain Poles**

Provide steel strain poles consisting of a uniformly tapered or equivalent upright shaft fitted with a removable pole top, J-hook wire support and 45-degree wire inlet near the top, a span wire clamp, a 5 x 8 inch handhole with reinforced frame and cover, bent anchor bolts, and all other accessories needed to make a complete installation. The pole and all of its component parts shall be designed to support tethered traffic signals of the type and number

shown on the Plans, suspended from a span wire assembly. Fabricate and certify the poles as specified for the upright shafts in **730.32**.

Determine the shaft length required to meet field conditions and vertical clearances of signal heads over the roadway. The signal head clearance shall be a minimum of 16 feet 6 inches and a maximum of 19 feet. Fasten the span wire no closer than 1 foot 6 inches from the top of the pole.

Unless otherwise specified, provide all strain pole traffic signal supports with a one-piece anchor type base, fabricated from drop forged or cast steel of sufficient cross-section to fully develop the ultimate strength of the poles. Fasten the base to the pole with a welded connection that develops the full strength of the pole. Provide the base with a minimum of four holes of sufficient size to accommodate the proper size anchor bolts that are capable of resisting at yield strength stress, the bending moment of the shaft at its yield strength stress. Provide removable cast iron covers for the anchor bolts.

The shaft shall be fabricated from material providing a minimum yield strength of 48,000 pounds per square inch after fabrication.

Galvanize the steel poles and hardware in accordance with ASTM A123.

Galvanize all steel and cast iron components, hardware, and threaded fasteners, except anchor bolts, after fabrication in accordance with ASTM A123, or A153 or A385, as applicable.

### **730.34 Pedestal Support Signal Poles**

Provide pedestal poles consisting of one upright pole with suitable base and other accessories or hardware as required to make a complete installation.

All poles shall be made of one continuous piece from top of base connection for the entire height of the pole. The cross-section shall be either cylindrical or octagonal and may or may not be uniformly tapered from butt to tip.

The cross-section at the tip shall have a 4-1/2 inch outside diameter.

#### **A. Type "A" Pedestal (Aluminum)**

Pedestals shall be of uniform octagonal or cylindrical cross-section of the tubular tapered type fabricated of one full length sheet.

Bases shall be octagonal or square in shape, of the ornamental type fabricated of cast material. Provide a handhole in each base.

Caps shall be of the nipple or tenon type mounting fabricated of cast material.

Furnish bases with four steel anchor bolts of sufficient size and length to securely anchor the base to the concrete footing. Weld the shaft to the cast metal base. Refer to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (current edition).

Type A pedestal shaft shall be fabricated from aluminum tubing 6063-T4 heat treated to T-6 temper after fabrication, and meeting ASTM B221.

Type A anchor base shall be made of sand-cast aluminum alloy 356-T6 meeting ASTM B26 - SF 70A-T5 specifications.

#### **B. Type "B" Pedestal (Steel)**

Pedestals shall be fabricated from a 4-1/2 inch (outside diameter) seamless steel pipe.

Bases shall be octagonal in shape of the ornamental type fabricated of cast or malleable iron and shall have minimum height of 12 inches. The top opening of the base shall be threaded to receive the shaft. Provide a handhole in each base.

Furnish bases with four steel anchor bolts of sufficient length to securely anchor the base to the concrete footing.

### **730.35 Wooden Pole Signal Supports**

#### **A. General**

Provide wooden poles of the class and length shown on the Plans and that meet **917.11**. Set poles to the depth shown on the Plans, and fit them with all the necessary hardware to make the installation complete.

The signal head clearance shall be 16 feet 6 inches minimum and 19 feet maximum. Fasten the span wire at least 2 feet below the top of the pole.

#### **B. Guying Components**

Guy clamps shall be steel, 3-bolt type, 6 inches in length, and of the proper strand size to fit the wire used. The clamp bolts shall have upset shoulders fitting into the clamp plate. Substitution of the cable grip is subject to the Engineer's approval.

Attach guy wire to the pole with a 5/8-inch diameter x 12-inch length single strand angle-type eye bolt with 2 x 2 inch square cut washers, lock washer, and square nut.

Instead of the eye bolt specified above, an angle single strand eye of drop forged steel may be used, fastened on threaded end of span wire eye bolt.

Sidewalk guy fittings shall consist of 2-inch inside diameter standard galvanized steel pipe of required length with malleable iron pole plate and guy clamp. Fasten the pole plate to the pole with a 3/8-inch thru bolt and 1/2-inch lag screws.

All guying components and hardware shall be galvanized in accordance with ASTM A123 or A153.

Anchors for guys shall be of the pressed steel four-way expanding fluke type or of the steel or malleable iron sliding plate type. The minimum unexpanded diameter shall be 8 inches, and the minimum expanded area shall be 110 square feet. Coat anchors with a black asphaltic paint.

Guy anchor rods shall be drop-forged steel, 3/4-inch diameter and 7-foot minimum length, threaded, of the single thimble eye type, with a square anchor bolt nut.

### **730.36 Pole Location**

Install all signal support poles at the locations shown on the Plans or where directed by the Engineer.

## **COMPENSATION**

### **730.37 Method of Measurement**

Measurement for traffic signals will be on a per item basis for each item to be furnished and installed, as specified herein and shown on the Plans.

With regard to items for signal head assemblies, each item to be furnished, installed, or both furnished and installed shall be distinguished with a code number as follows:

1. The first digit is the number of faces per assembly.
2. The second digit will indicate the number of 12-inch lenses per assembly (including arrow lenses).
3. The third digit is the quantity of 8-inch lenses per assembly.
4. The letter "A" indicates an arrow lens and the digit following the "A" indicates the number of 12-inch arrow lenses per assembly.
5. The letter "H" or "V" indicates the arrangement of arrow signal lenses to be horizontal or vertical with respect to solid ball indications.

EXAMPLE:

1 5 0 A 2 H

Digits indicate the following:

1 = one face

5 = five 12-inch lenses

0 = zero 8-inch lenses

A2 = two 12-inch arrow lenses

H = Arrow lenses placed horizontally with respect to circular indications

#### **A. Removal of Signal Equipment**

The Department will measure items of equipment or material designated or required for removal on a per each intersection basis. Removal and salvage of all signal heads, poles, control equipment, cabinets, span wire, cable, and similar features to be performed at an intersection shall be included as a unit cost per each intersection. This includes the cost of stockpiling salvable equipment for pick-up by the appropriate agency, as noted in the Plans.

#### **Signal Head Assembly (includes Pedestrian Signal Heads)**

The Department will measure signal heads of the type shown on the Plans by the individual assembly complete in place, per each. This item shall include the signal heads, terminals, lamps, attachment hardware, cable connection, and testing.

#### **Pull Box**

The Department will measure each pull box of the type required as one complete unit, installed, per each. This item includes the pull box, excavation, backfilling, crushed stone base, and other incidental items as called for in the Plans or Standard Drawings.

#### **Electrical Service Connection**

The Department will measure Electrical Service Connections on a per each signal installation basis. This item includes the electrical service supplied to the weatherhead by the local utility, all necessary materials and labor for connection of the electrical service from the controller to the weatherhead, the wiring of the controller and detectors, and all incidentals necessary to render a complete and operable system.

#### **Signal Cable**

The Department will measure the length of Signal Cable of each size (number of conductors) installed in linear feet to the nearest foot from point to point along the routing for each cable.

The Department will make horizontal measurements by center to center measurement from:

1. Pole to pole
2. Pole to signal head (when terminating in a signal head)
3. Pull box to pull box
4. Pull box to pole
5. Pull box to pole-mounted or base-mounted controller

For cable inside mastarms, the Department will measure from center of vertical support to signal head where cable terminates.

The Department will make vertical measurement by one of the following:

1. For cable inside poles or conduit risers, the distance from ground level to the point of attachment of the span wire.
2. For cable inside mast arm supports, the distance from ground level to the mast arm connection.
3. For cable to pole-mounted controller,
  - a. From ground level to bottom of controller.
  - b. From bottom of controller to point of attachment of span wire.
4. For cable to pole-mounted signal head or pushbutton,
  - a. From ground level to bottom of signal head or pushbutton
  - b. From bottom of signal head or pushbutton to point of attachment of span wire.

The Department will make no additional allowance for slack length, length inside equipment or supports (except as noted), length for the required 360-degree drip loop, and similar instances requiring additional length of cable.

### **Span Wire**

The Department will measure Span Wire Assembly, Tether Wire Assembly, and Messenger Cable by type in linear feet to the nearest foot. The measurement will be made from center to center of poles. These items include attachment hardware, strain insulators, and other hardware shown in the Plans as part of the assembly. The Department will make no additional allowance for slack length and other instances requiring additional length of wire.

### **Steel Conduit Riser Assembly**

The Department will measure conduit riser assemblies per each for each size conduit riser installed on the outside of a pole, as shown on the Plans. This item includes conduit, weatherhead, conduit, fittings, nuts, washers, banding, clamps, grounding, and other items necessary for installation.

### **Conduit**

The Department will measure conduit in linear feet to the nearest foot for each size and type of conduit installed.

The Department will measure underground conduit along the conduit by one of the following:

1. From the face of curb to the center of a pull box, pole or controller foundation,
2. From center to center of pull boxes,
3. From center to center of a pull box and a pole or controller foundation, or
4. From center to center of pole foundations or pole foundation and controller foundation.

The Department will add:

1. 1 foot to the above measurements for each entry to a pull box or pole foundation and each exit of a pull box or pole foundation.
2. 3 feet to the measurement for each capped extra entry (conduit stub) or exit to a pull box or pole foundation installed, as shown on the Plans.
3. 3 feet to the measurement for each connection between underground conduit and above ground riser.
4. 3 feet to the measurement for each entry or exit to a foundation for a base-mounted controller.

This item includes trenching, backfilling, sealing, capping, fittings, bushings, banding, grounding, and other accessories and hardware required for installation of the conduit system.

### **Vehicle Loop Detector (Amplifier)**

The Department will measure vehicle detector loop amplifier per each unit, including the cable and associated hardware necessary to electrically connect the amplifier to the controller and loop lead in.

The Department will measure two and four channel card rack type amplifiers per each unit, including the cable, card rack(s), and associated hardware necessary to electrically connect the amplifiers to the controller and loop lead-ins.

### **Shielded Detector Cable**

The Department will measure the two-conductor shielded detector cable installed between the controller cabinet and the loop detector wires in linear feet to the nearest foot.

The Department will make horizontal measurements (overhead and underground) by one of the following:

1. From center to center of pull boxes,
2. From center to center of pull box and pole,
3. From center to center of poles, or
4. From center to center of pull box or pole and controller foundation.

The Department will make vertical measurements by one of the following:

1. From ground level to the point of attachment of span wire, inside pole or conduit riser,
2. From the bottom of controller cabinet to the point of attachment of span wire, or
3. From ground level to the bottom of controller.

The Department will make no additional allowance for slack length, length inside equipment or supports (except as noted), splices, and similar instances requiring additional length of cable.

### **Saw Slot**

The Department will measure the length of saw slot for installation of detection loop and lead wiring in linear feet to the nearest foot. Measurement for detection loops in the traffic lanes will be made based on the loop size shown on the Plans (the nominal length plus the nominal width) times 2. The Department will make no additional allowance for saw overruns to obtain full depth of saw slot or diagonal cuts to prevent sharp bends in the loop wire. The Department will measure saw slot for detection loop leads from the conduit entry at the face of curb or edge of pavement and along the route of the lead-in to the detection loop.

This item includes backing rods, or polyethylene foam sealant, loop sealant, and all other incidentals necessary to render a complete and operable system.

**Loop Wire**

The Department will measure the length of loop wire for installation of detection loops and lead-ins in linear feet to the nearest foot. Measurement will be made from the pull box or pole to the detection loop, around the loop the required number of turns and back to the pull box, pole, or point of splice. The Department will make no additional allowance for slack length, length inside equipment or supports, splices, and similar instances requiring additional length of wire.

This item includes electrical connections, testing, and all other incidentals necessary to render a complete and operable system.

**Controller**

The Department will measure controllers as one complete unit, installed, per each. This item includes all auxiliary equipment shown the Plans to provide signalization control as shown on the Plans, and all hardware, including the cabinet (and cabinet foundation, if base-mounted), necessary for installation.

**Wood Pole**

The Department will measure Wood Poles, of the type and size shown on the Plans, per each, installed.

**Guying Device**

The Department will measure Guying Devices, of the type shown on the Plans, per each, installed. This item includes the guy wire, anchor, clamps, and all other components shown on the Plans necessary for installation.

**Steel Strain Pole**

The Department will measure Steel Strain Poles of the type and size shown on the Plans, per each, installed. This item includes the pole, foundation, anchor bolts, grounding, and all other hardware shown on the Plans necessary for a complete installation.

**Cantilever Signal Support**

The Department will measure Cantilever Signal Supports, of the type and size shown on the Plans, per each, installed. This item includes the vertical pole shaft, mast arm, foundation, anchor bolts, grounding, and all other hardware shown on the Plans necessary for a complete installation.

**Service Cable**

The Department will measure two conductor power service cable, of the type and size shown on the Plans, in linear feet to the nearest foot, installed. Horizontal runs will be measured center to center of poles. Vertical runs will be measured from the ground to the weatherhead inside a pole or conduit riser, or from the ground to the bottom of the controller, or from the bottom of the controller to the weatherhead. This item includes all necessary attachment hardware. The Department will make no additional allowance for slack length or other instances requiring additional length of cable.

**Pedestrian Pushbutton with Sign**

The Department will measure Pedestrian Pushbutton with Sign as one complete unit, in place, per each. This item includes the pushbutton, sign, mounting hardware, wiring of pushbutton, testing, and all other incidentals necessary for a complete installation.



**Pedestrian Signal Display with Pushbutton and Sign**

The Department will measure Pedestrian Signal Display with Pushbutton and Sign as one complete unit, in place, per each. This item includes the signal heads, terminals, lamps, cable connections, pushbutton, sign, all attachment hardware, testing, and other incidentals necessary for a complete installation.

**Portable Traffic Signal**

The Department will measure Portable Traffic Signal, of the type shown on the Plans or as directed by the Engineer, per each, installed. This item includes the all of the software and hardware necessary for a complete installation.

**730.38 Basis of Payment**

The Department will pay for accepted quantities, complete in place, at the contract prices as follows:

<i>Item</i>	<i>Pay Unit</i>
Traffic Signal	Lump Sum
Removal of Signal Equipment	Each
Signal Head Assembly (Description)	Each
Install Pull Box (Description)	Each
Electrical Service Connection	Each
Signal Cable – (Description)	Linear Feet
Span Wire Assembly ( ___ pounds min. break strength)	Linear Feet
Tether Wire Assembly – ___" Diameter	Linear Feet
Messenger Cable – ___" Diameter	Linear Feet
Riser Assembly (Description)	Each
Conduit ___" Diameter (Type)	Linear Feet
Vehicle Detector (Description)	Each
Shielded Detector Cable	Linear Feet
Saw Slot	Linear Feet
Loop Wire	Linear Feet
Controller (Description)	Each
Wood Pole (Description)	Each
Guying Device (Description)	Each
Steel Strain Pole (Description)	Each
Cantilever Signal Support (Description)	Each
Service Cable	Linear Feet
Pedestrian Pushbutton with Sign	Each
Pedestrian Signal Display with Pushbutton and Sign	Each
Portable Traffic Signal (Type)	Each

The unit price to be paid includes the cost of furnishing and installing, complete in place, each of the various types of equipment required by the Summary of Quantities shown on the Plans. Total payment is full compensation for all materials, labor, equipment, and incidentals necessary to produce a completely operative and finished installation of a traffic signal or traffic signal system as shown on the Plans and as specified herein, including restoration of pavements, sidewalks, and appurtenances damaged or destroyed during construction and tests. All additional materials and labor not specifically shown or called for, which are necessary to complete the traffic signal installation or traffic signal system described, will be considered incidental to the system and no additional allowance will be made.

**Subsection 730.32.A.** (pg. 868), 6-27-16; revise the last paragraph of subsection 730.32 A.:

“Provide a welded frame handhole, 5 x 8 inches minimum and located with a clear distance above the base of no less than the pole diameter, “D”.”

STATEOFTENNESSEE

(Rev. 05-05-10)

(Rev. 09-10-14)

March 1, 2006

**Roadside Development****Subsection 803.02, Revise the first paragraph to the following:**

**803.02-Sod.** New sod shall consist of live, dense, well-rooted growth of permanent grasses, free from Johnson grass, nut-grass, and other undesirable grasses or weeds, well-suited for the intended purpose and for the soil in which it is to be planted. Installed sod which does not meet these requirements shall be corrected as directed by the Engineer at the Contractors expense.

**Section 800, Add the following as an entirely new Section:****SECTION 806-ROADSIDE MAINTENANCE**

**806.01-Description.** Roadside and construction project maintenance shall consist of litter/debris removal, mowing, and trimming as specified or as directed by the Engineer for the entire highway rights-of-way where accessible (fence to fence where applicable), including shoulders for the length of the Project.

**EQUIPMENT**

**801.02-Equipment.** All equipment necessary for the satisfactory performance of this work.

**CONSTRUCTION REQUIREMENTS**

**801.03-General.** Remove litter and debris as directed by the Engineer for the entire construction limits. Disposal of litter and debris shall be in accordance with all permits, State, and Local ordinances.

Mowing and vegetation removal work shall consist of mowing and trimming of the rights-of-way for vegetation control to maintain a neat aesthetic appearance as directed by the Engineer.

**806.04-Definitions.**

Litter: Any object or group of objects foreign to the right-of-way which has been discarded or abandoned and is or may become visible from the edge of the roadway or shoulder as a result of mowing, vegetation management, construction, maintenance operations, or traffic. Examples under this definition include but are not limited to paper, plastic, bottles, cans, wood, tires, portions of tire, and metal products.

Mowing: The work associated with cutting or trimming vegetation primarily consisting of, but not limited to, grasses, invasive weeds, and small trees or shrubs to provide a consistent and aesthetically pleasing standing vegetation height as directed by the Engineer.

Trimming: The work associated with cutting or trimming vegetation in close proximity to objects or in areas not accessible to conventional mowers in an attempt to prevent damage and provide a consistent vegetation height.

**806.05-Time and Frequency.** Litter/debris removal shall be performed a minimum of twice per year or as directed by the Engineer. Mowing and trimming shall be performed a minimum of twice per growing season or as directed by the Engineer. A notice to begin will be issued to the Contractor at least five (5) days prior to the date the mowing cycle is to begin.

Work shall be performed only during the hours of daylight Monday through Saturday, or as directed by the Engineer. No work shall be conducted on Sunday.

**806.06-Mowing Operations.** Performed all mowing to the satisfaction of the Engineer. Standing vegetation shall be cut to a height of 4 inches while maintaining a consistent vegetation profile within construction limits. Mow only those areas that are designated as mowable acres, including, if present, a minimum of 5 feet up the back slope from the bottom of the ditch, and 5 feet behind all guardrails. Vegetation including small trees, shrubs, and bushes with a stem diameter of up to 1 inch which are inside of and encroaching upon the established mowing limits shall be cut using a mower or hand trimming methods as directed by the Engineer. Extreme care shall be taken not to damage the trees, plants and shrubs, which are designated by the Engineer to remain. Hand trimming may be required as directed by the Engineer for areas of vegetation inside the designated mowing limits which are not accessible to mechanical mowers. As work progresses, mowing and trimming shall be conducted in such a manner to provide a consistent standing vegetation height in all mowing limits adjacent to the roadway. Mow as close as practicable to all fixed objects. Hand trimming is required atop earth berms, within all rip rap areas, and around all fixed objects, including but not limited to earth berms, guardrails, cable rail, utility installations, utility poles, mailboxes, delineators, sign posts, wildflower plots, bridge abutments and bridge piers. Do not apply chemicals unless authorized by the Engineer. Actual dimensions & mowing limits shall be discussed at the Preconstruction Conference.

Mowing for site distance shall be performed as frequently as necessary to provide adequate visibility and will not be considered as part of a mowing cycle.

### **Compensation**

**806.09-Method of Measurement.** Litter/debris removal shall not be measured for payment but is considered incidental to the work unless otherwise specified in the contract.

Mowing and vegetation removal will be paid by the mowing cycle. A mowing cycle includes the mowing of all areas within project limits with overgrown vegetation one time.

Mowing for site distance will not be measured for payment and shall be considered incidental to the work.

**806.10-Basis of Payment.** The accepted quantities of mowing will be paid for at the contract unit price per mowing cycle. All costs associated with mowing and vegetation removal shall be included in the unit bid price for mowing Item No. 806-02.03. When the Contract does not contain a pay item for mowing and vegetation removal, it shall be incidental to other items of work.

**STATE**

**OF**

**TENNESSEE**

(Rev. 5-18-15)  
(Rev. 11-16-15)  
(Rev. 6-27-16)  
(Rev. 12-2-16)  
(Rev. 5-15-17)  
(Rev. 11-6-17)  
(Rev. 5-14-18)  
(Rev. 10-8-18)

January 1, 2015

**Supplemental Specifications - Section 900**

**of the**

**Standard Specifications for Road and Bridge Construction**

**January 1, 2015**

**Subsection 901.01** (pg. 918), 5-14-18; Add the following sentence as the second paragraph of the subsection:

Provide hydraulic cement, selected from the Department’s QPL, which conforms to the following for the kind and type specified or allowed:

- Portland cement.....AASHTO M 85
- Portland blast-furnace slag cement (Type IS) AASHTO M 240
- Portland-pozzolan cement (Type IP).....AASHTO M 240
- Portland-limestone cement (Type IL) .....AASHTO M 240

The maximum allowable equivalent alkalies is 0.60% for all cements and blended cements used in concrete riding surfaces with aggregates meeting the requirements of 903.24. This includes Class CP, A Paving, and DS concrete mixtures.

**Subsection 903.01** - Table 903.01-1 (pg. 920), 5-18-15; Replace Note (1) with the following:

“(1)If the fine aggregate is manufactured from crushed stone and if material finer than the No. 200 sieve consists of the dust of fracture, essentially free from clay or shale, this limit may be increased to 5%.

**Subsection 903.01** - Table 903.01-1, Table 903.01-2 (pg. 921), 5-15-17; replace Tables 903.01-1 and 903.01-2 with the following Tables:

**Table 903.01-1: Limits of Deleterious Substances in Fine Aggregate for Concrete**

Substance	Maximum Permissible Limits Percent by Weight
Clay Lumps	0.5
Coal and Lignite	0.5
Material Passing the No. 200 Sieve <sup>(1)(3)</sup>	3.0
Other deleterious substances (such as shale, alkali, mica, coated/grains, soft and flaky particles) <sup>(1)(2)</sup>	3.0
<p><sup>(1)</sup> If the fine aggregate is manufactured from crushed stone and if material finer than the No. 200 sieve consists of the dust of fracture, essentially free from clay or shale, this limit may be increased to 10%.</p> <p><sup>(2)</sup> Determine other organic impurities according to AASHTO T 267.</p> <p><sup>(3)</sup> If the fine aggregate is manufactured from crushed gravel and if material finer than the No. 200 sieve consists of the dust of fracture, essentially free from clay or shale, this limit may be increased to 3.5%.</p>	

**Table 903.01-2: Gradation Requirements for Fine Aggregate**

Sieve Size	Total Percent Passing by Weight
3/8 inch	100
No. 4	95-100
No. 16	50-90
No. 50	5-35
No. 100	0-20
No. 200 <sup>(1)</sup>	0-3

<sup>(1)</sup> If the fine aggregate is manufactured from crushed stone and if material finer than the No. 200 sieve consists of the dust of fracture, essentially free from clay or shale, this limit may be increased to 10%.

**Subsection 903.03** (pg. 922) 5-15-17; Coarse Aggregate for Concrete, add the following as the 4<sup>th</sup> paragraph:

“Coarse aggregate in two-lift composite pavements shall consist of Size No. 467 in the lower lift, graded as specified in 903.22. Coarse aggregate in the upper lift shall be Size No. 57 or 67 graded as specified in 903.22 and shall meet 903.24 riding surface requirements.”

**Subsection 903.03** (pg. 922-923) 11-16-15; Coarse Aggregate for Concrete, modify the 4<sup>th</sup> and 5<sup>th</sup> paragraphs, update Table 903.03-1: Coarse Aggregate Sizes to the following:

“Coarse aggregate in Portland cement concrete bridge decks and overlays on interstates and four or more lane highways consisting of Size No. 57 shall meet 903.24.

The coarse aggregates for travel lanes and bridge decks shall be crushed and consist of stone, slag, gravel, quartzite, gneiss, or combination thereof with an absorption of plus 4 material not to exceed 5%. Do not use uncrushed gravel, pea gravel, or any other uncrushed particles. Crushed gravel, if used, shall consist of siliceous washed particles after processing, of which at least 70% by count of the material retained on the No. 4 sieve contains a minimum of two fractured faces. One face shall be fractured for the approximate average diameter or thickness of the particle.”

Table 903.03-1

<b>Application</b>	<b>Coarse Aggregate Size <sup>(1)</sup></b>
Structural concrete	No. 57
Self-Consolidating concrete	Maximum-No.67
Prestressed concrete	No. 57 or 67
Precast concrete	Any size fraction
Concrete curbing placed by machine-extrusion methods	No. 7, 57, 67, or 78
Cement treated permeable base <sup>(2)</sup>	No. 57

<sup>(1)</sup> Gradation shall conform to **903.22**.

<sup>(2)</sup> Aggregate shall meet the quality requirements specified below.



**Subsection 903.03-2** (pg. 924) 5-15-17; Revise Table 903.03-2: Limits of Deleterious Substances in Coarse Aggregate for Concrete, update Material passing No. 200 Sieve and Footnote 2:

**Table 903.03-2: Limits of Deleterious Substances in Coarse Aggregate for Concrete**

Substance	Maximum Percent by Weight
Soft or non-durable fragments (fragments that are structurally weak such as shale, soft sandstone, limonite concretions, gypsum, weathered schist, or cemented gravel), and organic impurities as determined by AASHTO T 267 <sup>(1)</sup>	3
Coal and lignite <sup>(1)</sup>	1
Clay lumps <sup>(1)</sup>	0.25
Material passing the No. 200 sieve <sup>(1)(2)</sup>	1.5
Thin or elongated pieces (length greater than 5 times average thickness)	10
Other local deleterious substances <sup>(1)</sup>	1

<sup>(1)</sup> The sum of the percentages of these materials (i.e., soft or non-durable fragments, coal and lignite, clay lumps, material passing the No. 200 sieve, and other local deleterious substances) shall not exceed 5.0.

<sup>(2)</sup> For crushed aggregate, if all the material finer than the No. 200 sieve, as determined in accordance with AASHTO T 11, consists of the dust of fracture, essentially free of clay or shale, this limit may be increased to 2.0.

**Subsection 903.05 – B. Type B Aggregate** (pg. 927), 5-18-15; Replace the 1<sup>st</sup> paragraph of subsection 3. With the following:

- “3. Do not use material having clay content greater than 12%, as determined by hydrometer analysis performed in accordance with AASHTO T 88. Material may be used having a clay content exceeding 12% if a plasticity index-fines product does not exceed 3 when calculated by the following formula”

**Subsection 903.05 – Aggregate for Mineral Aggregate Base and Surface Courses** (pg. 928) 5-15-17; add section C to the bottom:

**C. Reclaimed Concrete Aggregate.** Provide material comprised of concrete reclaimed from the demolition of a concrete structure or pavement. Reclaimed Concrete Aggregate may only be used as a mineral aggregate base course, subbase or shoulder course. The material shall be free of any materials classified as Solid or Hazardous Waste, especially asbestos, lead and mercury, with test results submitted by the contractor to the Project Supervisor. These test results shall be certified and notarized. The percentage of wear as determined in accordance with AASHTO T 96 shall not exceed 50. Deleterious substances shall be kept to a minimum, and may not be higher than the amounts listed on Table 903.05-3.

Table 903.05-3: Deleterious Materials

Material	Maximum Permissible Limits Percent by Weight
Brick	5
Bituminous Concrete Materials	5
Weathered Rock	2
Wood	0.1
Metals	0.1

The gradations of the coarse and fine fractions of aggregate shall be such that, when combined in proper proportions, the resultant mixture will fall within the grading specified in Table 903.05-4.

Table 903.05-4: RCA Grading Tolerances

Sieve Size	Total Percent Passing per Weight
1 ½ inch	100
1 inch	85-100
¾ inch	60-95
3/8 inch	50-80
No. 4	40-65
No. 16	20-40
No. 100	5-18

**Subsection 903.05** – Aggregate for Mineral Aggregate Base and Surface Courses (pg. 925) 5-15-17; add reference to subsection **903.05 C.** in the second paragraph of subsection A.:

**“903.05 Aggregate for Mineral Aggregate Base and Surface Courses**

Provide crushed stone, crushed slag, crushed or uncrushed gravel, or crushed or uncrushed chert that may be blended with crushed recycled concrete or screened reclaimed asphalt pavement (RAP), together with material such as manufactured sand or other fine materials that are either naturally contained or added as needed to conform to these Specifications.

Provide aggregate of Types A and B, as specified below.

**A. Type A Aggregate**

Provide hard, durable particles or fragments of stone, slag, gravel, or chert, and other finely divided mineral matter.

The Contractor may use recycled concrete aggregate per 903.05 C. or reclaimed asphalt pavement, at a maximum rate of 25% by weight, for Type A aggregate, provided the combined aggregate blend meets all the requirements specified below. Crush and screen the recycled concrete and asphalt to produce a uniform stockpile before blending it with the virgin material. Keep the recycled stockpiles free of bricks, steel, wood, and all other deleterious materials. “

**Subsection 903.05** – Aggregate for Mineral Aggregate Base and Surface Courses (pg. 925-926) 5-15-17; add reference to subsection **903.05 C.** in the second paragraph of subsection B.:

“For Provide crushed or uncrushed gravel, crushed or uncrushed chert, crushed stone or crushed slag, and other finely divided particles.

The Contractor may use recycled concrete aggregate per 903.05 C. or reclaimed asphalt pavement, at a maximum rate of 30% by weight, for Type B aggregate, provided the combined aggregate blend meets all the requirements specified below. Crush and screen recycled concrete and asphalt to produce a uniform stockpile before blending it with the virgin material. Keep the recycled stockpiles free of bricks, steel, wood, and all other deleterious materials.”

**Subsection 903.06 - C. Combined Aggregate Grading** (pg. 930) 11-16-15; add the following sentence at the end of the first paragraph:

“For mixtures including recycled asphalt pavement, RAP, and/or recycled asphalt shingles, RAS, stockpiles will not be considered as contributing to the required minimum of three stockpile sizes.”

**Subsection 903.11 - Aggregate for Asphaltic Concrete Surface Coarses (Hot Mix)** (pg. 934) 11-16-15; add the following sentence at the end of the first paragraph:

“For mixtures including recycled asphalt pavement, RAP, and/or recycled asphalt shingles, RAS, stockpiles will not be considered as contributing to the required minimum of three stockpile sizes.”

**Subsection 903.11** (pg. 934) 11-16-15; A. Coarse Aggregate (retained on a No. 4 sieve), revise the 1<sup>st</sup> paragraph and subsection 3:

“Provide aggregate, consisting of crushed stone, crushed slag, crushed gravel, crushed granite, crushed quartzite, crushed gneiss, or natural combinations of these materials.”,

“3. Combined aggregate shall consist of siliceous particles processed from washed material, of which at least 70% by count of the material retained on the No. 4 sieve shall have a minimum of two fractured faces, one of which must be fractured for the approximate average diameter or thickness of the particle. Do not add pea gravel or uncrushed particles. The absorption of the crushed aggregate retained on the No. 4 sieve shall not exceed 5% when tested in accordance with AASHTO T 85.”

**Subsection 903.11 - A. Coarse Aggregate** (retained on a No. 4 sieve) (pg. 934), 5-18-15; revise subsection 2. as follows:

“2. Material retained on the No. 4 sieve shall contain a maximum of 10% elongated pieces (length greater than five times the average thickness)”

**Subsection 903.11 C. Combined Aggregate Grading** (pg. 936) 10-8-18; Table 903.11-2 Revise Table to add TLE information:

**Table 903.11-2: Asphalt Concrete Surface Course Mixture Designation  
Design Range of Gradations**

Sieve Size	Total Percent Passing by Weight				
	Grading D	Grading E	Grading TL	Grading TLD/ <u>TLE</u>	Grading OGFC
3/4 inch	--	--	--	--	100
5/8 inch	100	100	--	--	--
1/2 inch	95-100	95-100	100	100	85-100
3/8 inch	80-93	80-93	100	90-100	55-75
No. 4	54-76	54-76	89-94	54-76	10-25
No. 8	35-57	35-57	53-77	35-57	5-10
No. 30	17-29	17-29	23-42	17-33	--
No. 50	10-18	10-18	--	10-18	--
No. 100	3-10	3-11	9-18	3-10	--
No. 200	0-6.5	0-8	6-14	4-7	2-4

**Subsection 903.11 C. 2.** (pg. 937) Grading E, add TLE to the title:

**“Grading E and TLE.** When using Grading E as a surface for traffic lanes, 50% to 80% of the mineral aggregate shall be composed of crushed limestone, and the remaining 50% to 20% shall be natural sand, slag sand, sand manufactured from gravel or other approved non-skid aggregates, or any combination of these materials, with the following exceptions:

The sand percentage on the Job Mix Formula (JMF) shall range from 20% to 50%. However, if needed to meet or improve the specified design criteria, the Contractor may alter the limestone and sand percentage by 5% from the percentage shown on the original JMF. If altering the aggregate percentages shown on the original JMF, submit a revision of the original design showing the altered percentages of aggregate.

b. When using Grading E for surfacing of shoulders or other non-traffic lane construction, the mineral aggregate may be composed entirely of limestone, including Size No. 10 (screenings) and manufactured sand, but in no case shall the mineral aggregate for this construction consist of less than 50% limestone.

c. Recycled Asphalt Pavement (RAP) milled from Department or other State Highway Agency projects shall be assumed to contain 75% non-skid material.”

**Subsection 903.11 C.3.** (pg. 938), 6-27-16; revise the 1<sup>st</sup> paragraph of subsection C.3 to the following:

**“3. Grading OGFC.** A minimum of 75% of the aggregate shall meet the requirements specified in 903.24 for Surface Mixtures (Non-Skid Aggregates). The coarse aggregate shall have at least 90% crushed aggregate with two fractured faces and 100% with one fractured face as determined in accordance with ASTM D5821. The coarse aggregate shall have a LA Abrasion value of less than 40% and a maximum absorption of 3.0%.”

**Subsection 903.11** (pg. 938), 12-2-16; Add the following to C. as subsection 5.:

**“5. Grading C, CS, CW.** The mixture shall meet all requirements of **903.06**. When using Grading C, CS, or CW as a final riding surface for traffic lanes and the design ADT is greater than 1000, a minimum of 75% of the aggregate shall meet the requirements specified in **903.24** for Surface Mixtures (Polish-Resistant Aggregate) for the appropriate levels.”

**Subsection 903.12** (pg. 938) 11-16-15; A. Aggregate for Slurry Seal, revise the 1<sup>st</sup> paragraph a A. as shown; delete the 2<sup>nd</sup> paragraph:

“The aggregate shall be crushed slag, crushed granite, or crushed stone (crushed stone as specified in 903.24), meeting the requirements of ASTM D692, except the gradation shall be as specified in Table 903.12-1. The aggregate shall have a minimum sand equivalent, as determined in accordance with AASHTO T 176, of 45.

**Subsection 903.12** (pg. 939) 11-16-15; B. Aggregate for Micro-Surface: modify the first paragraph, delete the second paragraph:

“The aggregate shall be crushed slag, crushed granite, or crushed stone (crushed stone as specified in **903.24**) meeting the gradation limits specified in Table 903.12-2 and the physical properties of ASTM D692, except the percent of fractured pieces shall be 100. The aggregate shall have a minimum sand equivalent, as determined in accordance with AASHTO T 176, of 65. Polish-resistant aggregates will not be required for leveling courses, provided they will be covered with riding surface mixtures.

**Subsection 903.12** (pg. 939) 5-15-17; B. Aggregate for Micro-Surface: Add the following as the 2<sup>nd</sup> paragraph:

“If blending aggregates from more than one source, use automated proportioning and blending equipment which has individual bins for each aggregate source used to produce a stockpile meeting the job mix formula gradation. Proportion and blending equipment shall be calibrated at the beginning of production. All aggregate sources shall meet the requirements of **Table 903.24-1**. Do not blend aggregates with a front end loader. Proportion the aggregate to produce a uniform gradation meeting the requirements specified in Table 903.12-2. The contractor shall provide a Type A laboratory as defined by **106.06** capable of verifying gradation at the location where blending occurs.”

**Subsection 903.13** (pg. 940), 12-2-16; modify the last sentence of the 1<sup>st</sup> paragraph:

“Provide aggregate consisting of crushed stone, crushed slag, or crushed gravel, meeting the quality requirements of ASTM D692, except that at least 50% by count of crushed gravel aggregates shall have at least one fractured face. Crushed slag aggregate retained on the No. 4 sieve shall contain no more than 20% by weight of glassy particles. Provide aggregates meeting the requirements of **903.24 except, if ADT is less than 1000.**”

**Subsection 903.15** (pg. 941), 5-15-17; revise the 3<sup>rd</sup> paragraph:

“The Contractor may use recycled concrete aggregate per 903.05 C. or reclaimed asphalt pavement (RAP), at a maximum rate of 25% by weight, provided the combined aggregate blend meets all the requirements specified above. If blending, crush and screen the recycled concrete and/or asphalt to produce a uniform stockpile before blending it with the virgin material. Keep the reclaimed asphalt pavement stockpiles free of bricks, steel, wood, and all other deleterious materials. The virgin and reclaimed pavement blend shall meet the quality requirements specified in Table **903.05-1.**”

**Subsection 903.24** (pg. 946), 5-18-15; Modify the 1<sup>st</sup> paragraph to the following:

“Provide coarse aggregate consisting of crushed gravel, crushed granite, crushed slag, crushed quartzite, crushed gneiss, or crushed sandstone. Other crushed aggregate may be used provided it has the chemical, physical, and performance characteristics specified in Table 903.24-1.”

**Subsection 904.01** (pg. 948) 11-16-15; Asphalt Cements, add the following between the 4<sup>th</sup> and 5<sup>th</sup> paragraphs:

“Polyphosphoric acid may be used as a modified not exceeding 0.5% by weight of asphalt binder and may only be used when the primary modifier is one of the styrene-based products listed above.”

**Subsection 904.01** (pg. 948) 11-6-17; Asphalt Cements, modify the fourth paragraph with the following:

“To modify the asphalt, properly blend one or more modifier(s) consisting of styrene butadiene (SB), styrene butadiene styrene (SBS), or styrene butadiene rubber (SBR), or Ground Tire Rubber (GTR) to a PG 64-22 or PG 67-22 base asphalt.

GTR used to modify asphalt shall meet the requirements of 921.17. Blending of GTR into asphalt cement shall occur only at the asphalt terminal. ”

**Subsection 904.01** (pg. 948), 11-6-17; Asphalt Cements, add the following paragraph as the next to last paragraph:

“In addition to the above, asphalt cement modified with GTR shall meet the following requirement. The temperature difference determined by the Separation Test shall not exceed 15 °F. The separation test shall consist of taking the difference in softening point, as determined by the Ring and Ball Test (AASHTO T53), between the top and bottom thirds of a specimen prepared per ASTM D7173.”

Subsection 904.01 (pg. 949), 12-2-16; Modify Table 904.01-1:

“Table 904.01-1: Requirements for Asphalt Cement

Property*	PG 64-22, PG 67-22	PG 70-22	PG 76-22	PG 82-22
Non-recoverable creep compliance at 3.2kPa, Jnr(3.2), kPa <sup>-1</sup> at 64°C, Max	4.5	1.0	0.5	0.5
% Difference in Non-Recoverable Creep Compliance, Jnr(diff) at 64°C, %, Max	75	75**	n/a	n/a

\* Tested in accordance with AASHTO T350.

\*\* Shall be waived if Jnr(3.2) is equal to or less than 0.5

PG76-22 and PG82-22 grade asphalts shall meet the requirements for Indication of Elastic response as defined in Appendix X1 of AASHTO M332. PG70-22 grade asphalts shall have a minimum percent recovery at 3.2 kPa of 29%.”

Subsection 904.01 (pg. 948-950) 5-18-15; revise the 1st paragraph to add the word cement, add sentence to the end of the 2<sup>nd</sup> paragraph, add “cement high-temperature grade properties to the 4<sup>th</sup> paragraph, remove the grades of asphalts and add asphalt cements to the 5<sup>th</sup> paragraph, update Table 904-01-1 to remove “Ring and Ball” and” Elastic Recovery”, add “Non-recoverable creep compliance” requirements to Table 904-01-1, add footnote to Table, add a 6<sup>th</sup> paragraph, remove A. Test Procedures and Table 904.01-2, remove Materials Certification header, remove 8<sup>th</sup> paragraph, and revise the 9<sup>th</sup> paragraph:

“Only obtain asphalt cement for use on Department projects from Certified Asphalt Cement Suppliers that have an approved Quality Control Plan in accordance with the Department’s Standard Operating Procedures.

Asphalt cement shall conform to AASHTO M 320 and Department procedures. Direct Tension testing is not required.

Instead of PG 64-22, the Contractor may use asphalt cement graded to PG 67-22. PG 67-22 shall conform to the requirements of AASHTO M 320 when the applicable tests are conducted at 67 °C and -12 °C, and the dynamic shear of the rolling thin film, pressure aged vessel sample is tested at 26.5 °C.



To modify the asphalt cement high-temperature grade properties, properly blend styrene butadiene (SB), styrene butadiene styrene (SBS), or styrene butadiene rubber (SBR) to a PG 64-22 or PG 67-22 base asphalt.

In addition to the above requirements, asphalt cements shall meet the requirements specified in Table 904.01-1.

**Table 904.01-1: Requirements for Asphalt Cement**

<b>Property*</b>	<b>PG 64-22, PG 67-22</b>	<b>PG 70-22</b>	<b>PG 76-22</b>	<b>PG 82-22</b>
Non-recoverable creep compliance at 3.2kPa, Jnr(3.2), kPa <sup>-1</sup> at 64°C, Max	4.5	1.0	0.5	0.5
% Difference in Non-Recoverable Creep Compliance, Jnr(diff) at 64°C, %, Max	75	75	75	75

\* Tested in accordance with AASHTO T350.

All modified grades shall meet the requirements for Indication of Elastic response as defined in Appendix X1 of AASHTO M332.

Furnish a certification to the Engineer on each project stating that the asphalt cement provided meets the Department’s specification. Ensure that quality control and compliance testing are completed in accordance with the asphalt supplier’s approved quality control plan and Department procedures.

In addition, the asphalt cement supplier shall provide a temperature-viscosity curve for PG 64-22 and PG 67-22 asphalt cements with a recommended mixing temperature range. In order to develop a temperature-viscosity curve, it may be necessary to run the viscosity test at a higher temperature, based on the softening point of the modified asphalt cement.”

**Subsection 904.01**(pg. 949), 6-27-16; Modify Table 904.01-1:

Table 904.01-1: Requirements for Asphalt Cement

Property	PG64-22			
	PG67-22	PG70-22	PG76-22	PG82-22
Non-recoverable creep compliance at 3.2kPa, Jnr(3.2), kPa <sup>-1</sup> at 64°C, Max	4.5	1.0	0.5	0.5
% Difference in Non-Recoverable Creep Compliance, Jnr(diff) at 64°C, %, Max	75	75	75	n/a

**Subsection 904.01 B.** (pg. 949) 11-6-17; Asphaltic Cements, B. Materials Certification, add the following as the last sentence of the first paragraph:

“Furnish a certification to the Engineer on each project stating that the asphalt cement provided meets the Department’s specification. Ensure that quality control and compliance testing are completed in accordance with the asphalt supplier’s approved quality control plan and Department procedures. Identify on the certification, the type(s) of modifier used.”

**Subsection 904.03** (pg. 951) 11-16-15; Emulsified Asphalts, Add “TTT-3” to 904.03-1 with the following requirements:

Saybolt-Furol Viscosity @ 77 °F, seconds	10-100
Particle Charge	Positive
Sieve Test, %	0.1 Max
Residue by Distillation <sup>(1)</sup>	
Residue, %	50 Min
Demulsibility, %	65 Min
Penetration	40-90

<sup>1</sup>-Distill at 350°F

**Subsection 904.03** (pg. 954), 12-2-16; Revise Table 904.03-1(c) to remove TTT-1, TTT-2, and TTT-3:

Table 904.03-1(c): Test Requirements for Emulsified Asphalt

Practices	AASHTO Test Method	CRS-2P	RS-2	RS-1
Saybolt-Furol Viscosity @ 77 °F, seconds	T59	n/a	n/a	20-100
Saybolt-Furol Viscosity @ 122 °F, seconds	T59	100-400	75-400	n/a
Storage Stability Test, 24- h, %	T59	1 Max	1 Max	1 Max
5-day Settlement, %	T59	n/a	n/a	n/a
Particle Charge	T59	Positive	n/a	n/a
Sieve Test, %	T59	0.1 Max	0.1 Max	0.1 Max
Residue by	T59	<i>Evaporation</i>	Distillation	Distillation
Residue, %	T59	65 Min	63 Min	55 Min
Demulsibility, %	T59	40 Min	60 Min	60 Min
Distillate, %	T59	n/a	n/a	n/a
Oil Test, %	T59	n/a	n/a	n/a
Stone Coating	T59	n/a	n/a	n/a
Float Test, seconds	T50	n/a	n/a	n/a
Penetration	T49	75-175	100-200	100-200

Practices	AASHTO Test Method	CRS-2P	RS-2	RS-1
Elastic Recovery, % (2)	T301	50 Min	n/a	n/a
Ductility @ 77 °F, cm	T51	40 Min	40 Min	40 Min
Ductility @ 40 °F, cm	T51	n/a	n/a	n/a
R&B Softening Point, °F	T53	125 Min	n/a	n/a
Original G*/sind @ 82 °C	T315	n/a	n/a	n/a

**Subsection 904.03** (pg.954), 5-18-15; Replace with the following:

**Subsection 904.03, Table 904.03-1(c). Modify** as follows for TTT-1, TTT-2:

**Table 904.03-1(c): Test Requirements for Emulsified Asphalt**

Practices	AASHTO Test Method	CRS-2P	RS-2	RS-1	TTT-1	TTT-2
Saybolt-Furol Viscosity @ 77 °F, seconds	T59	n/a	n/a	20-100	20-100	10-100
Saybolt-Furol Viscosity @ 122 °F, seconds	T59	100-400	75-400	n/a	n/a	n/a
Storage Stability Test, 24- h, %	T59	1 Max	1 Max	1 Max	1 Max	1 Max
5-day Settlement,	T59	n/a	n/a	n/a	n/a	n/a

Practices	AASHTO Test Method	CRS-2P	RS-2	RS-1	TTT-1	TTT-2
%						
Particle Charge	T59	Positive	n/a	n/a	n/a	Positive
Sieve Test, %	T59	0.1 Max	0.1 Max	0.1 Max	0.1 Max	0.1 Max
Residue by	T59	<i>Evaporation</i>	Distillation	Distillation	Distillation	Distillation (1)
Residue, %	T59	65 Min	63 Min	55 Min	50 Min	50 Min
Demulsibility, %	T59	40 Min	60 Min	60 Min	n/a	n/a
Distillate, %	T59	n/a	n/a	n/a	n/a	n/a
Oil Test, %	T59	n/a	n/a	n/a	n/a	n/a
Stone Coating	T59	n/a	n/a	n/a	n/a	n/a
Float Test, seconds	T50	n/a	n/a	n/a	n/a	n/a
Penetration	T49	75-175	100-200	100-200	0-20	40-90
Elastic Recovery, % <sup>(2)</sup>	T301	50 Min	n/a	n/a	n/a	n/a
Ductility @ 77 °F, cm	T51	40 Min	40 Min	40 Min	n/a	n/a
Ductility @ 40 °F, cm	T51	n/a	n/a	n/a	n/a	n/a
R&B Softening Point, °F	T53	125 Min	n/a	n/a	60-75	n/a
Original G*/sind @ 82 °C	T315	n/a	n/a	n/a	1.0 Min	n/a
<sup>(1)</sup> Distill at 350 °F						
<sup>(2)</sup> Straight-sided mold, 20-cm elongation, 5min hold, 25 °C						

**Subsection 905.01** (pg. 956) 5-14-18, Revise subsection, add part C. Polypropylene Foam Type:

**“905.01 Preformed Joint Fillers (Non-Extruding and Resilient Types)**

Provide preformed joint fillers as shown on the Plans. When designated, punch holes in preformed joint filler to admit the dowels.

Furnish the filler for each joint in a single piece for the full depth and width required for the joint unless otherwise directed by the Engineer. If the Engineer approves the use of more than one piece for a joint, fasten the abutting ends securely, and hold to shape by stapling or using other positive means of fastening satisfactory to the Engineer.

**A. Bituminous Type**

Provide bituminous type preformed joint fillers conforming to AASHTO M 213.

**B. Non-Bituminous Types**

Provide non-bituminous types of preformed joint filler conforming to AASHTO M 153, Type I, II, or III, as specified.

**C. Polypropylene Foam Type**

Provide semi-rigid, closed-cell, polypropylene foam, preformed expansion joint filler conforming to ASTM D8139. ”

**Subsection 908.04** (pg. 968), 5-18-15, High Strength Bolts, A. Specifications; Add the following to the first paragraph:

“Unless otherwise shown on the Plans, mechanically galvanize all bolts, nuts and washers in accordance with ASTM B695 Class 50.”

**Subsection 908.04** (pg. 968), 12-2-16, High Strength Bolts, A. Specifications; revise the first paragraph:

“Unless otherwise shown on the Plans, all bolts, nuts and washers shall be coated with acceptable coating in accordance with ASTM F3125 for the respective grade.”

**Subsection 908.04** (pg. 968) 12-2-16; revise A. Specifications, 1.:

“A. Specifications: 1. Bolts. ASTM F3125, Grade 325 and Grade 490 - High Strength Bolts for Structural Joints”

**Subsection 908.04** (pg. 970) 12-2-16; Revise C. Testing, 3. Assemblies, subsection f., update Table 908-04-2:

C. Testing, 3. Assemblies, f. Table 908.04-2 The minimum rotation, from a snug tight condition (10% of the specified proof load), shall be as specified in Table 908.04-2.

**Table 908.04-2: Rotation from Snug Tight Condition**

<b>Bolt Length</b>	<b>Minimum Rotation from Snug</b>
Up to and including 4 diameters	240 degrees (2/3 turn)
Over 4 diameters, but not exceeding 8 diameters	360 degrees (1 turn)
Over 8 diameters	480 degrees (1-1/3 turn)

(Note: These values differ from those shown in ASTM F3125.)

**Subsection 908.07** (pg. 973), 5-14-18; Add the following as the last sentence in the subsection:

“Furnish the Engineer a certification from the manufacturer identifying each heat number and certifying that the requirements from AASHTO M 105 and the above additions have been met.”

**Subsection 909.02**(pg. 977), 12-2-16; Remove the 4<sup>th</sup> paragraph referencing a tolerance of 5% from B. Steel Posts and Braces.

**Subsection 909.02** (pg. 980-981), 12-2-16; Remove the word minimum from Table 909.02-1:

**Table 909.02-1: Post and Braces**

<b>Application</b>	<b>Material</b>	<b>ASTM Specification</b>	<b>Nominal Diameter (inches)</b>	<b>Outside Diameter (inches)</b>
Line Posts	Galvanized steel pipe	F1083	1.5	1.900
	Aluminum alloy standard (ANSI Schedule 40) pipe	B429, Alloy 6063, Temper T6	1.5	1.900
	Triple	F1043,	1.5	1.900

<b>Application</b>	<b>Material</b>	<b>ASTM Specification</b>	<b>Nominal Diameter (inches)</b>	<b>Outside Diameter (inches)</b>
	coated steel pipe with a 0.120-inch wall thickness	Group I-C		
End, Corner, and Pull Posts	Galvanized standard steel pipe	F1083	2.0	2.375
	Aluminum alloy standard (ANSI Schedule 40) pipe	B429, Alloy 6063, Temper T6	2.0	2.375
	Triple coated steel pipe with a 0.130-inch wall thickness	F1043, Group I-C	2.0	2.375
End and Corner Braces	Galvanized standard steel pipe	F1083	1.25	1.660
	Aluminum alloy standard (ANSI Schedule 40) pipe	B429, Alloy 6063, Temper T6 (for corner posts: B241)	1.25	1.660
	Triple coated steel pipe with a 0.111-inch wall thickness	F1043, Group I-C	1.25	1.660



**Subsection 909.03** (pg. 983), 12-2-16; Remove the last paragraph of the subsection.

**Subsection 912.05** (pg. 1001), 6-27-16; Add subsection 912.05 – Brick Paving Units:

**“912.05 Brick Paving Units**

Provide brick of the kind and grade specified.

**A. Masonry Brick**

1. Sidewalk: ASTM C902, Class SX, Type 1
2. Crosswalks and Roadway: ASTM C1272, Type R

**B. Concrete Brick and Truncated Dome Concrete Brick**

Provide brick conforming to ASTM C936

**C. Truncated Dome Brick**

Provide brick conforming to ASTM C902, Class SX, Type 1”

**Subsection 915.02** (pg. 1007), 6-27-16; modify the description of 915.03, remove zinc coated, iron from 915.02 A. update the first paragraph of 915.02 A., Remove subsection B. Aluminum Coated Steel Pipe, Revise C. to become B., revise D to become C, Remove 1<sup>st</sup> and 2<sup>nd</sup> paragraphs of D now C, revise E to become D, update 915.03 to match index title: :

**“SECTION 915 – METALLIC PIPE**

915.01 Ductile Iron or Cast Iron Pipe ..... 1007  
 915.02 Corrugated Metal Pipe Culverts, Pipe Arches, and Underdrains..... 1007  
 915.03 Polymer Pre-coated, Corrugated Steel Pipe, Culverts, and Underdrains.... 1008

**915.01 Ductile Iron or Cast Iron Pipe**

Provide ductile iron pipe conforming to ASTM A716 for the specified diameters and strength classes. Unless otherwise specified, either smooth, corrugated, or ribbed pipe may be furnished. For pipe diameters in excess of 48 inches, conform to ANSI Standard for Cast Iron Pit Cast Pipe, or as otherwise specified in the Contract, for the specified diameter and strength class.

Provide cast iron drain pipe conforming to ASTM A74. Unless otherwise specified, provide ductile iron pressure pipe for water lines or sewer construction conforming to the requirements of ASTM A377 for the diameters and working pressures specified.

**915.02 Corrugated Metal Pipe Culverts, Pipe Arches, and Underdrains**

**A. Corrugated Steel Pipe, Pipe Arches, and Underdrains**

Provide corrugated steel pipe, pipe arches, or underdrains, including special sections, such as elbows and flared ends, that conform to AASHTO M 36, aluminum-coated Type 2 meeting AASHTO M274. Special Sections shall be the same thickness as the pipe, arch, or underdrain to

which they are joined. Furnish shop-formed elliptical pipe and shop-strutted pipe only where shown on the Plans.

**B. Corrugated Aluminum Pipe, Pipe Arches, and Underdrains**

When using corrugated aluminum pipe, pipe arches, or underdrains, conform to the applicable requirements of AASHTO M 196. Use special sections, such as elbows and flared end sections that conform to the applicable requirements of AASHTO M 196 and that are of the same gauge as the conduit to which they are joined.

**C. Structural Plate Corrugated Steel and Aluminum Structures**

Corrugated aluminum alloy structural plate for pipe, pipe arches, and arches shall conform to the requirements of AASHTO M 219.

**D. Bituminous Coating**

When material supplied for any of the items specified above are to be bituminous-coated, ensure that the metal to be coated is free of grease, dirt, and other contaminants. Bituminous coating and paving shall conform to the requirements of AASHTO M 190. Apply the coating in accordance with the manufacturer’s recommended procedures and as directed by the Department.”

**915.03 Polymer Pre-coated, Corrugated Steel Pipe, Culverts and Underdrains**

Provide polymer pre-coated corrugated steel pipe conforming to AASHTO M 245, Grade 250/250, unless otherwise specified.”

**Subsection 916.05 E.** (pg. 1012); 12-2-16, Add sentence to first paragraph:

“Fabricators must be AISC certified as specified in **602.04 A.4.**”

**Subsection 917.02.A.6.** (pg. 1023), 6-27-16; Revise the following:

“**6. Anchor Bolts.** Use anchor rods of high strength steel meeting the requirements of ASTM F 1554, Grade to be determined by design. Fit each anchor bolt with a hex nut and lock-washer.”

**Subsection 918.01** (pg. 1033-1035), 5-14-18; Revise the 1<sup>st</sup> paragraph and 3<sup>rd</sup> paragraph of A. General, Revise Table 918.01-1, Table 918.01-2, Table 918.01-4, Table 918.01-5, Revise the last paragraph of B. Seed Groups, Revise Table 918.01-6 Temporary Seeding:

**A. General**

Provide seed meeting the rules and requirements of the Tennessee Department of Agriculture Chapter 0080-05-06.

Pack grass seed in new bags or bags that are sound and not mended.

The vendor shall notify the Department before making shipments to allow the Department to

arrange for inspection and testing of stock.

The vendor shall furnish the Department a certified laboratory report from a Society of Commercial Seed Technologists accredited commercial seed laboratory or from a State seed laboratory showing the analysis of the seed to be furnished. The report from an accredited commercial seed laboratory shall be signed by a Registered Member of the Society of Commercial Seed Technologists. The Department may take samples of the seed to check against the certified laboratory report. Sampling and testing will be in accordance with the requirements of the Tennessee Department of Agriculture.

Use commercial grade 10-10-10 fertilizer or equivalent.

### B. Seed Groups

When a seed group is used, provide mixtures meeting the requirements specified in Tables 918.01-1 through 918.01-5, unless otherwise specified.

**Table 918.01-1: Group A (February 1-July 1)**

Kind of Seed	Quantity, Percent by Weight
Kentucky 31 Fescue	80
Korean Lespedeza	15
Annual Rye Grass	5

**Table 918.01-2: Group B (June 1-August 15)**

Kind of Seed	Quantity, Percent by Weight
Kentucky 31 Fescue	5575
Korean Lespedeza	15
German Millet	10

**Table 918.01-3: Group B1 (April 15 - August 15)**

Kind of Seed	Quantity, Percent by Weight
Bermudagrass (hulled)	70
Annual Lespedeza	30

**Table 918.01-4: Group C (August 1-December 1)**

Kind of Seed	Quantity, Percent by Weight
Kentucky 31 Fescue	70
EAnnual Rye Grass	20
White Clover	10

**Table 918.01-5: Group C1 (February 1-December 1)**

<b>Kind of Seed</b>	<b>Quantity, Percent by Weight</b>
Crown Vetch	25
Kentucky 31 Fescue	70
Annual Rye Grass	5

Uniformly mix seed when forming Groups. Do not mix Group seed until each type seed that is used to form the Group has been tested separately and meets DOA requirements for purity and germination.

**C. Over-Seeding**

Groups A, B, and C, when sown on slopes 3:1 and steeper, shall be over seeded with Sericea Lespedeza at the rate of 15 pounds per acre. When over-seeding is performed between February 1 and July 1, use Scarified Sericea Lespedeza with an additional 2 pounds per acre of Weeping Lovegrass. Between July 1 and December, use unhulled Sericea Lespedeza. Only use Group C1 when shown on the Plans.

**D. Temporary Seeding**

For temporary seeding, use seed groups and approved varieties as specified in Table 918.01-6.

**Table 918.01-6: Temporary Seeding**

<b>Seed Group (Season)</b>	<b>Kind of Seed</b>	<b>Percent by Weight</b>
<b>Group D (January 1 – May 1)</b>	ItAnnual Rye Grass	33-1/3%
	Korean Lespedeza	33-1/3%
	SSpring Oats	33-1/3%
<b>Group E (May 1 – July 15)</b>	SSorghum-Sudan Crosses <sup>(1)</sup>	100%
	or StGerman Millet <sup>(2)</sup>	100%
<b>Group F (July 15 – January 1)</b>	BCereal Rye	66-2/3%
	ItAnnual Rye Grass	33-1/3%

**Subsection 918.04** (pg. 1036), 12-2-16; add as a 2<sup>nd</sup> paragraph:

“For small quantities less than 100 units of seeding or sod, bagged pelletized or agricultural limestone meeting the Department of Agriculture Tennessee Liming Materials Act may be utilized.”

**Subsection 921** (pg. 1049), 11-6-17, Section 921 – Miscellaneous Materials, add Ground Tire Rubber to the Index:

“921.17 Ground Tire Rubber .....1060”

**Subsection 921.01** (pg. 1049), 5-18-15, Water; Replace subsection with the following:

“For mixing concrete, use water that is reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter, and other substances injurious to the finished product. Water provided by a municipal utility may be used without testing.

All other water shall have quality results submitted in accordance with the frequency listed in Table 921.01-01. All water quality results shall adhere to Table 921.01-2.

**Table 921.01-1 Testing Frequency for Mixing Water**

Water Source	Testing Frequency <sup>(1)</sup>
Municipal	NA
Non-Municipal	Every 3 months; tested annually after 4 consecutive passing tests

(1) The frequency may vary at the discretion of the Department.

**Table 921.01-2 Quality Requirements for Mixing Water**

Maximum Concentration in Mixing Water	Limits	ASTM Test Method <sup>(1)</sup>
Chloride Ion Content, ppm	500	C114
Alkalies as (NaO2 + 0.658 K2O), ppm	600	C114
Sulfates as SO4, ppm	3000	C114
Total Solids by mass, ppm	50000	C1603
pH	4.5-8.5	<sup>(2)</sup>
Resistivity, Minimum, kohm-cm	0.500	D1125
Soluble Carbon Dioxide, ppm	600	D513
Calcium and Magnesium, ppm	400	D511
Iron, ppm	20	<sup>(2)</sup>
Phosphate, ppm	100	D4327

(1) Other methods (EPA or those used by water testing companies) are generally acceptable.

(2) No ASTM method available.

**Subsection 921** (pg. 1049) 10-8-18, Miscellaneous Materials, Remove 921.03 Sodium Chloride from the Content list:

921.01 Water ..... 1052  
 921.02 Calcium Chloride ..... 1053  
~~921.03 Sodium Chloride ..... 1053~~  
 921.04 Lime ..... 1053  
 921.05 Select Material for Soil-Cement Base ..... 1054  
 921.06 Chemical Additives ..... 1054

921.07 Masonry Stone ..... 1056  
 921.08 Waterstops ..... 1056  
 921.09 Grout ..... 1059  
 921.10 Precast Manholes and Catch Basins ..... 1059  
 921.11 Manhole Steps ..... 1059  
 921.12 Geotextile and Geosynthetic Material ..... 1060  
 921.13 Precast Prestressed Bridge Deck Panels ..... 1060  
 921.14 Applied Textured Finish Material ..... 1061  
 921.15 Fly Ash ..... 1063  
 921.16 Ground Granulated Blast Furnace Slag ..... 1063

**Subsection 921.01** (pg. 1049), 5-14-18, Water; Remove Resistivity, Soluble Carbon Dioxide, Calcium and Magnesium, Iron, and Phosphate from Table 921.01-2 Quality Requirements for Mixing Water:

**Table 921.01-2 Quality Requirements for Mixing Water**

Maximum Concentration in Mixing Water	Limits	ASTM Test Method <sup>(1)</sup>
Chloride Ion Content, ppm	500	C114
Alkalies as (NaO2 + 0.658 K2O), ppm	600	C114
Sulfates as SO4, ppm	3000	C114
Total Solids by mass, ppm	50000	C1603
pH	4.5-8.5	<sup>(2)</sup>

(1) Other methods (EPA or those used by water testing companies) are generally acceptable.

(2) No ASTM method available.

**Subsection 921.03** (pg. 1050) 10-8-18, Miscellaneous Materials, Remove subsection 921.03 Sodium Chloride:

~~“**921.03 Sodium Chloride**  
 Provide sodium chloride conforming to ASTM D632, for the type specified.”~~

**Subsection 921.06** (pg.1051) 11-16-15; B. Bituminous Additives - 1. Anti-Stripping Additive, replace the ASTM C977 reference with AASHTO M 303.

“Use hydrated lime conforming to AASHTO M 303 or other heat-stable asphalt anti-stripping additive containing no ingredient harmful to the bituminous material or the workmen and that does not appreciably alter the specified characteristics of the bituminous material when added in the recommended proportions.”

**Subsection 921.06 B.** Bituminous Additives (pg.1052) 10-10-16; revise the 3<sup>rd</sup> paragraph to the following:

“When using an anti-stripping additive other than hydrated lime, use a dosage rate of 0.3%, unless either gravel is used as a coarse aggregate or test results indicate moisture susceptibility, in which case mix at a dosage rate of 0.5%.

**Subsection 921.06 B. 2.** (pg. 1052) 11-6-17; B. Bituminous Additives, 2. Silicone Additives, Remove description and add the following sentence:

“2. Silicone Additives. The amount of silicone added to asphalt cement shall not exceed 2 oz. of silicone per 5500 gallons asphalt cement.”

**Subsection 921.17** (pg. 1060) 11-6-17; Ground Tire Rubber, add the following subsection:

**“921.17 Ground Tire Rubber**

Provide Class 30-1 Ground Tire Rubber (GTR) as defined by ASTM D5630 except for as noted in table 921.17-1. The material shall also be certified to meet the requirements of Table 921.17-01. Include certification of the GTR with the bill of lading for the modified asphalt cement.

**Table 921.17-1: Requirements for Ground Tire Rubber**

Property	Specification
Specific Gravity	1.15 +/- 0.05
Moisture Content	0.75% Max
Ferrous Metal Content	0.01% Max
Fiber Content	0.5% Max
Ash (ASTM E1131)	10% Max

**INSERT ALL APPLICABLE SPECIAL PROVISIONS**

Include all special provisions required by the Local Government Guidelines and any other applicable special provisions.



**S T A T E**

**O F**

**T E N N E S S E E**

(Rev. 2-17-15)

January 1, 2015

**SPECIAL PROVISION**

**REGARDING**

**UNBALANCED BIDS**

The Department will review all unit prices submitted by the apparently lowest responsible bidder and will decide whether any of the unit prices are excessively above or below a reasonable cost analysis value determined by the Engineer.

In the event any unit prices are determined to be unbalanced and contrary to the interest of the Department, the right is reserved to reject such bid at the discretion of the Department or to award the Contract and limit progress payments on units of work performed on any excessively priced items to costs that are satisfactorily documented by the Contractor plus 20 percent, until 85 percent of the Contract has been completed. Upon completion of 85 percent of the Contract, the Contractor will be reimbursed in accordance with **Subsection 109.08** of the Standard Specifications for the accepted quantities of work performed on the excessively priced items.

**STATE**

**OF**

**TENNESSEE**

Rev: October 10, 2016

January 1, 2015

**SPECIAL PROVISION**

**REGARDING**

**EMPLOYING AND CONTRACTING WITH ILLEGAL IMMIGRANTS**

The State shall endeavor to do business only with those contractors and subcontractors that are in compliance with the Federal Immigration and Nationality Act. This policy shall apply to all State Contractors including subcontractors. This policy statement is issued to establish implementation guidance to procuring state agencies and contractors reflecting the requirements of *Tennessee Code Annotated* §12-3-309 regarding the employment of illegal immigrants in the performance of state contracts.

1. The Contractor hereby attests, certifies, warrants, and assures that the Contractor shall not knowingly utilize the services of an illegal immigrant in the performance of this Contract and shall not knowingly utilize the services of any subcontractor who will utilize the services of an illegal immigrant in the performance of this Contract. The Contractor shall reaffirm this attestation, in writing, by submitting to the State a completed and signed copy of the “Attestation form” provided by the Department, semi-annually during the period of this Contract.
2. Prior to the use of any subcontractor in the performance of this Contract, and semi-annually thereafter, during the period of this Contract, the Contractor shall obtain and retain a current, written attestation that the subcontractor shall not knowingly utilize the services of an illegal immigrant to perform work relative to this Contract and shall not knowingly utilize the services of any subcontractor who will utilize the services of an illegal immigrant to perform work relative to this Contract.
3. The Contractor shall maintain records for its employees used in the performance of this Contract. Said records shall include a completed federal Department of Homeland Security Form I-9, *Employment Eligibility Verification*, for each employee and shall be subject to review and random inspection at any reasonable time upon reasonable notice by the State.

The Contractor understands and agrees that failure to comply with this section will be subject to the sanctions of *Tennessee Code Annotated* § 12-3-309 for acts or omissions occurring after January 1, 2007. This law requires the Chief Procurement Officer, Department of General Services, to prohibit a contractor from contracting with, or submitting an offer, proposal, or bid to contract with the State of Tennessee to supply goods or services for a period of one year after a

contractor is discovered to have knowingly used the services of illegal immigrants during the performance of this contract.

For the Purposes of this policy, “illegal immigrant” shall be defined as a non-citizen who has entered the United State of America without federal government permission or stayed in this country beyond the period allowed by a federal government-issued visa authorizing the non-citizen to enter the country for specific purposes and a particular time period.

STATE

OF

TENNESSEE

January 1, 2015

**CERTIFICATION REGARDING**  
**DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS**  
**PRIMARY AND LOWER TIER COVERED TRANSACTIONS**

The prospective Primary and/or Lower Tier participant certifies, by signing and submitting this proposal, to the best of its knowledge and belief, that it and its principals:

Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal, State or local department or agency.

Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in the preceding paragraph of this certification; and

Have not within a three- year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

Where the prospective Primary and/or Lower Tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

(Exceptions to the above are to be submitted on a separate sheet with the bid proposal)

For any exception noted, indicate to whom it applies, initiating agency, and dates of action. Providing false information may result in criminal prosecution or administrative sanctions.

**STATE**

**OF**

**TENNESSEE**

January 1, 2015

**SPECIAL PROVISION**

**REGARDING**

**NON-DISCRIMINATION IN EMPLOYMENT**

Bidders are cautioned as follows:

By signing this bid, the bidder will be deemed to have signed and agreed that all persons, firms or corporations supplying goods, material, equipment or service of any kind to the State of Tennessee will not discriminate against any employee or applicant for employment on the basis of handicap, race, religion, national origin or sex and further, that while under contract with the State will show proof upon request that all employment practices including, but not limited to, promotion, rates of pay, transfers, recruitment, recruitment advertising, terminations, layoffs and training and apprenticeship programs are not discriminatory in nature. Each contractor shall be required to post in conspicuous places, available to all employees and applicants for employment, notices of non-discrimination.

## PROPOSAL

### TO THE CITY OF LEBANON, TENNESSEE

By submitting this Proposal, the undersigned bidder represents that it has carefully examined the site of the work described herein, has become familiar with local conditions and the character and extent of the work; has carefully examined the Plans, the *Standard Specifications for Road and Bridge Construction* (January 1, 2015) adopted by the State of Tennessee, Department of Transportation, with subsequent revisions which are acknowledged to be a part of this Proposal, the Special Provisions, the Proposal Form, the Form of Contract, and the Form of Contract Payment and Performance Bond; and thoroughly understands their stipulations, requirements, and provisions.

The undersigned bidder has determined the quality and quantity of materials required; has investigated the location and determined the sources of supply of the materials required; has investigated labor conditions; and, has arranged for the continuous prosecution of the work herein described.

By submitting this Proposal, the undersigned bidder agrees to provide all necessary equipment, tools, labor, incidentals, and other means of construction, to do all the work, and furnish all the materials of the specified requirements which are necessary to complete the work in accordance with the Plans, and the Specifications, and agrees to accept as payment in full the unit prices for the various items described in the Specifications that are set forth in this Proposal. The bidder understands that the quantities of work specified are approximate only and are subject to increase or decrease and that any such increase or decrease will not affect the unit prices set forth in this Proposal. Compensation for "extra work" which may be required by the CITY OF LEBANON in connection with the construction and completion of the work but which was not reflected in the Plans and Specifications at the time of bidding, will be made in the following manner: work for which there is a unit price set forth in this Proposal will be compensated at that unit price; work for which there is no unit price set forth in this Proposal will be compensated in accordance with the applicable Tennessee Department of Transportation Standard Specifications.

By submitting this Proposal, the parties hereto, in the performance of this Contract, shall not act as employees, partners, joint ventures, or associates of one another. It is expressly acknowledged by the parties hereto that such parties are independent contracting entities and that nothing in this Contract shall be construed to create an employer/employee relationship or to allow either to exercise control or direction over the manner or method by which the other transacts its business affairs or provides its usual services. The employees or agents of one party shall not be deemed or construed to be the employees or agents of the other party for any purpose whatsoever.

By submitting this Proposal, the undersigned bidder, if awarded the contract, agrees that it will be responsible for compliance with the Patient Protection and Affordable Care Act ("PPACA") with respect to itself and its employees, including any obligation to report health insurance coverage, provide health insurance coverage, or pay any financial assessment, tax, or penalty for not providing health insurance. The Contractor shall indemnify the State and hold it harmless for any costs to the State arising from Contractor's failure to fulfill its PPACA responsibilities for itself or its employees.

By submitting this Proposal, the undersigned bidder, if awarded the contract, shall be registered with the Department of Revenue for the collection of Tennessee sales and use tax or provide confirmation from the Department of Revenue that the bidder is not required to register for the Tennessee sales and use tax. This registration requirement is a material requirement of this Contract.

By submitting this Proposal, the undersigned bidder hereby agrees to be bound by the award of the Contract and, if awarded the Contract on this Proposal, to execute the required Contract and the required Contract Payment and Performance Bond within ten (10) days after receipt of notice of the award. The undersigned bidder submits herewith the required Proposal guaranty in an amount of not less than five percent (5%) of the total amount of the Proposal offered and agrees and consents that the Proposal guaranty shall immediately be at the disposal of the CITY OF LEBANON, not as a penalty, but as an agreed liquidated damage if the required Contract and Contract Payment and Performance Bond are not executed within ten (10) days from receipt of the notice of award.

By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief that each bidder is not on the list created pursuant to § 12-12-106. This list is generated to identify entities ineligible to contract with the State of Tennessee or any political subdivision of the State per the Iran Divestment Act, T.C.A. §§ 12-12-101 – 113, and the current list may be found at the Tennessee Department of General Services, Central Procurement Office, website under the Public Information Library webpage at the following link: [http://tn.gov/assets/entities/generalservices/cpo/attachments/List\\_of\\_persons\\_pursuant\\_to Tenn. Code Ann. 12-12-106. Iran Divestment Act-July.pdf](http://tn.gov/assets/entities/generalservices/cpo/attachments/List_of_persons_pursuant_to_Tenn._Code_Ann._12-12-106._Iran_Divestment_Act-July.pdf).

THIS PROPOSAL SUBMITTED BY:

\_\_\_\_\_  
Bidder (1)

By: \_\_\_\_\_

\_\_\_\_\_  
Printed Name and Title

\_\_\_\_\_  
Address

\_\_\_\_\_  
City/State/Zip

Bidder (1) being \_\_\_\_\_ composed of officers, partners, or owners as  
a \_\_\_\_\_ follows:  
(Type of business entity)

\_\_\_\_\_  
Name/Title

\_\_\_\_\_  
Name/Title

\_\_\_\_\_  
Name/Title

\_\_\_\_\_  
Name/Title

\_\_\_\_\_  
Name/Title

\_\_\_\_\_  
Name/Title

\_\_\_\_\_  
Bidder (2)\*

By: \_\_\_\_\_

\_\_\_\_\_  
Printed Name and Title

\_\_\_\_\_  
Address

\_\_\_\_\_  
City/State/Zip

Bidder (2) being \_\_\_\_\_ composed of officers, partners, or owners as  
a \_\_\_\_\_ follows:  
(Type of business entity)

\_\_\_\_\_  
Name/Title

\_\_\_\_\_  
Name/Title

\_\_\_\_\_  
Name/Title

\_\_\_\_\_  
Name/Title

\_\_\_\_\_  
Name/Title

\_\_\_\_\_  
Name/Title



**INSERT BID FORM HERE**

**PROPOSAL CERTIFICATION**

The undersigned, being first duly sworn, certifies on behalf of the bidder that it has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with this Proposal or Contract. This is an official document that is required or authorized by law to be made under oath and is presented in an official proceeding. A person who makes a false statement in this certification is subject to the penalties of perjury.

The undersigned further certifies that said bidder is not under the control of any person, firm, partnership, or corporation, which has or exercises any control of any other person, firm, partnership, or corporation, which is submitting a bid on this Contract.

\_\_\_\_\_ Sworn to and subscribed before me  
Bidder (1)  
this \_\_\_\_\_ day of \_\_\_\_\_,  
By: \_\_\_\_\_

\_\_\_\_\_ Notary Public  
Printed Name and Title  
My commission expires \_\_\_\_\_

(Seal)

\_\_\_\_\_ Sworn to and subscribed before me  
Bidder (2)  
this \_\_\_\_\_ day of \_\_\_\_\_,  
By: \_\_\_\_\_

\_\_\_\_\_ Notary Public  
Printed Name and Title  
My commission expires \_\_\_\_\_

(Seal)

**\*NOTE: The signature and information for Bidder (2) is to be provided when there is a joint venture.**

**CITY OF LEBANON, TENNESSEE**

**PROPOSAL BOND**

**CONTRACT NO. 111887**

Principal: \_\_\_\_\_  
Print Name of Principal

Surety: \_\_\_\_\_  
Print Name of Surety

**KNOW ALL MEN BY THESE PRESENTS**, that we, the Principal and Surety above named, are held and firmly bound unto the CITY OF LEBANON in the full and just sum of five percent (5%) of the total amount bid by the Principal for the project stated above, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

**NOW, THEREFORE**, the condition of this obligation is: the Principal shall not withdraw its bid within sixty (60) days after the opening of the bids, or within such other time period as may be provided in the Proposal, and if the CITY OF LEBANON shall award a Contract to the Principal, the Principal shall, within ten (10) days after written notice of the award is received by him, fully execute a Contract on the basis of the terms, conditions and unit prices set forth in his Proposal or bid and provide bonds with good and sufficient surety, as required for the faithful performance of the Contract and for the protection of all persons supplying labor, material, and equipment for the prosecution of the work. In the event the Principal withdraws its bid after bids are opened, or after award of the Contract has been made fails to execute such the Contract and/or such additional documents as may be required and to provide the required bonds within the time period specified above, then the amount of the Proposal Bond shall be immediately paid to the CITY OF LEBANON, not as a penalty, but as agreed upon liquidated damages.

**IN WITNESS WHEREOF**, the Principal has caused these presents to be signed by a duly authorized official and the Surety has caused these presents to be duly signed and sealed by an authorized agent or attorney-in-fact.

---

Principal (1)	Surety (1)
By: _____	By: _____
	General Agent or Attorney-in-Fact

---

Print Name and Title	Date
_____	
Date	(Seal)

---

Principal (2)	Surety (2)
By: _____	By: _____
	General Agent or Attorney-in-Fact

---

Print Name and Title	Date
_____	
Date	(Seal)

**\*NOTE: The signature and information for Principal(2) and Surety(2) is to be provided when there is a joint venture.**

**CITY OF LEBANON, TENNESSEE**

**PROPOSAL GUARANTEE**

**CONTRACT NO. 111887**

Bidder: \_\_\_\_\_  
Print Name of Bidder

**KNOW ALL MEN BY THESE PRESENTS**, that the above-named Bidder has tendered the attached cashier's or certified check in an amount equal to five percent (5%) of the total amount it bid for the project stated above, payable to the CITY OF LEBANON, to be held pending the fulfillment of the following obligation conditions.

**NOW, THEREFORE**, the condition of this obligation is: the Bidder shall not withdraw its bid within sixty (60) days after the opening of the bids, or within such other time period as may be provided in the Proposal, and if the CITY OF LEBANON shall award a Contract to the Bidder, the Bidder shall, within ten (10) days after it receives written notice of the award, fully execute a Contract on the basis of the terms, conditions and unit prices set forth in its Proposal or bid and provide bonds with good and sufficient surety, as required for the faithful performance of the Contract and for the protection of all persons supplying labor, material, and equipment for the prosecution of the work. In the event the Bidder withdraws its bid after bids are opened, or after award of the Contract has been made fails to execute such the Contract and/or such additional documents as may be required and to provide the required bonds within the time period specified above, then the CITY OF LEBANON shall cash the attached check and retain the funds, not as a penalty, but as agreed upon liquidated damages.

**IN WITNESS WHEREOF**, the Bidder has caused these presents to be signed by a duly authorized official.

_____	
Bidder (1)	Bidder (2)*
By: _____	By: _____
_____	
Print Name and Title	Print Name and Title
_____	
Date	Date

**\*NOTE: The signature and information for Bidder(2) is to be provided when there is a joint venture.**

**CITY OF LEBANON, TENNESSEE**

**CONTRACT NO. 111887**

This agreement is made and executed in three (3) originals, between the CITY OF LEBANON, and \_\_\_\_\_ hereinafter referred to as the "Contractor."

**WITNESSETH**

The CITY OF LEBANON did advertise for, receive and accept a bid from the Contractor for work on the above identified contract.

In consideration of the agreements herein contained, to be performed by the parties hereto and of the payments hereafter agreed to be made, it is mutually agreed by both parties that:

1. The contract between the parties consists of the following "Contract Documents" all of which constitute one instrument:
  - (a) the Instructions to Bidders
  - (b) the Proposal
  - (c) all conditions and terms of this Contract form
  - (d) the Contract Payment & Performance Bond and/or Letter of Credit, where applicable
  - (e) the most current version of the *Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction* (herein referred to as *TDOT Standard Specifications*)
  - (f) Supplemental Specifications
  - (g) Revisions and Additions
  - (h) Special Provisions
  - (i) Addenda
  - (j) The most current version of the TDOT Standard Drawings
  - (k) The Contract Plans,
  - (l) The Work Order
  - (m) Construction Changes
  - (n) Supplemental Agreements

All of the provisions contained in the listed Contract Documents are incorporated herein by reference with the same force and effect as though set out in full.

2. The Contract Documents are intended to be complementary and to describe and provide for a complete work. Requirements in one of these are as binding as if occurring in all of them. In case of discrepancy, Supplemental Specifications will govern over the TDOT Standard Specifications; the TDOT Standard Specifications will govern over the local government standard specifications; the Contract Plans will govern over both Supplemental and Standard Specifications, and Special Provisions will govern over both Plans and Specifications. In interpreting Plans, calculated dimensions will govern over scaled dimensions. Contract Plans, typical cross sections and approved working drawings will govern over Standard Drawings.

3. The Contractor agrees to furnish all materials, equipment, machinery, tools and labor and to perform the work required to complete the project in a thorough and workmanlike manner, to the satisfaction of the appropriate official of the CITY OF LEBANON.
4. The CITY OF LEBANON agrees to pay to the Contractor such unit prices for the work actually done as are set out in the accompanying proposal, in the manner provided for in the TDOT Standard Specifications, Supplemental Specifications and applicable Special Provisions.
5. The Contractor shall, at all times, observe and comply with all applicable federal, state and local laws, ordinances and regulations and shall indemnify and hold harmless the CITY OF LEBANON and all of its officers, agents and servants against any claim of liability or assessment of fines or penalties arising from or based upon the Contractor's and/or its employees' violations of any such law ordinance or regulation. The Contractor shall maintain documentation for all charges against the CITY OF LEBANON under this Contract. The books, records and documents of the Contractor insofar as they relate to the work performed or money received under this contract shall be maintained for a period of seven (7) full years from the date of the final payment and shall be subject to audit at any reasonable time and upon reasonable notice by the CITY OF LEBANON, the State, the Comptroller of the Treasury, the Tennessee Department of Transportation, or their duly appointed representatives.
6. The Contractor shall be responsible for any and all injury or damage to persons or to property arising from the prosecution of the work and due to any act, omission, neglect or misconduct in its manner or method of prosecuting the work or due to its non-execution of the work or due to defective work or materials. The Contractor shall provide proof of adequate and appropriate general liability insurance providing liability coverage in an amount not less than \$1 million dollars per occurrence and \$300,000 per claimant, naming the CITY OF LEBANON as an additional insured.
7. The Contractor shall indemnify and hold harmless the CITY OF LEBANON and all of its officers, agents and employees from all suits, actions or claims of any character arising from the Contractor's acts or omissions in the prosecution of the work, use of unacceptable materials in constructing the work, infringement of patent, trade mark or copyright, or claims for Workers' Compensation. If any such suit, action or claim is filed, the CITY OF LEBANON may retain from the monies due to the Contractor under this Contract a sum deemed sufficient by the CITY OF LEBANON to protect the CITY OF LEBANON from loss therefrom. Upon resolution of the suit, action or claim, any remaining retained funds will be released.
8. Upon execution of this Contract, the Contractor shall be prepared to begin the work to be performed under the Contract, but will not proceed until it has received official "Notice to Proceed". This official notice will stipulate the date upon which it is expected that the Contractor will begin his work, and from which date the working days tabulated against its time limit will begin. All other requirements in regard to the beginning of construction set forth in the Proposal and Special Provisions will date from the official notice.

**IN WITNESS WHEREOF**, the parties hereto have cause this Contract to be signed and executed by their respective authorized agents or officials.

<hr/>	
Contractor 1	Contractor 2*
By: _____	By: _____
<hr/>	
Print Name and Title	Print Name and Title
<hr/>	
Date	Date

**CITY OF LEBANON, TENNESSEE**

This Contract is accepted \_\_\_\_\_ day of \_\_\_\_\_ ,  
this \_\_\_\_\_  
and is effective on the \_\_\_\_\_ day of \_\_\_\_\_ ,

\_\_\_\_\_  
[CITY/COUNTY Official]

Approved:

\_\_\_\_\_  
CITY OF LEBANON Attorney

**\*NOTE: The signature and information for Contractor 2 is to be provided when there is a joint venture.**



**CONTRACT PAYMENT AND PERFORMANCE BOND**

**Note: to be filled out post-award**

**CONTRACT NO. 111887**

Be it known that \_\_\_\_\_,  
as Principal, and \_\_\_\_\_,  
as Surety(ies), all authorized to do business in the State of Tennessee, hereby bind themselves to the CITY OF LEBANON, and other potential claimants, for all obligations incurred by the Principal under its contract with CITY OF LEBANON, for the construction of the above identified contract; in the full contract amount of \_\_\_\_\_ (\$\_\_\_\_\_).

The obligations of the Principal and Surety(ies) under these payment and performance bonds shall continue in full force and effect until all materials, equipment and labor have been provided AND all requirements contained in the contract, plans and specifications have been completed in a timely, thorough and workmanlike manner. The parties agree that these bonds are statutory in nature and are governed by the provisions contained in Title 12, chapter 4 and Title 54, chapter 5 of the Tennessee Code Annotated relating to bonds required of contractors and that those provisions constitute a part of this bond.

By this instrument, the Principal and Surety(ies) specifically bind themselves, their heirs, successors, and assigns, *in solido*, under the following bonds:

**Payment Bond.** To the CITY OF LEBANON and all "Claimants," as contemplated by T.C.A. Title 54, chapter 5, in the full contract amount of

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (\$\_\_\_\_\_),  
in order to secure the payment in full of all timely claims under the project.

**Performance Bond.** To the CITY OF LEBANON in the full contract amount of

\_\_\_\_\_  
\_\_\_\_\_ (\$\_\_\_\_\_),  
in order to secure the full and faithful performance and timely completion of the project according to its plans and specifications, inclusive of overpayments to the contractor and liquidated damages as assessed.

Upon receipt of notice that the Principal is in default under the contract, the Surety(ies) shall undertake to complete performance, without regard to cost. If the Surety(ies) fail or refuse to complete performance of the contract, the CITY OF LEBANON may then proceed with the work in any lawful manner that it may elect until it is finally completed. When the work is thus finally completed, the total cost of the same will be computed. All costs and charges incurred by the CITY OF LEBANON in completing the Work will be deducted from any monies due or which may become due to the Principal. If the total costs of completion exceeds the sum which would have been payable under the Contract, then the Principal and the Surety(ies), *in solido*, shall be liable for and shall pay to the CITY OF LEBANON the amount of such excess.

*In witness whereof we have signed this instrument as dated.*

**Principal/Contractor 1:**

By: \_\_\_\_\_ Date: \_\_\_\_\_

\_\_\_\_\_  
Printed Name and Title

**(For Joint Venture)**

**Principal/Contractor 2:**

By: \_\_\_\_\_ Date: \_\_\_\_\_

\_\_\_\_\_  
Printed Name and Title

**Surety 1:**

**Surety 2:**

By: \_\_\_\_\_ Attorney-in-Fact By: \_\_\_\_\_ Attorney-in-Fact

\_\_\_\_\_  
Printed Name Printed Name

\_\_\_\_\_  
Agency Name Agency Name

\_\_\_\_\_  
Street Address Street Address

\_\_\_\_\_  
City/State/Zip City/State/Zip

\_\_\_\_\_

(Seal)

(Seal)

Subsequent correspondence/communication from CITY OF LEBANON with respect to monthly progress reports and/or the contract bonds should be directed to:

**For Surety 1:**

**For Surety 2:**

_____	_____
Name	Name
_____	_____
Address	Address
_____	_____
City	City
_____	_____
State/Zip	State/Zip
_____	_____
Phone Number	Phone Number
_____	_____
Fax Number	Fax Number