



Iowa Department of Transportation

# GS-12006

(Replaces GS-12005, SS-12011)

## General Supplemental Specifications for Highway and Bridge Construction

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THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS, ADDITIONS, AND DELETIONS. THESE ARE GENERAL SUPPLEMENTAL SPECIFICATIONS AND SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

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## Division 11. General Requirements and Covenants.

### Section 1101

#### 1101.02, Definition of Abbreviations.

**Add** the definition:

AMG - Automated Machine Guidance

#### 1101.03, Definition of Terms.

**Add** the definition:

##### **Electronic Support File.**

A file provided to the Contractor for their convenience that is not part of the contract documents. Electronic support files may include, but are not limited to:

- Machine control data files.
- Tabulations of plan quantities.
- Earthwork files.
- Alignment files.
- Soil testing data files.
- CADD files.

### Section 1102

#### 1102.01, A.

**Replace** the fifth sentence:

The statement shall be filed with the ~~Contracting Authority~~ Department at least 5 calendar days before the date on which proposals are to be received.

#### 1102.01, C.

**Replace** the first sentence:

The ~~Contracting Authority~~ Department will compute the Contractor's maximum prequalification amount based on the following prequalification formula:

#### 1102.01, D.

**Replace** the first sentence:

The ~~Contracting Authority~~ Department will qualify Contractors into three categories:

#### 1102.01, G.

**Replace** the Article:

The necessary forms and instructions for furnishing the "Contractor's Financial - Experience - Equipment Statement" will be supplied by the ~~Contracting Authority~~ Department upon application.

#### 1102.01, H.

**Replace** the Article:

For proposals involving only the furnishing of materials, granular surfacing, lighting, buildings, asbestos removal, salvage and removal, debris removal, wells, traffic signals, pavement marking, or mowing, the following shall apply in lieu of the above requirements of this article:

Bidders submitting proposals must be recognized contractors engaged in the class of work provided for in the contract documents, and must possess all necessary licenses, certificates and resources to complete the work. Before the contract is awarded to a bidder, the bidder may be required to furnish evidence to the satisfaction of the ~~Contracting Authority~~ Department of the bidder's ability to perform and complete the contract.

**1102.02, Reduction in Bidder Qualification Restrictions.****Replace the Article:**

- A. The requirements and conditions for bidder qualification as contained in Article 1102.01 may be reduced by the ~~Contracting Authority~~ Department either for contractors who have well established performance records in other fields or for contractors having adequate financial responsibility and experienced supervisory personnel available for the work that is under consideration or for both the above reasons.
- B. Likewise, the requirements may be modified by the ~~Contracting Authority~~ Department for newly formed or reorganized firms or corporations whose basic organization is composed of individuals who are veterans of the construction industry, with proven records of satisfactory performance in the field in which they have elected to bid, provided, however, that they have adequate financial responsibility, equipment, and available experienced supervisory personnel.

**1102.05, Issuance of Proposals.****Replace the Article:**

Requests for proposal forms to bid construction and maintenance contracts must be filed by noon of the working day prior to the letting. These requests ~~should~~ shall be ~~on the request form provided by the Department~~ submitted via the Bid Express website (www.bidx.com). Unless otherwise specified, proposal forms will be furnished provided to qualified bidders who have filed properly completed "Certification of Uncompleted Work Under Contract" forms (Form 650022) documented uncompleted work under contract information with their request. Any contractor knowingly submitting ~~any~~ false information ~~required by Form 650022~~ related to their request may be suspended from bidding as provided in Article 1102.03.

**1102.09, A.****Replace the Article:**

Only contractors who have been authorized to bid a proposal may submit a bid for a contract. ~~For bids submitted to the Department that exceed \$1 million, the bidder shall use subparagraph 2 or subparagraph 3 below. The Department may wave this requirement for unique or isolated situations.~~

- ~~1. Submit the signed, original Bidding Document furnished by the Contracting Authority with a Schedule of Prices from the Estimating Proposal.~~
- ~~2. Submit the signed, original Bidding Document furnished by the Contracting Authority with the computer printout and diskette of the Schedule of Prices from the bidding software furnished by the Department.~~
- ~~3. Submit an electronic bid with digital signature using the bidding software furnished by the Department and the electronic bid submittal procedures of the Department.~~

Unless otherwise specified, bidder shall submit an electronic bid proposal with digital signature using bidding software furnished by the Department and electronic bid submittal procedures of the Department. ~~When prequalification is waived per Article 1102.01, H, or elsewhere in the contract documents, bidder may submit the signed proposal schedule of prices from the estimating proposal and the signed original bidding document on the original forms furnished by the Contracting Authority Department, in lieu of submitting an electronic bid.~~

Proposals received after the bid deadline will not be read.

**1102.09, N.****Replace the Article:**

If a prospective ~~bidder~~ contractor or supplier, for a proposal for which the Department is accepting bids, is in doubt as to the true meaning of any part of the contract documents, the ~~bidder~~ contractor or supplier may submit to the Contracts Engineer a request for additional information, explanations, or interpretations. The request shall be submitted to the Q&A forum at the letting website used by the Department. Interpretations may be in the form of an addendum to the contract documents. The Contracting Authority will not be responsible for any information, explanation, or interpretation from any other source.

**1102.10, Irregular Proposals.**

**Add the Article:**

- G.** If a bidder fails to acknowledge receipt of an addendum. For electronic bidding, loading of the addendum into the Department's bid preparation software is acknowledgment of receipt by bidder.

**1102.11, Proposal Guaranty.**

**Replace the Article:**

- A.** Each proposal shall be supported by a proposal guaranty in the form and amount prescribed in the proposal. Bids not so supported will not be read. The proposal guaranty shall be filed ~~at the place designated in the notice to bidders,~~ prior to the time advertised for opening of bids.
- B.** The proposal guaranty ~~shall~~ **may** be in the form of a certified check or credit union certified share draft, cashier's check, money order, or bank draft drawn on a solvent bank or credit union. Certified checks or credit union certified share drafts shall bear an endorsement signed by a responsible official of such bank or credit union as to the amount certified. Cashier's checks, money orders, or bank drafts shall be made payable either to the Contracting Authority or to the bidder and, where made payable to the bidder, shall contain an unqualified endorsement to the Contracting Authority signed by the bidder or the bidder's authorized agent. Certified checks and credit union share drafts shall be certified, or the cashier's check shall be drawn and endorsed, in an amount not less than prescribed in the proposal.
- C.** A Proposal Guaranty/Bid Bond (Form 131084) may be used for the proposal guaranty in lieu of that specified above, **using the electronic bid bond verification feature authorized by the Department.** Bid bonds will be declared invalid and bid proposals will not be considered if any of the following items are omitted or incorrect:
- Date of Letting.
  - Bid Order Number.
  - Name of Contractor.
  - **Original Digital** Signature of Contractor: In case of joint venture bid, all contractors must sign.
  - Name of the Surety Company.
  - **Original Digital** Signature of Surety (if Surety's limitation is less than the amount of the bid bond, a certificate of reinsurance must be attached).

**1102.12, Filing of Proposal.**

**Replace the title and Article:**

**~~Filing of~~ Optionally Combined Proposal.**

- ~~**A.** The proposal, proposal guaranty, and other supporting documents for each proposal shall be filed in an envelope, which is marked to indicate its contents. All proposals shall be filed with the Contracting Authority at the place designated in the notice to bidders, prior to the time advertised for opening of bids. Proposals received after the time of opening bids will be returned to the bidder.~~
- ~~**B.** The Contracting Authority may take bids on the same project as an individual proposal or part of an Optionally Combined Proposal. When an Optionally Combined Proposal is designated, the consideration for award of contracts will be based on which of the following gives the lowest total cost:~~
- ~~1 **A.** The sum of the lowest ~~responsible~~ responsive bid on each of the individual proposals.~~
  - ~~2 **B.** The lowest ~~responsible~~ responsive bid on the Optionally Combined Proposal.~~

**1102.17, E, 2, d.**

**Replace the Article:**

The completed form shall be ~~filled out in ink or~~ be computer generated and submitted with the bidding documents. Failure to attach this completed form or submitting incomplete forms will cause the bid to be rejected as irregular, in accordance with Article 1102.10. Only DBE firms listed in the ~~Directory~~ electronic DBE.BIN file supplied by the Department for the current letting may be used.

**1102.17, E, 3, b.****Replace the Article:**

The Department's process used to judge the Good Faith Effort of a bidder who has not met the established DBE goal is as follows:

**~~1) 80% of the Goal.~~**

~~A bidder who has achieved 80% of the established goal will be assumed to have made Good Faith Effort to achieve the goal.~~

**~~2) 80% of the Average Commitment.~~**

~~The Department has established the following objective measurement of Good Faith Effort. Good Faith Effort will be determined by calculating 80% of the average of the percentages of the goal and the DBE commitments submitted by all bidders satisfying Article 1103.01, and comparing the percent of DBE commitment of each bidder to that percentage average. The following example shows how the Department will compute the average DBE participation:~~

- ~~a) Only that amount of a bidder's DBE commitment that does not exceed the established goal will be used.~~
- ~~b) The amount of the goal will be used as the DBE commitment amount from DBE bidders who are bidding the project as the prime contractor.~~
- ~~c) The commitments to DBE firms who are affiliates of the bidder will not be included in the calculation.~~
- ~~d) The project DBE Goal will be included in the computation.~~

~~Example:~~

~~80% of the Average Good Faith Effort calculation~~

~~Project Proposal has a 10% Goal for DBE participation = 10.0%~~

~~Contractor "A" submits a commitment of 11.8% = 10.0%~~

~~Contractor "B" submits a commitment of 7.0% = 7.0%~~

~~Contractor "C" submits a commitment of 11.4%  
(of which 4.0% was committed to a DBE affiliate) = 7.4%~~

~~Contractor "D" submits a commitment of 3.6% = 3.6%~~

~~Contractor "E" is a DBE = 10.0%~~

~~Sum of Commitments = 48.0%~~

~~Average DBE Commitment = 48.0 / 6  
= 8.0%~~

~~80% of the Average Commitment = 80% of 8.0 = 6.4%~~

~~Contractors "A", "C", and "E" would all be responsive for meeting the DBE goal. Contractor "B" would be responsive for meeting 80% of the Average DBE Commitment. Contractor "D" would not be responsive for meeting 80% of the Average DBE Commitment. Should the low bidder's DBE commitment be lower than 80% of the average, with the contract goal included in the calculation, that bidder will be considered non-responsive for Good Faith Effort to meet the project DBE goal. If the lowest bid is non-responsive due to lack of Good Faith Effort, the next bidder is compared to this 80% of the average commitment until a bidder is identified as having made a Good Faith Effort to achieve the DBE goal.~~

**~~3) Contractors with History of Utilizing DBEs.~~**

- ~~a) A bidder who has demonstrated their ability to utilize DBE firms on both Federal aid and non-Federal aid projects let by the Department in the 24 months prior to the letting will be assumed to have made a Good Faith Effort to achieve the project goal.~~
- ~~b) The Department's objective evaluation of prior usage of DBE firms will include all contracts let by the Department that were awarded to the Contractor during the 24 months prior to the letting. The calculation will include one point for each percentage of average DBE subcontracted dollars for the 24 months prior to the letting (e.g. an average 7.5% dollars subcontracted to DBE equals 7.5 points)~~

~~A contractor under consideration for having a history of utilizing DBE firms must have been awarded at least two contracts during the period being reviewed.~~

~~A contractor under consideration for having a history of utilizing DBE firms must have been awarded a dollar amount of contracts that exceed at least twice the dollar amount of the contract under consideration. For example, to be awarded a \$1,000,000 contract, the contractor under review would have to have been awarded \$2,000,000 in the Annual Good Faith Effort calculation.~~

~~The Annual Good Faith Effort points used for a letting would be based on the signed contractors and Request for Subcontract forms submitted by 5 calendar days before the letting. The number of points a contractor will need to be considered to demonstrate a history of utilizing DBE firms must exceed 67% of the Department's Annual DBE Goal (e.g. if the Department's annual DBE Goal is 7.8%, the contractor must have over 5.2 points). It is assumed that 67% of the DBE usage will be subcontract work and 33% of the dollars paid to DBE firms will be to DBE firms who have been awarded prime contracts.~~

**~~4) Administrative Reconsideration of Project Specific Good Faith Effort.~~**

- ~~a) Contractors who have not met the specified DBE goal or have not been determined to have demonstrated Good Faith Effort by the above methods can request administrative reconsideration of their Good Faith Effort.~~
- ~~b) Within 2 business days after the deadline for bid submittal, the Department will use the three two Good Faith Effort methods to determine which bidders have made a Good Faith Effort to meet the DBE goal on each proposal for which bids were received. The Department will contact all otherwise lowest responsive bidders who have not met any of the Good Faith Effort criteria and offer that bidder an opportunity for an Administrative Reconsideration meeting with the Department's Administrative Reconsideration Committee. This committee consists of representatives from the Department's Offices of Contracts, Construction, and Employee Services. The bidder shall request the Administrative Reconsideration meeting within 1 business day of the Department's offer of an Administrative Reconsideration meeting.~~

**1) Good Faith Effort Evaluation Committee.**

- a) When the apparent low bidder does not meet the DBE goal with the commitment listed in their DBE Commitment Form (Form 102115), their good faith effort to meet the goal will initially be determined by the Good Faith Effort Evaluation Committee.
- b) This committee will be comprised of three members of the Department appointed by the Director. They will meet within one business day following the letting and will only consider information provided on the bidder's DBE Commitment Form (Form 102115).
- c) In the event the committee determines the bidder performed a good faith effort, their bid will be determined responsive for meeting the DBE goal and will be further considered for award. In the event the committee determines the bidder did not perform a good faith effort, the bidder will be denied award. A written decision will be issued.
- d) A bidder denied award by the Good Faith Effort Evaluation Committee may appeal the decision to the Good Faith Effort Evaluation Administrative Review Committee by request to the Contracts Engineer. The bidder will be allowed one business day following the committee's written decision to request an appeal. If an appeal is not requested, the Good Faith Effort evaluation process starts over with the next lowest bidder.

**2) Good Faith Effort Administrative Review Committee.**

- a) The Department's Good Faith Effort Administrative Review Committee will consist of three members of the Department appointed by the Director. The members will not have been involved in the original evaluation of Good Faith Effort.
- b) The bidder must request appeal from the Contracts Engineer within one business day of being notified of the decision by the Good Faith Effort Evaluation Committee. The bidder will have the opportunity for a face to face meeting with the committee and to provide written documentation of their efforts. The Good Faith Effort Administrative Review Committee will meet within one business day of the request and will issue a written decision to the bidder.
- c) Any bidder who has requested Administrative ~~Reconsideration~~ Review shall not adjust their DBE Commitment or provide any additional documentation of DBE firms contacted that were not listed on Form 102115. However, the bidder will be allowed to provide documentation on other Good Faith Efforts they did to utilize DBE firms that are listed on Form 102115. Only those efforts prior to the bid deadline will be considered. These efforts may include:
  - (1) Efforts to provide interested DBEs with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.
  - (2) Written documentation of negotiation with certified DBE firms including the names, addresses, and telephone numbers of DBEs that were considered; a description of the

information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBEs to perform the work.

- (3) Written documentation of follow-ups made after the initial solicitations to encourage DBE firms to quote.
- (4) Written documentation that the DBE firm's quote was not reasonable or that the DBE firm was not capable of performing the work for which they quoted. The fact that there may be some additional costs involved in finding and using DBE firms is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also, the ability or desire of a bidder to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make Good Faith Efforts.
- (5) Written documentation of efforts to assist interested DBE firms in obtaining bonding, lines of credit, or insurance as required by the specifications.
- (6) Written documentation of efforts to assist interested DBE firms in obtaining necessary equipment, supplies, materials, or related assistance or services needed for the project.
- (7) Other activities of the bidder that by their quality, quantity, and intensity demonstrate that the bidder took all necessary and reasonable steps to achieve the contract goal, and could reasonably have expected to do so but were unsuccessful.
- d) The determination made by the Good Faith Effort Administrative ~~Reconsideration~~ Review Committee shall be considered final.
- e) In the event the bidder's appeal is denied by the Good Faith Effort Administrative Review Committee, the Good Faith Effort Evaluation process starts over with the next lowest bidder.
- 3) The Department may perform validation of any Good Faith Effort information submitted by any bidder.

#### 1102.17, G, 2.

##### **Replace** the Article:

If the contract contained a DBE commitment, the Engineer will verify that the Contractor has attained the DBE commitment specified to each DBE firm listed on Form 102115. ~~If the commitment is not met and was less than the goal, the price adjustment is the difference between the actual dollars paid and the commitment. If the commitment is not met and was greater than the goal the price adjustment is the difference between the actual dollars paid and the goal.~~ A price adjustment will be assessed for the amount of commitment not paid to each DBE firm used unless the DBE commitment to that DBE firm was reduced as allowed by Article 1102.17, G, 3.

#### 1102.19, E, 5, a.

##### **Replace** Article 4:

- 4) ~~Form FHWA-1495, regarding wage rate information for a Federal aid highway project, required only if Davis/Bacon predetermined wage rates apply to the project.~~ Form WH-1321, Employee Rights Under the Davis-Bacon Act, required only if Davis/Bacon predetermined wage rates apply to the project.

##### **Replace** Article 5:

- 5) ~~Current Iowa Predetermined Wage Rate Decision, identifying Davis/Bacon predetermined wage rates for the State of Iowa.~~ All wage rate decisions required by the contract. The wage rate decision shall be arranged on a bulletin board so that all wage rate and classification information is visible.

##### **Replace** Article 9:

- 9) ~~Form FHWA-1495A (Spanish version of form FHWA-1495), stating "Informacion Sobre Escalas De Salarios Proyecto De Carretera Con Ayuda Federal", required only if Davis/Bacon predetermined wage rates apply to the project.\*~~ WH-1321 SPA (Spanish version of Form WH-1321) stating "DERECHOS DEL EMPLEADO BAJO LA LEY DAVIS-BACON" recommended only if Davis/Bacon predetermined wage rates apply to the project.\*

**1102.19, F, 5.****Replace the Article:**

~~An individual, group of individuals, or entity believing they have been subjected to discrimination prohibited by Title VI Nondiscrimination Provisions may file a written complaint with OES Civil Rights. A formal, signed complaint shall be filed within 180 calendar days of the alleged occurrence.~~

~~Upon receipt of the complaint, the OES Civil Rights Coordinator will determine its jurisdiction, acceptability, need for additional information, and investigative merit of the complaint. In cases where the complaint is against one of the Department's sub-recipients of federal highway funds or federal transition funds, the Department will assume the jurisdiction and will investigate and adjudicate the case.~~

~~Once the Coordinator decides to accept the complaint for investigation, the complainant and the respondent will be notified in writing of such determination within five calendar days. The complaint will receive a case number and be logged into the OES Civil Rights' records identifying its basis, race, color, national origin, and gender of the complainant.~~

~~In cases where the Department assumes the investigation of the complaint, the Coordinator will provide the respondent with the opportunity to respond to the allegations in writing. The respondent will have 10 calendar days to furnish OES Civil Rights their response to the allegations.~~

~~Within 40 calendar days of receipt of the complaint, the OES Civil Rights investigator\* will prepare an investigative report for the Director of the Department's Operations and Finance Division to review. The report will include a narrative description of the incident, identification of persons interviewed, findings and recommendations for disposition. \*This may be the District/Division Title VI Liaison, Coordinator, or Title VI Specialist.~~

~~The investigative report and its finding will be sent to the Attorney General's Office for review. The Attorney General's Office will review the report and associated documentation and provide input within 10 calendar days.~~

~~Comments or recommendations from the Attorney General's Office will be reviewed by the Department's Operations and Finance Division. The Department's Operations and Finance Division will discuss the report and recommendations with the Title VI Coordinator. The report will be modified as needed and made final for its release.~~

~~Once the Department's investigative report becomes final, the parties will be properly notified of the outcome and appeal rights.~~

~~The Department's investigative report and a copy of the complaint will be forwarded to FHWA, Washington Division Office, within 60 calendar days of the receipt of the complaint.~~

~~If the complainant is not satisfied with the results of the investigation, they shall be advised of their rights to appeal the Department's determination to the FHWA - Washington Division Office, U.S. DOT or U.S. Department of Justice. Appeals shall be filed within 180 calendar days after FHWA's final resolution. Unless new facts not previously considered come to light, reconsideration of the Department's determination will not be available.~~

~~The Department will serve as appealing forum to a complainant that is not satisfied with the outcome of an investigation conducted by a Department sub-recipient. The Department will analyze the facts of the case and issue its conclusion to the appellant within 60 calendar days of the receipt of the appeal.~~

~~The Contractor shall promptly, within 14 calendar days, investigate complaints of alleged discrimination made to the Contractor in connection with its obligation under this contract, attempt to resolve such complaints, and take appropriate corrective action within a reasonable time. If the investigation indicates the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the Contractor shall inform complainant of their avenues of appeal.~~

~~If the complaint cannot be resolved at the contractor level, or when a contractor has a complaint against another contractor, the complainant or the Contractor can contact the Department's Office of Employee Services-Civil Rights (OES-Civil Rights) Team.~~

~~The Department has a formal Civil Rights Complaint procedure. This procedure is available at [www.iowadot.gov/civilrights/documents/IowaDOTExternalComplaintProcedure.pdf](http://www.iowadot.gov/civilrights/documents/IowaDOTExternalComplaintProcedure.pdf). An individual, group of~~

individuals, or contractor believing they have been subjected to discrimination may file a written complaint with the Department's OES-Civil Rights Team. A formal signed complaint shall be filed within 180 calendar days of the alleged occurrence.

## **1102, Proposal Requirements and Conditions.**

**Add the Article:**

### **1102.20, Title VI Assurance:**

To comply with US DOT Order 1050.2 (dated August 24, 1971) the following Appendix A is a contract requirement of each contract and shall be included in each subcontract.

### **APPENDIX A**

During the performance of this contract, the contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

1. Compliance with Regulations: The contractor shall comply with the Regulations relative to nondiscrimination in Federally-assisted programs of the Department of Transportation (hereinafter, "DOT") Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time, (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.
2. Nondiscrimination: The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, national origin, sex, age, or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.
3. Solicitations for Subcontracts, Including Procurement of Materials and Equipment: In all solicitations either by competitive bidding or negotiation made by the contractor for work to be performed under a subcontract, including procurement of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, national origin, sex, age, or disability.
4. Information and Reports: The contractor shall provide all information and reports required by the Regulations or directives issued pursuant there to, and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Iowa Department of Transportation or Federal Highway Administration to be pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information the contractor shall so certify to the Iowa Department of Transportation or the Federal Highway Administration as appropriate, and shall set forth what efforts it has made to obtain the information.
5. Sanctions for Noncompliance: In the event of the contractor's noncompliance with the nondiscrimination provisions of this contract, the Iowa Department of Transportation shall impose such contract sanctions as it or the Federal Highway Administration may determine to be appropriate, including, but not limited to:
  - a. withholding of payments to the contractor under the contract until the contractor complies, and/or
  - b. cancellation, termination or suspension of the contract, in whole or in part.
6. Incorporation of Provisions: The contractor shall include the provisions of paragraphs (1) through (6) in every subcontract, including procurement of materials and leases of equipment, unless exempt by the Regulations, or directives issued pursuant thereto. The contractor shall take such action with respect to any subcontract or procurement as the Iowa Department of Transportation or the Federal Highway Administration may direct as a means of enforcing such provisions including sanctions for non-compliance: Provided, however, that, in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the contractor may request the Iowa Department of Transportation to enter into such litigation to Protect the interests of the Iowa Department of Transportation and, in addition, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

**Section 1105****1105.03, Working Drawings.****Replace Articles B through E:**

- B.** For projects on the Secondary Road System (non-Primary projects), working drawings shall be submitted to the Engineer unless noted otherwise in the contract documents.
- C.** Unless specified otherwise in the contract documents, Contractor submittal time will be subject to the specified review time and the Contractor's need based on their schedule for the work.
- D.** Submittals shall not be subdivided or made in a piecemeal fashion unless approved by the Engineer. If subdivided submittals are approved by the Engineer, they shall be made in packages with logical break points (e.g. structural steel units) so the Engineer may make a complete review of subdivided submittal.
- E.** Submittals that are required to be revised and resubmitted shall have the revisions clouded or annotated to designate revisions. Resubmittals made in accordance with this provision will have a review time in calendar days of half of the review time shown in Table 1105.03-1. Resubmittals that are not in accordance with this provision will be allowed the review time shown in Table 1105.03-1.

**F. Electronic Submittals.**

1. For Primary and Interstate projects, electronic submittals may be made via email and sent to the following email addresses corresponding to the review office identified in Table 1105.03-1, or to the consultant email address indicated on the contract documents:

**REVIEW OFFICE**  
 Bridges and Structures  
 Design (Soils Design Section)  
 Traffic and Safety

**EMAIL ADDRESS**  
 Bridges.Structures@dot.iowa.gov  
 Soils.Design@dot.iowa.gov  
 Traffic.Safety@dot.iowa.gov

2. Provide a courtesy copy of the submittal to the Engineer ~~and District Materials Engineer.~~
3. When the contract documents specify submittals to be sent to the design consultant's email address, the review office shall be courtesy copied, in addition to the Engineer ~~and District Materials Engineer.~~
4. Electronic submittals shall be sent from the Contractor's email address that is applicable to the project. Emails sent from subcontractor's, fabricator's, and supplier's email address will not be accepted. Emails from personal email addresses are discouraged and may require authentication by the Engineer prior to acceptance for review.
5. Submittals shall be limited to 15 MB attachment file size. Split larger files and send in multiple emails.
6. The submittal file shall be Portable Document Format (PDF) sized to print on 11 inch by 17 inch (279.4 mm by 431.8 mm) or 8.5 inch by 11 inch (215.9 mm by 279.4 mm) paper. Full size print documents cannot be accepted in electronic format. Minimum resolution of 300 dpi (118 dots/cm) is recommended. Ensure document submitted is legible. Submittal files in other formats (e.g. CAD files) will not be accepted.
7. Provide project number and submittal description in the email subject line. The email will serve as the transmittal and shall include the Contractor's name, address, and telephone number, and the fabricator's name, address, and telephone number (if applicable) in the body of the email, or on the electronic attachment.
8. Shop drawings submitted electronically via email will be returned to the Contractor via email. Paper copies will not be distributed.

**G. Paper Submittals.**

For Primary and Interstate projects, all paper submittals shall be processed by the Contractor and sent to the review office identified in Table 1105.03-1 below with a copy of the cover letter sent to the Engineer ~~and District Materials Engineer.~~ The cover letter shall include the following information:

- Date of submittal or resubmittal
- Project number
- Description of submittal
- Contractor's name, address, and telephone number
- Number of submittal copies
- Fabricator's name, address, and telephone number (if applicable).

When the contract documents specify submittals to be sent to the design consultant, copies of the cover letter shall be sent to the review office, as well as the Engineer ~~and District Materials Engineer.~~

**Table 1105.03-1: Review Offices for Working Drawings**

DESCRIPTION	REVIEW OFFICE	NUMBER OF COPIES <sup>(a)</sup>	REVIEW TIME (calendar days)
Falsework for slab bridges	Bridges and Structures	2 (6)	30
Cofferdam design (when required)	Bridges and Structures	2 (6)	30
Reconstruction of substructure (detailed plans for supporting the superstructure)	Bridges and Structures	2 (6)	30
Steel Structures	Bridges and Structures	7 2 (7)	30
Detail plans for falsework or centering support of steel structures (i.e. erection plans)	Bridges and Structures	2 (6)	30
Steel and aluminum pedestrian hand rails and aesthetic fences	Bridges and Structures	2 (7)	30
Highway sign support structures (i.e. bridge-type trusses, cantilevers trusses, & bridge mounts)	Bridges and Structures	2 (7)	30
Precast concrete (i.e. deck panels, RCB culverts, noise wall panels, arch sections, etc.)	Bridges and Structures	2 (8)	30
Tower lighting	Bridges and Structures	2 (7)	30
Highway lighting	Traffic & and Safety	2	30
Highway signing steel breakaway posts	Traffic and Safety	2	30
Traffic signalization <sup>± (b)</sup>	Traffic and Safety	2	30
Highway signing - Type A & and B signs	Traffic and Safety	2	30
Bridge components	Bridges and Structures	2 (7)	30
Pre-engineered steel truss recreational trail bridge	Bridges and Structures	2 (8)	30
MSE, segmental, & and modular block retaining walls	Design (Soils Design Section)	Preliminary submittal: 3 design calculations, 3 shop drawings, & and 3 field construction drawings	30
		Final submittal: 3 design calculations, 3 shop drawings, & and 3 field construction drawings	14
Soil nail & and tie-back retaining walls	Design (Soils Design Section)	6 final design plans	60
Intermediate foundation improvement (IFI) (i.e. stone columns, geopiers, etc.)	Design (Soils Design Section)	4 design calculations & and 8 field construction drawings	30
Removal of box girder bridges	Bridges and Structures	2 (5)	30
Structural erection manual	Bridges and Structures	2 (6)	30
Temporary shoring	Bridges and Structures	2 (6)	30
Temporary sheet pile retaining wall	Bridges and Structures	2 (6)	30
Safety grates for RCB culverts	Bridges and	2 (7)	30

	Structures		
Architectural mock-ups	Bridges and Structures	1	30
Architectural paving	Bridges and Structures	1	30
Architectural paint color samples and manufacturer data	Bridges and Structures	3	30
Architectural concrete texture form liner samples and drawings	Bridges and Structures	3	30
Architectural concrete sealer samples and manufacturer data	Bridges and Structures	3	30
Architectural ornamental brick	Bridges and Structures	3	30
(a) Number of copies only applies to paper submittals. Number of copies in parenthesis is the number required for full size prints. Full size prints are any print exceeding 11 inches by 17 inches (279.4 mm by 431.8 mm).			
* (b) Submittal time shall be within 45 calendar days from the date of award of contract.			

~~D. Unless specified otherwise in the contract documents, Contractor submittal time shall be subject to the specified review time and the Contractor's need based on their schedule for the work.~~

~~E. When the contract documents specify submittals to be sent to the Design Consultant, copies of the cover letter shall be sent to the specified Review Office, Resident Construction Engineer, and District Materials Engineer.~~

#### 1105.04, A

Add the Article:

#### 11. Notice to Bidders

#### 1105.04, Conformity with and Coordination of the Contract Documents.

Renumber Articles B, C, D, E, and F and Add the Article:

B. Electronic support files, if available, will be provided prior to letting and are for information only. Should there be a discrepancy between an electronic support file and a contract document, the contract document shall govern.

~~B C.~~

~~C D.~~

~~D E.~~

~~E F.~~

~~F G.~~

#### 1105.06, Construction Stakes.

Renumber Article to 1105.16.

#### 1105.12, B.

Add as the second sentence of the sixth paragraph:

The Contractor will not be billed for crossings located within areas designed for removal of pavement after cross hauling is completed as long as the pavement is not damaged by the cross hauling.

#### 1105.13, B, 3.

Replace the first sentence of the Article:

When temporary Primary Road haul roads are required, the Contractor shall submit the suggested haul route or routes to the Department within 24 14 calendar days after the approval for award.

#### 1105.14, C, 12, Indiana Bats.

Replace the title and Article:

Indiana Threatened/Endangered Bats.

~~Suitable habitat for the Indiana bat (*Myotis sodalis*) threatened/endangered bats, as identified by the Contracting Authority, shall be removed between September 15<sup>th</sup> and April 15<sup>th</sup> when Indiana bats are not expected to be using potentially suitable trees. To protect threatened/endangered bats, trees shall be removed in accordance with Article 2101.01, unless otherwise directed in the contract documents. The Contractor shall limit removal of forest cover to those areas which are absolutely necessary for the construction of the work. Questions regarding this condition shall be directed to the Engineer.~~

#### **1105.17, Automated Machine Guidance.**

Add the Article:

##### **1105.17 AUTOMATED MACHINE GUIDANCE.**

- A.** Contractor may use equipment with AMG that results in meeting the same accuracy requirements as conventional construction as detailed in the Standard Specifications.
- B.** Use this section in conjunction with Section 2526 unless construction survey is being provided by the Engineer.
- C. Electronic files.**
  1. Available electronic files will be provided by the Contracting Authority with the Proposal Form. This information is available at the Office of Contracts' website.
  2. Convert electronic data provided by the Contracting Authority into the format required by AMG system. Files made available will be in a generic format. For naming conventions and file formats refer to Office of Design's online design manual. Note that additional files, such as storm sewer design files, may be included in the original design software format. Files provided may include:
    - a.** CAD Files: Primary CADD (Computer Aided Design and Drafting) design file that may include:
      - CADD cross section files.
      - CADD Right of Way file.
      - CADD Topography files.
      - 3D Design break line files in an industry standard format.
    - b.** Machine Control Surface Model Files (including topsoil placement where required on the plans): Documentation file describing all of surface models, typically in LandXML format. Areas where a surface model is not provided, Contractor may, at no additional cost to Contracting Authority, develop required surface models to facilitate AMG.
    - c.** Alignment Data Files: Documentation file describing alignment information both horizontal and vertical, typically in LandXML format.
  3. For PCC overlays, compute an estimated quantity of overlay concrete based on existing pavement profile and the electronic model. This quantity will serve as the estimated concrete quantity for the project and must be approved by the Engineer prior to start of construction.
  4. For full-depth paving projects, provide a digital terrain model (DTM) of subgrade surface.
  5. For paving projects, provide an electronic file such as a D45 file, or equivalent, identifying x, y, and z coordinates for shoulder and pavement edges as well as the pavement centerline based on project alignments and elevations.
  6. No guarantee is made that the data systems used by the Engineer will be directly compatible with the systems the Contractor uses.
  7. Electronic information shall not be considered a representation of actual conditions to be encountered during construction. Providing the Contractor this information does not relieve the Contractor from the responsibility of making an investigation of conditions to be encountered, including but not limited to site visits, and basing the bid on information obtained from these investigations and professional interpretations and judgment. Contractor assumes the risk of error if the information is used for any purposes for which the information was not intended.

Assumptions the Contractor makes from this electronic information or manipulation of the electronic information is at their risk.

8. Engineer may perform spot checks of the machine control results, surveying calculations, records, field procedures, and actual staking. If the Engineer determines the work is not being performed in a manner assures accurate results, the Engineer may order such work to be redone, to the requirements of the contract documents, at no additional cost to the Contracting Authority.

**D. Additional Contracting Authority Responsibilities.**

1. For new construction, Engineer will set initial horizontal and vertical control points in the field for the project as indicated in the contract documents. For reconstruction or PCC overlays, Engineer will furnish information on existing horizontal and vertical control points.
2. Engineer will provide project specific localized coordinate system if required. The control information utilized in establishing the localized coordinate system, specifically rotation, scaling, and translation may be requested from the Engineer.
3. For paving, Engineer will review and approve proposed surface model within two weeks following receipt of the model.

**E. Additional Contractor Responsibilities.**

1. Provide a rover, readily available for Engineer to use, during duration of contract.
2. Provide Engineer up to 8 hours of formal training on Contractor's AMG systems.
3. Contractor bears all costs, including but not limited to cost of actual reconstruction of work that may be incurred due to errors in application of AMG techniques. Grade elevation errors, rework resulting from errors or failures of AMG system, and associated quantity adjustments resulting from Contractor's activities are at no cost to Contracting Authority. Delays due to late submittals or satellite reception of signals to operate AMG system will not result in adjustment to contract unit prices or justification for granting contract extensions.
4. Check and recalibrate, if necessary, AMG system at beginning of each work day.
5. At least one week prior to preconstruction conference, submit to Engineer for review a written AMG work plan which includes the following:
  - Equipment type,
  - Control software manufacturer and version,
  - Proposed location of local GPS base station for broadcasting differential correction data to rover units, and
  - Proposed locations where AMG will be used. Provide minimum of 30 calendar days notice when there are changes to proposed AMG locations that will require additional construction staking by Contracting Authority. Contractor may perform this additional staking at no additional cost to Contracting Authority.

**Section 1106**

**1106.07, Waste.**

**Rename and Replace the Article:**

**1106.07 CONTRACTOR FURNISHED BORROW AND WASTE AREAS.**

- A. The Contractor shall obtain necessary environmental clearances and permits.
- B. ~~The Contractor shall provide waste areas or disposal sites for excess material (excavated material or broken concrete) not desirable to be incorporated into the work. The Contractor shall ensure areas (including haul roads and staging areas) selected for waste or disposal do not impact~~ of excess

material (excavated material or broken concrete), or furnishing borrow have been reviewed for impacts to, but not limited to the following:

- Culturally sensitive sites or graves.
- Wetlands or "Waters of the U.S.", including streams or stream banks below the "ordinary high water mark", without an approved U.S. Army Corps of Engineers Section 404 Permit.
- Threatened or endangered species.
- Floodplains.
- Sovereign lands.
- Storm water discharge.

- C. No payment for overhaul will be allowed for material hauled to or from these sites. Excess material shall not be placed within the right-of-way unless specifically stated on the plans.

### **Section 1107**

#### **1107.02, B, 7, Payment.**

**Replace** the Article.

Payment to the Contractor for insurance required ~~in the contract documents~~ by Article 1107.02, B, shall be ~~considered as incidental to other items in the contract~~ per the contract documents.

#### **1107.06, Federal Participation.**

**Retitle** the Article:

**Federal Participation Requirement.**

**Replace** Article B and **Add** the title:

##### **B. Buy America.**

~~On all contracts involving Federal aid, all products of iron, steel, or a coating of steel which are incorporated into the work must have been~~ shall be of domestic origin and shall be melted and manufactured in the United States. The Engineer may allow minimal amounts of these materials from foreign sources, provided the cost does not exceed 0.1% of the contract sum or \$2,500, whichever is greater. ~~The Contractor shall certify that these materials are of domestic origin.~~ This amount shall include transportation, assembly, and testing as delivered cost of foreign products to the project. Per Materials I.M. 107, miscellaneous steel or iron components, subcomponents, and hardware, as defined by FHWA, will not be subject to Buy America requirements.

#### **1107.07, E.**

**Replace** the second sentence.

On Primary Roads and Primary Road extensions, on temporary Primary Road haul roads, and when designated in the contract documents construction areas adjacent to Primary Roads on which traffic is maintained, the Contractor will be paid for watering ordered by the Engineer at the rate of \$45 60 per thousand gallons (\$4 16 per kL).

#### **1107.08, Public Convenience and Safety.**

**Renumber Article M to Article N.**

**Add the Article:**

**M.** Paved shoulder construction adjacent to existing travel lanes shall meet the following:

##### **1. HMA Shoulder.**

Drop-offs greater than 2 inches (50 mm) will not be allowed when the adjacent lane is open to traffic, Place the final lift of HMA shoulder material within 48 hours of the previous lift.

##### **2. PCC Shoulder.**

Do not open adjacent lane until PCC shoulder is cured enough to support traffic control devices.

## Section 1108

### 1108.01, Subletting of Contract.

**Replace** Articles B, C, and D, and the first paragraph of Article E:

- B. Except for the furnishing and transportation of materials, no portion of ~~the~~ a contract let through the Department shall be sublet, assigned, or otherwise disposed of except with written ~~consent~~ authorization of the ~~Contracting Authority~~ Department. Where a subcontract has been ~~approved~~ authorized, the ~~approved~~-subcontractor shall be responsible to complete that portion of the contract with its own organization. On contracts involving federal aid, the agreement between the Contractor and subcontractor shall be in writing, and Form FHWA-1273 shall be physically attached to each such agreement.
- C. ~~Where a subcontract does not exist, but a DBE firm is manufacturing, supplying, or trucking materials to the job site; terms of the agreement~~ Work performed by a DBE firm not otherwise required to be authorized as a subcontractor shall be described and documented on the Subcontract Request and Approval form (Form 830231). This will assure the Engineer that a Contractor is meeting commitments previously stated on the Statement of DBE Commitments form (Form 102115). This dollar value will not be used to determine the percent subcontracted as specified previously. Where Davis/Bacon wage requirements apply, the Contractor shall be responsible for collecting and submitting certified payrolls for all drivers. Owner/operators shall be listed on the certified payrolls as owner/operators.
- D. Request for permission to subcontract, assign, or otherwise dispose of any portion of any contract shall be ~~submitted in writing with the Contractor's signed contract to the Office of Contracts,~~ documented on a Subcontract Request and Approval form (Form 830231). ~~For contracts that exceed \$600,000, the Contractor shall submit the Subcontract Request and Approval form electronically~~ The form shall be prepared using the software furnished by the Department- and submitted electronically to the Office of Contracts at the time the signed contract is returned to the Contracting Authority. On contracts where the Department is not the Contracting Authority, also provide a copy to the Engineer. In certain situations, with approval of the Department, the Contractor may request an extension of up to 30 calendar days to submit the Subcontract Request and Approval forms.
- E. Either the Contractor or approved subcontractors (~~e.g. contractors~~) can use leased employees from a firm that does not perform highway construction with its own organization. Work performed by a DBE firm using leased employees will not count towards meeting the Department's annual DBE goal.

### 1108.02, E, 4.

**Replace** the Article:

Working days will not be charged for Saturdays, Sundays, and recognized legal holidays the Contractor does not work. Working days will be charged for Saturdays, Sundays, and recognized legal holidays the Contractor does work. Work not requiring inspection may be performed on Saturdays with no time charged.

### 1108.02, E, 5.

**Delete** the Article:

- ~~5. Working days will not be charged for Saturdays the Contractor does work, unless a 6 day work week is specified in the contract documents.~~

## Section 1109

### 1109.01, B, 1, a, Reinforced Concrete Box (RCB) Culvert.

**Delete** the Article:

#### ~~a. Reinforced Concrete Box (RCB) Culvert.~~

- ~~1) The Contractor, as an option, may construct a comparable size single or twin box culvert in metric units using the MRCB-G1-95 or MTWRCB-G1-95 culvert standards in lieu of the English culvert standards specified on the letting plans. Exceptions/substitutions on special designs that are not covered by the MRCB-G1-95 or MTWRCB-G1-95 standards will not be allowed.~~
- ~~2) After being awarded the contract, if the Contractor intends to exercise this option, the Contractor shall submit to the Engineer an amended copy of the letting plan showing the alternate units for all the~~

appropriate dimensions. These shall include the fill height, the culvert span and rise, all longitudinal (along the culvert) dimensions and a list of the MRCB-G1-95 or MTWRCB-G1-95 culvert standard sheets required to build the RCB, including headwall sheets and bell joint sheets if required.

- 3) A list of comparable metric culvert opening sizes that can be constructed in lieu of a specified English culvert opening is as follows:

**Table 1109.01-5: Comparable Metric Culvert Opening Sizes**

English (feet)	Comparable Metric (millimeters)	English (feet)	Comparable Metric (millimeters)
3 x 3	900 x 900	8 x 6	2400 x 1800
4 x 4	1200 x 1200	8 x 10	2400 x 3000
5 x 3	1500 x 900	10 x 4	3000 x 1200
5 x 4	1500 x 1200	10 x 5	3000 x 1500
5 x 5	1500 x 1500	10 x 6	3000 x 1800
5 x 6	1500 x 1800	10 x 8	3000 x 2400
6 x 3	1800 x 900	10 x 10	3000 x 3000
6 x 4	1800 x 1200	10 x 12	3000 x 3600
6 x 5	1800 x 1500	12 x 6	3600 x 1800
6 x 6	1800 x 1800	12 x 8	3600 x 2400
6 x 8	1800 x 2400	12 x 10	3600 x 3000
8 x 4	2400 x 1200	12 x 12	3600 x 3600
8 x 5	2400 x 1500		

### 1109.03, B, 2, g.

**Replace** the first sentence:

Rental rate for machinery, tools, or equipment (except small hand tools which may be used) and fuel and lubricants shall be based on the average monthly rate published in the RENTAL RATE BLUE BOOK by Primedia Information, Inc. Equipment Watch.

### 1109.05, B, 4, a.

**Replace** the Article:

The request for a joint check from the prime contractor is made by the materials supplier subcontractor.

### 1109.05, D, 4.

**Replace** the first sentence:

If the initial attempt to resolve the issue does not result in satisfactory payment for completed work, the Contractor or subcontractor shall submit a written complaint to OES-Civil Rights on Form 650197.

### 1109.05, E, Required Records.

**Replace** the last paragraph:

Failure to comply with Article 1109.05, B may result in price adjustment credits, loss of Annual Good Faith Effort points, or suspension of bidding qualification in accord with Article 1102.03, A, 2.

### 1109.12, Arbitration.

**Delete** the Article:

#### **1109.12 ARBITRATION.**

**A.** If a Contractor's claim as outlined in Article 1109.11 has been disallowed in whole or in part, then the Contractor may, within 30 calendar days from the date the ruling of the Engineer is mailed, make a written request to the Engineer that the claim or claims be submitted to a board of arbitration. The Engineer will decide whether the matter is one which is subject to arbitration and will, within 30 calendar days of the receipt of the request for arbitration, grant or deny the same. The Engineer's decisions will be final.

**B.** The board of arbitration will consist of three persons; one to be chosen by the Engineer, one by the Contractor, and the third by the two arbitrators thus chosen.

- ~~C. The arbitrators selected will be persons experienced and familiar with construction or engineering practices in the general type of work involved in the contract, but will not have been a regular employee or an individual retained by either party at the time involved in the controversy, or at the time of arbitration.~~
- ~~D. The board of arbitration will make its own rules of procedure and will have authority to examine records kept by the Engineer and the Contractor. If the desired records are not produced within 14 calendar days after they are requested, the board of arbitration will proceed without them as best it may. In determining the findings or award, or both, the majority vote of the board will govern. Copies of the findings or award, or both, signed by the arbitrators will be filed with the Engineer and the Contractor. A unanimous report or minority report may be filed. The board of arbitration will fix the cost of the proceedings, including a reasonable compensation to the arbitrators, and will determine how the total cost shall be borne.~~
- ~~E. The board of arbitration will have jurisdiction to pass upon questions involving compensation to the Contractor for work actually performed or materials furnished and upon claims for extra compensation which have not been allowed by the Engineer. Jurisdiction of the board will not extend to a determination of quality of work or materials furnished or to an interpretation of the intent of the plans and specifications except as to matters of compensation. Jurisdiction of the board will not extend to setting aside or modifying the terms or requirements of the contract.~~
- ~~F. The findings or award, or both, of the arbitration board, if acceptable to both parties to the contract, may become a basis for final payment.~~
- ~~G. If the findings of the arbitration board are unacceptable to either party to the contract, said findings may become the basis for further negotiations between the parties. If a solution agreeable to both parties has not been reached through the filing of a claim, through arbitration, or if arbitration has been denied, either party may resort to whatever other methods for resolving the claim are available.~~

## Division 20. Equipment Requirements.

### Section 2001

#### 2001.01, General.

##### Add the Article:

- E. Do not mix, transport, or place concrete using equipment or forms with aluminum that will come in contact with the concrete.

#### 2001.22, A, 3, a.

##### Replace the Article:

A dual system of weigh belts system is used to control delivery of virgin aggregates and recycled material to the dryer.

#### 2001.22, A, 3.

##### Add the Article:

- f. Calibrated bins are dedicated to deliver each recycled asphalt material to the drum unless materials are pre-blended under the direction of the Engineer.

#### 2001.22, D, Aggregate Bins.

##### Add the Article:

4. The plant has a dedicated bin for each virgin aggregate product used in the job mix formula.

## Division 21. Earthwork, Subgrades, and Subbases.

### Section 2101

#### 2101.01, A.

Replace the Article:

**Clearing:** Cut and remove trees 3 inches (75 mm) or more in diameter. Cutting shall be performed between October 1<sup>st</sup> and March 31<sup>st</sup>.

### Section 2102

#### 2102.02, D, Borrow.

Replace the Article:

**Borrow Material Suitability.**

##### 1. Select Treatment Material.

###### a. Cohesive Soils.

Meet all of the following requirements:

- 1) 45% or less silt size fraction. Silt size particles are 2.91 to 0.79 mils (0.074 to 0.002 mm).
- 2) 110 pcf (1750 kg/m<sup>3</sup>) or greater density (AASHTO T 99 Proctor Density or Materials I.M. 309).
- 3) Plasticity index greater than 10.
- 4) A-6 or A-7-6 soils of glacial origin.

###### b. Granular Soils.

Meet all of the following requirements:

- 1) 15% or less silt and clay.
- 2) 110 pcf (1750 kg/m<sup>3</sup>) or greater density (AASHTO T 99 Proctor Density or Materials I.M. 309).
- 3) Plasticity index, 3 or less.
- 4) A-1, A-2, or A-3 (0).

###### c. Special Backfill Material Material.

Meet the requirements of Section 4132.

###### d. Modified Subbase Material.

Meet the requirements of Section 4123.

##### 2. Suitable Soils.

a. Ensure all soils provided for the construction of embankments meet the requirements below. They are suitable when moisture control or moisture and density control is designated.

- 1) 95 pounds per cubic foot (1500 kg/m<sup>3</sup>) or greater density (AASHTO T 99 Proctor Density or Materials I.M. 309).
- 2) AASHTO M 145-94 index of less than 30.
- 3) Liquid Limit (LL) less than 50.

b. Soils not meeting these requirements are considered unsuitable soils, regardless of classification.

c. When placing soil below water, use clean granular material.

##### 3. Unsuitable Soils.

Unsuitable soils shall be placed in the work only as specified by Standard Road Plan RL-1B EW-102 or shall be removed as directed by the Engineer. Use in the work will be according to the definitions in Table 2102.02-1:

**Table 2102.02-1: Uses for Unsuitable Soils**

Definition	Use
<del>1. Peat or Muck.</del> <del>2. Soils with a plasticity index of 35 or greater.</del> <del>3. A-7-5 or A-5 having a density less than 85 pcf (1350 kg/m<sup>3</sup>) (AASHTO T 99 Proctor Density or Materials I.M. 309).</del>	<del>Slope Dressing Only.</del> <del>Topsoil Applications.</del>

<ol style="list-style-type: none"> <li>1. Soils with a plasticity index of 35 or greater.</li> <li>2. A-7-5 or A-5 having a density less than 85 pcf (1350 kg/m<sup>3</sup>) (AASHTO T 99 Proctor Density or Materials I.M. 309).</li> </ol>	To be wasted off-site, unless shown otherwise in the contract documents.
<ol style="list-style-type: none"> <li>1. All soils other than A-7-5 or A-5 having a density of 95 pcf (1500 kg/m<sup>3</sup>) or less (AASHTO T 99 Proctor Density or Materials I.M. 309).</li> <li>2. All soils other than A-7-5 or A-5 containing 3.0% or more carbon.</li> </ol>	Type C placement placed 3 feet (1 m) below top of subgrade in fills.
<ol style="list-style-type: none"> <li>1. A-7-6 (30 or greater).</li> <li>2. Residual clays (overlying bedrock), Paleosols, claypan, gumbo, and gumboils regardless of classification.</li> </ol>	Type B placement placed 5 feet (1.5 m) below top of subgrade in fills.
<ol style="list-style-type: none"> <li>1. Shale.</li> <li>2. A-7-5 or A-5 soils having a density greater than 86 pcf (1351 kg/m<sup>3</sup>) but less than 95 pcf (1500 kg/m<sup>3</sup>) (AASHTO T 99 Proctor Density or Office or Materials I.M. 309).</li> </ol>	Type A placement placed in layers 5 feet (1.5 m) below top of subgrade in fills (Alternate layers to consist of suitable soils or Type C placement soils).

### 2102.03, F, Borrow.

Replace the Article:

#### 1. General.

- a. Unless provided otherwise in the contract documents, when the quantity of material required for embankments is not available within the limits of the roadway cross sections or specific borrow areas as indicated, make up the deficiency from borrow areas the Contracting Authority provides and defines on the plans or furnish equivalent material from alternate borrow areas (in lieu of plan borrows) or Contractor furnished borrow.
- b. The following definitions apply to this specification:
  - 1) **Designated Borrow Areas.**  
A general term for borrow areas the Contracting Authority provides; including mandatory and optional borrow areas.
    - a) **Mandatory Borrow Areas.**  
An area provided by the Contracting Authority from which the Contractor is expected to obtain borrow material and to operate in the area according to the contract documents. Mandatory borrow areas will be designated in the contract documents.
    - b) **Optional Borrow Area.**  
An area provided by the Contracting Authority from which the Contractor may obtain borrow material. If so obtained, the Contractor is expected to operate in the area according to the contract documents. Borrow areas are optional borrow areas unless specifically designated as mandatory borrow areas.
  - 2) **Alternate Borrow Areas.**  
An area outside the highway right-of-way provided by the Contractor from which the Contractor may obtain borrow material in lieu of designated borrow areas and to be used according to the contract documents.
  - 3) **Contractor Furnished Borrow.**  
A general term for borrow material provided by the Contractor. ~~The type of material shall be as specified in the contract documents. If the type of material is not specified, provide Suitable Soils. Contractor may elect to provide Select Treatment Material in lieu of Suitable Soils.~~ Unsuitable Type A, B, and C materials, with the exception of shale and residual clays, will be allowed. Place unsuitable materials as specified in Standard Road Plan EW-102.
- c. Upon completion of designated borrows, excavate borrow areas that are sufficiently regular in cross section to permit accurate measurement. Carefully blend to natural land forms and avoid unnecessary damage to the land. Do not turn natural drainage of surface water on to adjoining owners. Use diligence in draining the surface water in its natural course or channel. Complete excavation consistent with the existing natural drainage conditions or as shown in the contract documents.

- d. Where a mandatory borrow area is designated in the contract documents, it is mandatory that borrow material be obtained from the borrow location designated and in accordance with the borrow design on the contract documents, unless permission is obtained from the Engineer to obtain borrow from another location.
- e. Unless the contract documents designate borrow areas as mandatory borrow areas, borrow areas will be considered optional borrow areas. The Contractor has the option of either using the optional borrow areas or proposing to furnish equivalent material from alternate borrow areas.
- f. Do not place the estimated edge of water for a pond borrow closer than 100 feet (30 meters) from any public right-of-way. A pond borrow is a borrow that has the intention of excavation below natural ground and leaving a body of water for a designated purpose.
- g. Refer to Federal Aviation Administration (FAA) Advisory Circular 150/5200-33B for separation criteria for hazardous wildlife attractants on or near airports.

**2. Contactor's Plan for Alternate Borrow or Revisions to Designated Borrow.**

- a. Submit a plan to the Engineer for use of proposed alternate or designated borrow intended to be used in a manner different from that shown in the contract documents. Also, sample the proposed alternate borrow areas by core drilling or test pits. When the Contracting Authority determines it is necessary, sample in the presence of the Engineer. Test samples and provide results and verification samples to the Contracting Authority
- b. The submission for use of alternate borrow areas shall include all such areas necessary or contemplated for completion of the planned work.
- c. Approval of materials and their use will be based on AASHTO M 145-94 and includes the following:
  - 1) **Select Treatment Materials.**
    - a) The Engineer's approval is required for all soils required for select subgrade treatments. The Contractor may elect to substitute with special backfill material or modified subbase material at one-half the required rate at no additional cost to the Contracting Authority. If special backfill material or modified subbase material is used in lieu of select material, ~~the Contractor shall~~ provide for suitable surface and subsurface drainage of this material and provide suitable soils in lower portion of original subgrade treatment layer at no additional cost to the Contracting Authority.
      - (1) **Cohesive Soils.**  
Meet the requirements of Article 2102.02, D, 1, a.
      - (2) **Granular Soils.**  
Meet the requirements of Article 2102.02, D, 1, b.
      - (3) **Special Backfill Material.**  
Meet the requirements of Section 4132.
      - (4) **Modified Subbase Material.**  
Meet the requirements of Section 4123.
    - b) Use select treatment sources with sufficient uniformity and size to assure that complete individual treatment areas will be constructed with similar material. Substitution of treatment types (cohesive, granular, special backfill, or modified subbase material) will be allowed only with the Engineer's permission.
  - 2) **Suitable Soils.**  
Meet the requirements of Article 2102.02, D, 2.
  - 3) **Unsuitable Soils.**  
Meet the requirements of Article 2102.02, D, 3.
  - 4) **Other Materials.**  
Place materials not covered above as required by Standard Specifications.
- d. The Engineer may decline approval of an alternate borrow area when:
  - 1) Necessary clearances cannot be obtained prior to the time scheduled for commencement of work.
  - 2) Restrictions attached to clearances will delay or interfere with scheduled completion of work or may result in less than necessary quantities of required borrow materials.
  - 3) Contractor's plan for use of borrow areas, including Contractor's verification of quantity and quality of required material, is not sufficient to assure availability of required material.
  - 4) Contractor's proposed plans fail to meet requirements of the contract documents.
- e. The Engineer will be allowed time to evaluate each alternate borrow area. If the clearance is not obtained within 30 calendar days, the proposed use of that borrow area may be rejected. During this evaluation period, the Contractor will not be charged for working days the Contractor does not work because the Contractor cannot use the borrow area.

- f. The maximum allowance for each contract is not to exceed 30 working days. This allowance will not apply to work for which an intermediate completion time is specified. It will be given only when the delay will not interfere with others authorized to work on the project. It does not increase the Engineer's responsibility to provide coordination.
- g. The Contracting Authority will not be responsible for damages due to a delay in approval of an alternate borrow area or when approval of an alternate borrow area is declined.

### 3. Contractor's Plan for Contractor Furnished Borrow.

#### a. General.

- 1) Approval of materials for use as Contractor furnished select treatment materials will be based on Article 2102.02, D, 1.
- 2) Contractor may elect to substitute with special backfill material or modified subbase material as shown in the contract documents at no additional cost to the Contracting Authority. If special backfill material or modified subbase material is used in lieu of select material, provide for suitable surface and subsurface drainage of this material and provide suitable soils in lower portion of original subgrade treatment layer at no additional cost to the Contracting Authority.
- 3) The Engineer may decline approval of a contractor furnished borrow(s) when:
  - a) The Contractor's submittal fails to meet Proposed Borrow Report requirements.
  - b) The Contractor's plan for use of borrow areas, including quantity and quality of required material, is not sufficient to assure availability of required material.

#### b. Sampling and Testing

- 1) **Total Project Quantity of Contractor Furnished Borrow Greater than 10,000 Cubic Yards (7650 m<sup>3</sup>).**  
Sample and test the proposed contractor borrow areas and submit Proposed Borrow Report as specified in Materials I.M. 545. When the Contracting Authority determines it is necessary, sample in the presence of the Engineer. Submit the report electronically to the Engineer. Include Iowa DOT Proposed Contractor Borrow Identification Form, sampling/field logs, and test reports. A minimum of 21 calendar days is required for review and approval by the Engineer. The Contracting Authority will not be responsible for damages or delays due to incomplete submittals or when approval of a borrow is declined.
- 2) **Total Project Quantity of Contractor Furnished Borrow less than 10,000 Cubic Yards (7650 m<sup>3</sup>).**  
Sample proposed contractor borrow areas. When the Contracting Authority determines it is necessary, sample in the presence of the Engineer. Provide verification samples to the Engineer. A minimum of 14 calendar days is required for review and approval by the Engineer.

### 3 4. Contractor ~~Provided~~ Obtained Clearances and Permits.

Obtain ~~and provide engineer~~ necessary environmental, archaeological, and historic preservation clearances and permits, and comply with all restrictions attached to these clearances and permits for alternate borrow areas and sites where Contractor furnished borrow is obtained. ~~Obtain other licenses and permits involved in the proposed use of these areas.~~

### 4 5. Restoration.

- a. Optional borrow areas shown on the Contractor's plan shall be left in at least as good a condition as that required by the contract documents for designated borrow areas. This applies whether all or only a part of the site or the material is used for borrow.
- b. Use and rehabilitate optional borrow areas and alternate borrow areas (unless Contractor and landowner have agreed to the final design of the alternate borrow area) so that:
  - 1) The sites can continue to be used for the purpose for which they were used prior to removal of borrow.
  - 2) The sites may still be used for those higher and more profitable or better potential uses to which the site might have been put prior to removal of borrow material.
- c. The Engineer will require restoration according to 314.12, Code of Iowa, to meet the above requirement. The overall Contractor's plan shall neither detract from nor interfere with the air, light, and view of motorists nor of adjacent landowners.

### 5 6. Obligations and Payment.

Use of an alternate borrow area shall not increase future obligations or total cost to the Contracting Authority. Complete all excavation from the roadway and the mandatory borrow areas.

**6 7. Starting Work.**

Except for exploratory purposes, do not start work and take material from an alternate borrow or a Contractor furnished borrow area until after:

- The Engineer approves the borrow proposal in writing, and
- Providing the Engineer with a written release executed by the property owner and the Contractor relieving the Contracting Authority of any and all obligations to the property owner and saving the Contracting Authority harmless from all claims for injury to persons or damage to property resulting from the Contractor's operations.

**7 8. Material Verification.**

Material supplied from alternate borrow areas ~~or Contractor furnished borrow~~ may be verified by the Contracting Authority for compliance with these requirements. When testing by the Contracting Authority is required, a minimum of ~~40 working~~ 14 calendar days is necessary for testing. When the Engineer orders, remove and replace material verified not in close compliance with these requirements, at no additional cost to the Contracting Authority.

**2102.04, A, 1, d.**

**Add to the end of the Article:**

Shrinkage will not be included in the quantity.

**2102.04, A, 4, Special Backfill Material.**

**Replace the Article:**

- a. Tons (megagrams) ~~or cubic yards (cubic meters)~~ of material placed. If measurement by weight (mass) is impractical, material may be measured by volume in the transporting vehicle. This volume will be converted to tons (megagrams) using a conversion factor the Engineer determines.
- b. ~~If measurement by weight (mass) is impractical, the material may be measured by volume in the transporting vehicle. This volume will be converted to tons (megagrams) using a conversion factor the Engineer determines.~~ Cubic yards (cubic meters) of Special Backfill will be the quantity shown in the contract documents.

**2102.04, A.**

**Add to the end of the Article:**

**8. Contractor Furnished Select Treatment.**

Cubic yards (cubic meters) shown in the contract documents, adjusted by changes in available on site select treatments.

**9. Contractor Furnished Embankment-in-Place.**

Cubic yards (cubic meters) shown in the contract documents. Shrinkage will not be included in the quantity.

**2102.05, A, 4, b.**

**Delete the second bullet:**

Excavating material,

**2102.05, A, 6, Locating Tile Lines.**

**Replace the Article:**

- a. Per station (meter).
- b. Payment is full compensation for constructing trench, locating and sizing tile lines, repairing tile lines damaged during locating, and placing backfill material.

**2102.05, A.**

**Replace the Articles:**

**8. Contractor Furnished Select Treatment.**

According to Article 2102.05, A, 3. Payment includes furnishing material.

**9. Contractor Furnished Embankment-in-Place.**

According to Article 2102.05, A, 3. Payment includes furnishing material.

**Section 2105**

**2105, Stripping, Salvaging, and Spreading Topsoil.**

Replace the Section:

**2105.01 DESCRIPTION.**

- A.** Strip topsoil and prepare sod.
- B.** Haul, deposit, and spread topsoil.

**2105.02 MATERIALS.**

~~None.~~ For topsoil furnished by the Contractor, provide material meeting the requirements of Articles 4170.09, A, 1 and 4170.09, A, 3, or strip existing topsoil from beneath template fill sections within the project limits if stripping of that topsoil is not already included as part of the project. Replace topsoil stripped from beneath template fill with an equivalent quantity of Class 10 or Embankment-in-Place material at no additional cost to the Contracting Authority.

**2105.03 CONSTRUCTION.**

**A. Stripping Topsoil.**

Remove topsoil from borrows pits, cuts, or areas to be covered by embankments. ~~Prepare sod. Haul, deposit, and spread topsoil on shoulders, slopes, excavated areas, borrow pits, and other designated areas according to the contract documents.~~

**A 1. Sod Preparation.**

Mow, ~~burn~~, or remove, weeds, grass and growing crops or other herbaceous vegetation close to the ground as directed by the Engineer. Shred sod by shallow plowing or blading and thoroughly disking. Shred sod thoroughly enough to permit the soil to be easily spread in a thin layer over areas to be covered.

**~~B~~ 2. Topsoil Excavation.**

After existing sod has been prepared, remove the topsoil to the depth specified. If not otherwise specified, the depth shall be 12 inches (0.3 m). The topsoil may be moved directly to an area where it will be used or may be stockpiled for future use.

**~~C~~ B. Placing Topsoil.**

~~Spread topsoil uniformly over the area to be covered.~~ Haul, deposit, and spread topsoil uniformly on shoulders, slopes, excavated areas, borrows, and other designated areas according to the contract documents to a minimum depth of 4 inches (100 mm) or to the depth specified in the contract documents. Smooth the surface of the topsoil and leave in a finished condition so that it will drain properly.

**2105.04 METHOD OF MEASUREMENT.**

**A. Topsoil Stripped Onsite.**

**A 1.** The number of cubic yards (cubic meters) of topsoil moved will be computed on the basis of a uniform 12 inch (0.3 m) cut, or the depth as specified in the contract documents, over the area involved. Sufficient field measurements will be taken to assure reasonable conformity with the required depth of cut.

**~~B~~ 2.** Topsoil salvaged from excavated areas and paid for as topsoil will not be included in excavation quantities for which payment is made.

**B. Topsoil Furnished by Contractor or Previously Stockpiled Onsite.**

The number of cubic yards (cubic meters) of topsoil will be computed on the basis of a uniform 8 inch (0.2 m) placement, or the depth as specified in the contract documents, over the area involved. Sufficient field measurements will be taken to assure reasonable conformity with the required depth of placement.

**2105.05 BASIS OF PAYMENT.**

- A. Payment will be the contract unit price per cubic yard (cubic meter).
- B. Payment is full compensation for preparing, stripping (if required), transporting, and placing the topsoil according to the contract documents.
- C. Overhaul will not be paid for this item.

**Section 2107****2107.03, N, 1.****Replace the Article:**

Unsuitable soils may be used in embankments according to Standard Road Plan EW-102.

**2107.03, Construction.****Add the Article:****P. Quality Control Program (Embankment Construction).**

On projects where the Department is the Contracting Authority:

1. Provide and maintain a Quality Control Program (Embankment Construction). This is defined as process control sampling, testing, and inspection as described in Materials I.M. 540 for construction of embankments with moisture control, or moisture and density control.
2. Provide a Quality Control Technician who is responsible for all process control sampling, testing, and inspection. The Quality Control Technician shall obtain Soils Technician certification through the Iowa DOT Technical Training and Certification Program (TTCP).
3. Provide a laboratory facility and necessary calibrated equipment to perform required tests.
4. Notify the Engineer when a moisture content falls outside specified control limits or density falls below required minimum. If a moisture content falls outside control limits, fill material in this area will be considered unacceptable for compaction. Perform corrective action(s) to bring uncompacted fill material within control limits. If material has been compacted, disk it, bring to within control limits, and re-compact. When project has a density requirement, if an in-place density does not meet the requirements, compacted fill material in this area will be considered unacceptable. Perform corrective action(s) to material to meet density requirements. Compensation will not be allowed for delays resulting from moistening, diskings, or re-compacting.

**2107.05, A, 1, Compaction with Moisture and Density Control.****Add the Article:**

- c. On projects where the Department is the Contracting Authority, payment includes process control sampling, testing, and inspection.

**2107.05, A, 2, Compaction with Moisture Control.****Add the Article:**

- c. On projects where the Department is the Contracting Authority, payment includes process control sampling, testing, and inspection.

**Section 2108****2108.05, Basis of Payment.**

Add the article:

- C. Overhaul will not be paid for Contractor furnished material (such as borrow or topsoil) and waste material.

**Section 2109****2109.03, A, 1.**

Replace the first sentence:

Construct the subgrade to have a uniform stability for a width at least equal to that of the proposed pavement or base, plus  $\pm 3$  feet (1 m) on each side.

**2109.03, C, Special Compaction of Subgrade.**

Add the Article:

5. On projects where the Department is the Contracting Authority, perform process control sampling, testing, and inspection according to the provisions of Article 2107.03, P.

**2109.05, B.**

Add the Article:

3. On projects where the Department is the Contracting Authority, payment includes process control sampling, testing, and inspection

**Section 2111****2111.04, Method of Measurement.**

Replace the Article:

~~A. Measurement for Granular Subbase material furnished and placed in accepted portions of work will be in square yards (square meters) for the specified design thickness will be the quantity shown in the contract documents. The measured area will be based on plan dimensions for the finished surface but will exclude fillets.~~

~~B. The design thickness of the placed material will be verified by spot checks of the grade.~~

**Section 2112****2112, Wick Drains.**

Replace the Section:

**2112.01 DESCRIPTION.**

- A. Furnish all necessary labor, equipment, and materials and perform operations necessary for installation of prefabricated vertical drainage wicks (wick drains) according to the contract documents.
- B. Wick drains consist of a band-shaped plastic case which permits continuous vertical drainage, wrapped in a filter material, installed in the subsoils by displacement methods, and spaced and arranged as shown on the plans.

**2112.02 MATERIALS AND EQUIPMENT.**

~~At least two weeks prior to construction, submit wick drain samples and certification indicating the source and material properties of the drain materials. At the Preconstruction Conference, submit to the Engineer for review and approval details of the sequence and method of installation, including installation equipment, anchoring, manufacturer's splicing method, certification indicating source of wick drain material, drain layout, and numbering plan. Approval Review by the Engineer does not relieve the Contractor of the responsibility of installing the wick drains according to the contract documents.~~

**A. Materials.**

Install prefabricated wick drains consisting of a plastic drainage core encased in or integrated with a filter jacket. ~~Ensure it is band-shaped with an aspect ratio (width divided by thickness) not exceeding 50. Prefabricated wick drains meeting this specification are listed in~~ Inspection and acceptance of wick drain materials will be according to Materials I.M. 442.01.

**1. Core.**

- Meet the following requirements:
- Provide continuous vertical drainage.
- Continuous plastic material (excluding splice area) fabricated to promote drainage along the axis of the vertical drain.

**2. Jacket.**

- Install a jacket that allows free passage of pore water to the core without loss of soil material or piping. Meet the following requirements for jacket material:
  - Manufactured from a synthetic non-woven geotextile capable of resisting all bending, punching, and tensile forces imposed during installation and during the design life of the drain.
  - Sufficiently rigid to withstand lateral earth pressures due to embedment and surcharge so that the vertical flow capacity through the core will not be adversely affected.
  - Sufficiently flexible to bend smoothly during installation and induced consolidation settlement without damage.
  - Comply with the following specifications:

**Table 2112.02-1: Wick Drain Jacket Specifications**

Test Item	Designation	Minimum Average Roll Value* <sup>1</sup>
Grab Tensile Strength <sup>2</sup>	ASTM D 4632	80 125 lb. (355 578 N)
Trapezoidal Tear <sup>3</sup>	ASTM D 4533	25 55 lb. (110 267 N)
Puncture Strength	ASTM D 4833	50 lb. (220 N)
Burst Strength	ASTM D 3796	130 psi (900 kPa)
Permittivity	ASTM D 4491	100 gal/min/ft <sup>2</sup> (4285 L/min/m <sup>2</sup> ) 0.7 sec <sup>-1</sup>
Apparent Opening Size (max.)	ASTM D 4751	60 sieve (250 µm)
<sup>*</sup> 1 Ensure the jacket material is tested in saturated and dry conditions. <sup>2</sup> For bonded drains, tensile strength test may be conducted on assembled drain using ASTM D 4595. <sup>3</sup> For bonded drains, trapezoidal tear test is waived.		

- Do not allow the jacket material to be subject to localized damage (for example, punching through the filter by sand/gravel particles). Ensure the jacket material does not undergo cracking and peeling during installation of the drain.

**3. Assembled Drain.**

Meet the requirements below. The Engineer may reject material that is damaged during shipment, storage, or handling, or which does not meet the minimum requirements of the drain material.

- One single type of assembled drain used on the project, unless the Engineer approves otherwise.
- Mechanical properties (strength and modulus) of the assembled vertical drain equal to or greater than those specified for the component jacket and core.
- Resistant against wet rot, mildew, bacterial action, insects, salts in solution in the groundwater, acids, alkalis, solvents, and any other significant components in the site groundwater.
- Minimum discharge capacity of ~~3500 cubic feet per year (100 m<sup>3</sup>/yr)~~ 1.5 gallons per minute (9.46 x 10<sup>-5</sup> m<sup>3</sup>/s) when measured under a gradient of one at a minimum lateral confining pressure of 25 psi (172 kPa) according to ASTM D 4716.
- Ensure it is band-shaped with an aspect ratio (width divided by thickness) not exceeding 50.
- Minimum equivalent diameter of 2 inches (50 mm) using the following definition of equivalent diameter:
- $dw = (a+b)/2$ .

- dw = diameter of a circular drain equivalent to the band shaped drain (inches (mm)).
- a = width of the band shaped drain (inches (mm)).
- b = thickness of the band shaped drain (inches (mm)).
- Drain material labeled or tagged in such a manner that the information for sample identification and other quality control purposes can be read from the label. Ensure, as a minimum, each roll is identified by the manufacturer as to lot or control numbers, individual roll number, date of manufacture, manufacturer, and product identification of the jacket and core.
- Ensure during shipment and storage the drain is wrapped in heavy paper, burlap, or similar heavy duty protective covering and according to the manufacturer's recommendations.

## B. Equipment.

1. Install wick drains using equipment of a type that will cause minimum disturbance of the subsoil during the installation operation.
2. Install the wick drains using a mandrel. Push (in one continuous movement, except as needed for splicing) the mandrel through the sand blanket (if required by the contract documents) and into the soil. Vibrating or driving are options if the Engineer approves. Obtain the Engineer's approval for use of vibratory methods. Driving or jetting installation methods are not permitted. Ensure the mandrel:
  - Protects the wick material from tears, cuts, and abrasions during installation,
  - Is rectangular or rhombic in shape and of a cross sectional area not to exceed 10 square inches (6500 mm<sup>2</sup>), and
  - Is provided with an "anchor" rod or plate at the bottom to prevent soil from entering the bottom of the mandrel during installation of the drain and to anchor the bottom of the drain at the required depth at the time of mandrel removal.

## 2112.03 CONSTRUCTION.

- A. Familiarity with site conditions and the available geotechnical information is a necessity. Prior to installation of the wick drains, demonstrate the equipment, method, and materials produce a satisfactory drain installation. Drill at least two borings within the area designated on the plans in order to select the equipment, method, and materials: 1) suitable for the existing site conditions; and 2) capable of producing a satisfactory drain installation to the minimum elevation. Installation of up to ten trial drains may be required in each of two to four test locations designated by the Engineer. Compensation will be made for each trial drain if the installation satisfies the requirements of the contract documents. No compensation will be allowed for installing unsatisfactory trial drains. This may require the contractor to drill additional soil borings. Demonstrate the equipment, method, and materials produce a satisfactory drain installation by installing a trial drain at the location of the first production drain.
- B. The Engineer's approval review of the method and equipment used to install the trial drains does not constitute acceptance of the method for the remainder of the project. If the Engineer considers that the method of installation does not produce a wick drain that satisfies the requirements of the contract documents, alter the method or equipment, or both, in order to achieve compliance.
- C. Prior to installing the drains, grade the site sufficiently level (at no additional cost to the Contracting Authority) to allow vertical and proper drain installation.
- D. Install the wick drains following placement of the sand blanket (if required by the contract documents). Install a granular blanket of sufficiently coarse material and compact to provide a stable working surface.
- E. Locate, number, and stake wick drains. Take all reasonable precautions to preserve the stakes. Ensure drain locations vary by no more than 3 inches (75 mm) from the locations indicated on the drawings. Two weeks prior to construction, submit drawings to the Engineer for approval showing the method of field locations, drain layout, and numbering plan.

- F.** Auguring or other methods may be used to loosen stiff upper soils prior to the installation of the drains, provided such operations do not extend more than 2 feet (600 mm) below the bottom of the sand blanket into underlying compressible soils. After the wick drain has been satisfactorily installed, fill all holes or voids created by such operations with sand.
- G.** Check the installation equipment for plumbness prior to advancing each drain. Ensure the plumbness of the mandrel does not deviate more than 1/4 inch per foot (50 mm per meter) from vertical. Install the drains to the minimum elevation as shown on the plans. If the penetration shown on the plans is more than 1 foot (300 mm) into the underlying foundation layer and difficulties are encountered prior to achieving the indicated depths, install the drains to a depth of 1 foot (300 mm) below the bottom of the soil layer(s) being improved by wick drain installation as shown on the plans.
- H.** Raising the mandrel is permitted only after completion of drain installation.
- I.** The Engineer will reject wick drains that vary from their proper location by more than 6 inches (150 mm) at the ground surface, drains that are damaged during installation or subsequent construction, or drains that are improperly completed. No compensation will be allowed for any materials furnished or for any work performed on such drains.
- J.** During installation, provide the Engineer with suitable means of measuring the vertical length of each wick drain installed at a given location and deriving a tip elevation for each drain.
- K.** Splices or connections in the wick drain material will not be allowed. Provide splices with structural and hydraulic continuity of the drain. A maximum of one splice, constructed according to manufacturer's splicing method, per drain is allowed. Ensure manufacturer's splicing method is compatible with installation equipment.
- L.** When obstructions that cannot be penetrated by the drain installation equipment are encountered below the working surface, notify the Engineer and complete the drain from the elevation of the obstruction to the working surface. At the direction of the Engineer, attempt to install a new drain (maximum of two attempts, as directed by the Engineer) within an 18 inch (450 mm) radius from the obstructed drain. The Contractor will be compensated for each obstructed drain unless the drain is improperly completed, in which case no compensation will be allowed.
- M.** After installation, cut each drain horizontally such that approximately 6 inches (150 mm) of drain material extends above the top of the sand blanket or as otherwise specified by the contract documents.
- N.** The Engineer Contractor will shall keep a daily log which lists for each drain the date of installation, top elevation, tip elevation, and pay length. A copy of each daily log will shall be provided to the Contractor Engineer.

#### **2112.04 Method of Measurement.**

- A.** Measurement for Wick Drain (including trial wick drains) will be feet (meters) installed according to the contract documents, calculated from measurements taken from the top of the drain to the tip elevation of the drain.
- B.** In the case of obstructions, the Engineer will calculate the number of feet (meters) from measurements taken from the top of the drain to the elevation at which the obstruction was encountered.

#### **2112.05 Basis of Payment.**

- A.** Payment for Wick Drain will be the contract unit price per foot (meter).
- B.** Payment includes:
- Field staking for the location of wick drains, and
  - All labor, equipment, and materials necessary to complete the installation according to the contract documents.

- C. No payment will be made for unacceptable drain or trial drain installations.
- D. In instances where pre-auguring is permitted, the cost of pre-auguring and subsequent placing of sand backfill material is incidental to the price bid for Wick Drains.
- E. The cost of additional borings drilled to select the equipment, method, and materials suitable for the existing site conditions to produce a satisfactory drain installation is incidental to the price bid for Wick Drains.
- F. No payment will be made for constructing any work platform other than that shown in the contract documents.

### Section 2120

#### 2120.03, A.

**Replace** the Article:

Applied to eligible items as the work is done, ~~according to this specification when indicated in the contract documents~~ the contract quantity of that eligible item is 50,000 cubic yards (38,228 m<sup>3</sup>) or more.

#### 2120.03, B.

**Add** the Article:

- 9. Select Treatment, Contractor Furnished

#### 2120.03, C.

**Replace** the Article:

Fuel adjustment using a FUF factor of 0.27 gallon per cubic yard (1.3 L/m<sup>3</sup>) will be applied to Embankment-in-Place, Contractor Furnished, and Embankment-in-Place (non-dredge material).

### Section 2122

#### 2122.04, B, Special Backfill.

**Replace** the Article:

~~Contract quantity.~~ Article 2102.04, A, 4, applies.

### Section 2123

#### 2123.02, A.

**Replace** the second sentence of the Article:

~~Do not use unsuitable soils of Article 2102.02, D, 3, or topsoils.~~ Place topsoil as required by Article 2105.03, B.

#### 2123.03, B, 1.

**Add** the Article:

- c. Placing material resulting from subgrade trimming operations and completing construction with a minimum of 4 inches (100 mm) of topsoil.

## Division 22. Base Courses.

### Section 2210

#### 2210.03, D, 2.

##### Replace the Article:

If the material is prewetted before delivery, or if water is added to the base after delivery, ensure the water is uniformly distributed throughout the material so that all particles are uniformly wet moist. ~~Verify water is within 2.0% of the amount determined as field optimum to produce maximum density together with stability with the field compaction procedure. This moisture content will usually be 85 to 90% of the optimum determined according to Materials Laboratory Test Method No. Iowa 103. Maintain this moisture content in the material until base compaction is complete.~~

### Section 2212

#### 2212.03, B, 2, b, Full Depth Repair Patches.

##### Replace the Article:

- 1) Construct full depth repair patches according to Section 2529. ~~with the following exceptions:~~
  - a) ~~If the thickness of full depth repair patches is not shown in the contract documents, base the thickness on the existing pavement type.~~
  - b) ~~Construct patches to be no less than:~~
    - (1) ~~6 inches (150 mm) for County Roads.~~
    - (2) ~~9 inches (230 mm) for Primary Roads.~~
    - (3) ~~12 inches (300 mm) for Interstate Roads.~~
- 2) ~~Base maximum full depth repair patch thickness on the following:~~
  - a) ~~Portland Cement Concrete Repair Patch.~~
    - (1) ~~Rigid Pavement:~~ Pavement thickness, but not more than 12 inches (300 mm).
    - (2) ~~Rigid Pavement resurfaced with HMA (composite patch):~~ Rigid pavement thickness and the patch covered with HMA surface.
    - (3) ~~Flexible Pavement:~~ Same as above for resurfaced rigid pavement.
  - b) ~~Hot Mix Asphalt Repair Patch.~~
    - (1) ~~Rigid Pavement:~~ Pavement thickness, but not more than 12 inches (300 mm).
    - (2) ~~Rigid Pavement resurfaced with HMA:~~ Thickness of pavement, including resurfacing, but not more than 12 inches (300 mm).
    - (3) ~~Flexible Pavement:~~ Thickness of surface and base course, but not more than 12 inches (300 mm).

### Section 2213

#### 2213.05, G, Samples.

##### Replace the Article:

HMA base widening samples: according to Article 2303.05, H G.

### Section 2214

#### 2214.03, D, 6.

##### Delete the Article:

6. ~~When resurfacing is part of the contract, sign the approaches to scarified areas on Primary Roads with ROUGH ROAD signs. Repeat the signs for traffic that may enter within the scarified area from intersecting public roads. Erect, move (if appropriate), and maintain these signs until the scarified areas are covered with new mixture.~~

**Section 2217****2217.03, B, Rubblizing Existing PCC Pavement.**

**Replace** Articles 2, 3, and 4:

2. Operate breaker unit at a speed so existing pavement is reduced into particles with a nominal maximum size of 4 inches (100 mm), based on visual inspection of rubblized pavement surface. When conditions warrant in specific locations, the Engineer may direct or allow larger maximum particle dimensions, not to exceed 12 inches (300 mm). Additional passes may be required if larger sizes remain after initial rubblizing pass. Do not operate breaker unit within 50 feet (15 m) of bridge abutments and other locations designated by the Contracting Authority.
3. Begin rubblizing procedure at a free shoulder edge and work towards centerline joint.
4. Operate vibratory steel drum roller close behind rubblizing operation at a speed not to exceed 6 feet (2 m) per second. Compact and seat rubblized pavement with a minimum of 4 coverages. In addition, roll surface immediately ahead of paving equipment to remove distortion that may occur from batch haul trucks or other equipment.

**Division 23. Surface Courses.****Section 2301****2301.02, B, 5, Admixtures.**

**Replace** the Article:

Use Approved admixtures complying with Section 4103 ~~may be used with the Engineer's authorization.~~

**2301.03, A, 3, a, 2, Integral Curb Forms.**

**Replace** the Article:

- ~~a) Use metal forms to form the back of all integral curbs, except where returns have a small radius or other special sections making the use of metal forms impractical.~~
- ~~b) Rigidly attach back forms for curb to the side forms for the pavement slab. Use all fastenings provided by the form manufacturer. Supply a sufficient length of curb forms and number of fastenings to make it possible to leave the forms in place for at least 6 hours after the curb is place.~~
- ~~c) At the time the curb form is placed, ensure the top of the pavement is free of all substances which prevent the rigid fastening or accurate alignment of the curb form. Ensure the curb form extends the plane of pavement form without a variation of more than 1/8 inch (3 mm). Set the top of the curb form at the elevation of top of curb being built, except at curb runouts.~~
- ~~d) Sloping faced curb not more than 4 inches (100 mm) in height may be shaped to the desired cross section with a curb mule without the use of face forms.~~
- ~~e) For straight sections of integral curb more than 4 inches (15 mm) high, the Contractor may use face forms or a slip form curb mule. If face forms are used, provide no less than 100 feet (30 m) for each curb being constructed. Properly secure face forms to maintain their shape and position during use. Ensure the face forms produce a curb cross section matching that of the details within the contract documents. Approved hand tools and methods may be used to supplement the forms in shaping the top roll and on returns and other special sections.~~
- ~~f) If a slip form curb mule is used, use a slip form curb mule that is no less than 6 feet (1.8 m) long, unless mounted on a machine. Obtain the Engineer's approval before using the slip form curb mule. Both back and face forms will be required when constructing barrier curbs or any curb having a top width of 8 inches (200 mm) or more.~~

Meet the requirements of section 2512, 03, C.

**2301.03, E, 2, d.**

**Replace** the Article:

~~Cutting the tie wires of the load transfer assemblies is optional.~~ A maximum of three tie wires may remain uncut on each load transfer assembly.

**2301.03, H, 3, Macrotexture.****Replace the Article:****a. General.**

- ~~1) Macrotexture (tining) is constructed by placing grooves in the surface of a pavement, normally while the concrete is plastic. The Contractor may either transversely or longitudinally provide macrotexture tining.~~
- ~~2) When longitudinal grooving is used on mainline pavement, transverse grooving may be used on other pavement on the same project.~~

**b. Application.**

- ~~1) Where the speed limit is greater than 35 mph (60 km/h), place macrotexture on all mainline pavement, turn lanes, and the traveled portion of ramps as required in Table 2301.03-1. Macrotexturing is not required on radii, crossovers, paved medians, shoulders, and other irregular areas.~~
- ~~2) Transversely or longitudinally groove gapped sections of mainline pavement that utilize longitudinal texture. Hand methods may be used on these mainline sections.~~
- ~~3) 2) When surface corrections are made in the hardened concrete, no macrotexture replacement is required.~~
- ~~4) Unless specified otherwise, groove or otherwise finish bridge approach sections in the same manner as either the adjacent bridge or pavement surface.~~
- ~~5) When finishing by hand methods, except for mainline pavement and ramps as described above, only microtexture will be required.~~

**Table 2301.03-1: Macrotexture Requirements**

Pavement/Placement Type	Macrotexture Orientation		Macrotexture Not Required
	Longitudinal	Transverse	
Mainline - slip-form	X		
Mainline - handwork		X	
Turn lanes - slip-form	X	1	
Turn lanes - handwork		X	
Ramps - slip-form	X	1	
Ramps - handwork		X	
Gapped sections of mainline - slip-form	X	1	
Gapped sections of mainline - handwork		X	
Radii			X
Crossovers			X
Paved Medians			X
Shoulders			X
Irregular Areas			X
Bridge Approaches		2	
1. Transverse macrotexture permitted for placements less than 600 feet (180 m) in length. 2. Transverse tining required unless longitudinal grooving in concrete is specified in the contract documents.			

**c. Operation.****1) General.**For ~~grooving~~ tining, use a mechanical device that:

- Has a single row of tines that are 1/8 inch  $\pm$  1/64 inch (3 mm  $\pm$  0.5 mm) wide, and
- Forms grooves in the plastic concrete that are 1/8 inch (3 mm) deep as a target, with a  $\pm$  1/16 inch ( $\pm$  1.5 mm) tolerance.

**2) Transverse ~~Grooving~~ Tining.**

- a) For transverse ~~grooves~~ tining, ~~randomly space the tines from 3/8 inch to 1 5/8 inch (10 to 40 mm) with no more than 50% of the spacing exceeding 1 inch (25 mm)~~ uniformly space tines at 1/2 inch (12 mm) intervals.
- b) At transverse joints, leave a 4 inch to 6 inch (100 to 150 mm) wide strip of pavement surface (centered along the joint) that is not ~~grooved~~ tined for the length of the joint.
- c) Transverse tining may be placed by hand methods.
- 3) **Longitudinal Grooving Tining.**
  - a) For longitudinal ~~grooves~~ tining, uniformly space the tines at 3/4 inch (20 mm) intervals.
  - b) Accomplish longitudinal ~~grooving~~ tining using equipment with horizontal and vertical ~~string-line~~ controls to ensure straight, uniform grooves.
  - c) At longitudinal joints, leave a 2 inch to 3 inch (50 to 75 mm) wide strip of pavement surface (centered along the joint) that is not ~~grooved~~ tined for the length of the joint.
  - d) Do not place longitudinal tining by hand methods.
- d. **Limitations.**
  - 1) ~~Form grooves~~ Place tining in a time and manner producing the desired surface texture while minimizing displacement of larger aggregate particles. Complete ~~grooving~~ tining before pavement surface permanently sets.
  - 2) Where abutting pavement is to be placed, extend ~~grooving~~ tining as close as possible to the edge without damaging the edge. Where abutting pavement is not to be placed, do not ~~groove~~ tine the 6 inch (150 mm) area nearest the edge or 1 foot (300 mm) from the face of the curb.
  - 3) Do not ~~groove~~ tine the outside 2 feet (0.6 meters) if placing structural rumble strips (rumble strips placed in the outside 2 feet (0.6 meters) of PCC pavements, as shown in the contract documents, to deter traffic).
  - 4) ~~Uniform width slabs of 20 feet (300 mm) or narrower and less than 600 feet (200 m) long may be transversely grooved by hand methods. Mainline and ramp pavement may also be grooved by hand methods during equipment breakdowns.~~

**2301.03, K, 3, b.**

Replace Note (a) of Table 2301.03-1 and title:

**Table 2301.03-4 2: Concrete Pavement Protection Requirements**

- (a) Protection shall remain until overnight the first night covering is required. After the first night of covering, protection may be removed when one of the following conditions is met:
  - 1. Pavement is 5 calendar days old.
  - 2. Opening strength is attained.
  - 3. Forecasted low temperatures exceed 35°F (2°C) for the next 48 hours.
  - 4. Forecasted high temperatures exceed 55°F (13°C) in the next 24 hours and subgrade temperatures are above 40°F (4°C).

**2301.03, U, 1.**

Replace Table 2301.03-2, Minimum Flexural Strength and title:

**Table 2301.03-2 3: Minimum Flexural Strength**

Strength Class of Concrete	Minimum Age	psi (MPa)
A	14 calendar days <sup>(a)</sup>	500 (3.45)
B	14 calendar days	400 (2.80)
C	7 calendar days <sup>(b)</sup>	500 (3.45)
M	48 hours <sup>(c)</sup>	500 (3.45)
(a) 10 calendar days for concrete 8 inches (200 mm) thick or more. (b) 5 calendar days for concrete 9 inches (230 mm) thick or more. (c) Pavement may be opened for use prior to 48 hours when minimum flexural strength requirements are met.		

**2301.04, A, 1.**

**Add** as the second sentence of the Article:

The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

**2301.05, K, 1.**

**Delete** the Article:

1. ~~Deduction will not be made from the area of pavement for fixtures with an area less than 9 square feet (1 m<sup>2</sup>).~~

**Section 2303****2303, Hot Mix Asphalt Mixtures.**

**Replace** the Section:

**Section 2303. Hot Mix Asphalt Mixtures Flexible Pavement****2303.01 DESCRIPTION.**

- A. Design, produce, place, and compact flexible paving (HMA and warm mix asphalt (WMA)) mixtures. Use proper quality control practices for the construction of surface, intermediate, or base course on a prepared subbase, base, or pavement to the dimensions specified in the contract documents.
- B. A surface course is the upper lift for a wearing surface of a designated thickness. An intermediate course is the next lower lift or lifts of a designated thickness. Use intermediate course mixtures for leveling, strengthening, and wedge courses. A base course is the lift or lifts placed on a prepared subgrade or subbase.
- C. WMA refers to asphalt concrete mixtures produced at temperatures approximately 50°F (28 °C) or more below those typically used in production of HMA, but no higher than ~~280°F (135 °C)~~ that shown in Article 2303.03, C, 3, d, 3, a. Temperature reductions may be achieved through additives or water injection systems approved by the Bituminous Engineer. The goal with WMA is to produce mixtures with similar or better strength, durability, and performance characteristics as HMA using substantially reduced production temperatures.
- D. Unless explicitly stated, produce and place WMA mixtures meeting the same requirements established for HMA mixtures. Equivalent WMA mixtures may be substituted for HMA mixtures unless it is prohibited by the specifications.

**2303.02 MATERIALS.**

Use materials meeting the following requirements:

**A. Asphalt Binder.**

The Performance Graded asphalt binder, PG XX-XX, will be specified in the contract documents to meet climate, traffic, and pavement conditions. Use asphalt binder meeting requirements of Section 4137. Unless otherwise specified in the contract documents, use PG 58-28 for shoulder mixtures.

**B. Aggregates.****1. Individual Aggregates.**

- a. Use virgin mineral aggregate as specified in Materials I.M. 510 and meeting requirements of Section 4127.
- b. When frictional classification of the coarse aggregate is required, the contract documents will specify the friction level and location. Furnish friction aggregate from sources identified in Materials I.M. T203. Limestone aggregate sources defined as containing less than 15% magnesium oxide (MgO) are identified in Materials I.M. T203.

**1) Friction Classification L-2.**

- a) On Interstates and all mixtures designed for 30,000,000 ESALS and higher (cross-overs and detours with posted speeds below 60 mph excluded), if 40% or more of the total aggregate is a limestone, use a combined aggregate such that:
  - 1) At least 80% of the combined aggregate retained on the No. 4 (4.75 mm) sieve is Type 4 or better friction aggregate,
  - 2) At least 30% of the combined aggregate retained on the No. 4 (4.75 mm) sieve is Type 2 or better friction aggregate,
  - 3) At least 25% of the combined aggregate passing the No. 4 (4.75 mm) sieve is Type 2 or better friction aggregate, and
  - 4) The fineness modulus of the combined Type 2 aggregate is at least 1.0. Calculations for fineness modulus are shown in Materials I.M. 501.
- b) For all other mixtures that do not satisfy Article 2303.02, B, 1, a, use a combined aggregate such that:
  - 1) At least 80% of the combined aggregate retained on the No. 4 (4.75 mm) sieve is Type 4 or better friction aggregate, and
  - 2) At least 25% of the combined aggregate retained on the No. 4 (4.75 mm) sieve is Type 2 or better friction aggregate, and
  - 3) For Interstates and all mixtures designed for 30,000,000 ESALS and higher, the fineness modulus of the combined Type 2 aggregate is at least 1.0. Calculations for fineness modulus are shown in Materials I.M. 501.

**2) Friction Classification L-3.**

Use a combined aggregate such that:

- At least 80% of the combined aggregate retained on the No. 4 (4.75 mm) sieve is Type 4 or better friction aggregate, and
- At least 45% of the combined aggregate retained on the No. 4 (4.75 mm) sieve is Type 3 or better friction aggregate, or if Type 2 is used in place of Type 3, at least 25% of the combined aggregate retained on the No. 4 (4.75 mm) sieve is Type 2.

**3) Friction Classification L-4.**

Use a combined aggregate such that at least 50% of the combined aggregate retained on the No. 4 (4.75 mm) sieve is Type 4 or better friction aggregate.

**2. Blended Aggregates.**

- a. Use a blended aggregate meeting the combined aggregate requirements in Materials I.M. 510.
- b. When mixtures include RAP, use a blended mineral aggregate gradation consisting of a mixture of RAP aggregate combined with virgin aggregate.

**C. Recycled Asphalt Materials.**

1. Recycled Asphalt Materials (RAM) includes Recycled Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS). RAP is salvaged asphalt pavement. Use RAP from a source designated in the contract documents, or furnish Classified RAP, Certified RAP, or Unclassified RAP from the Contractor's stockpile. The designations Classified, Certified, and Unclassified are exclusively for the use of RAP in HMA.
2. Identify each RAP stockpile and document Classified and Certified RAP stockpiles as directed in Materials I.M. 505. Include the following information when documenting Classified RAP material in a stockpile for future use in HMA:
  - Identification of the project from which the material was removed,
  - Mix data from the original project including mixture type,
  - Aggregate classification,
  - Location and depth in the pavement structure,
  - Extracted gradation information, if available, and
  - Description of stockpile location and quantity.

Do not add material to a Classified or Certified RAP stockpile without the approval of the District Materials Engineer.

3. The Engineer may reject a RAP stockpile for non-uniformity based on visual inspection. Work the stockpiles in such a manner that the materials removed are representative of a cross section of the pile.

4. Place stockpiles of RAP on a base sufficient to prevent contamination, as directed in Materials I.M. 505. Do not use RAP stockpiles containing concrete chunks, grass, dirt, wood, metal, coal tar, or other foreign or environmentally restricted materials. RAP stockpiles may include PCC (not to exceed 10% of the stockpile) from patches or composite pavement that was milled as part of the asphalt pavement. Track equipment may operate on the stockpile during its construction.
5. When RAP is taken from a project, or is furnished by the Contracting Authority, the contract documents will indicate quantity of RAP expected to be available and test information, if known. Salvage this material. Unless otherwise specified in the contract documents, RAP not used in HMA becomes the property of the Contractor.
6. For mix design purposes, the Contracting Authority will test samples of the RAM. The aggregate gradation and amount of asphalt binder in the RAM will be based on the Contracting Authority's extraction tests. For mixtures containing RAM, adjust the contract binder grade as directed in Materials I.M. 510. No adjustments will be made to the contract unit price for required changes to the asphalt binder grade.
  - a. **Classified RAP.**
    - 1) Classified RAP is from a documented source with the aggregate meeting the appropriate quality requirements in Materials I.M. 510, and properly stockpiled.
    - 2) Classified RAP may be used in the base, intermediate, and surface mixtures for which the RAP aggregate qualifies. Classified RAP may be used in accordance with Table 2303.02-1.
    - 3) Credit for frictional aggregate may be given for virgin aggregates used in the original pavement to be reclaimed. Types 4 and 5 frictional aggregate content in the RAP may be given full credit, while Types 2 and 3 content may be given credit for half the proportion in the original pavement. Credit may be used toward the total frictional aggregate requirement. No frictional credit shall be given beyond one generation of the RAP's service life.
    - 4) Credit may be given for crushed particles in the original pavement to be reclaimed as determined in the paving history (or mix design when paving history is unavailable).
  - b. **Certified RAP.**  
Any stockpiled RAP not meeting the requirements of Classified RAP or from an unknown source may be given a Certified status when meeting quality control sampling, testing, and reporting requirements in Materials I.M. 505. Certified RAP may be used in accordance with Table 2303.02-1.
  - c. **Unclassified RAP.**
    - 1) Any stockpiled RAP not meeting the requirements of Classified RAP or Certified RAP shall be designated as Unclassified RAP. Unclassified RAP may be used in accordance with Table 2303.02-1. No frictional aggregate credit or aggregate crushed particles credit will be given for Unclassified RAP.
    - 2) When an Unclassified RAP stockpile is characterized by sampling and testing for mix design, no material can be added to the stockpile until the project is completed.

Table 2303.02-1: Allowable RAP Usage

Mix Designation	Aggregate Quality Type	Maximum Allowance Allowable Usage		
		Unclassified RAP	Certified <sup>2,3</sup> RAP	Classified RAP
HMA 100K S	B	0%	10%	No limit <sup>1</sup>
HMA 100K I	B	10%	20%	No Limit
HMA 100 K B	B	10%	20%	No Limit
HMA 300K S	B	0%	10%	No limit <sup>1</sup>
HMA 300 K I	B	10%	20%	No Limit
HMA 300K B	B	10%	20%	No Limit
HMA 1M S L-4	A	0%	0%	No limit <sup>1</sup>
HMA 1M S	A	0%	0%	No limit <sup>1</sup>
HMA 1M I	B	10%	20%	No Limit
HMA 1M B	B	10%	20%	No Limit
HMA 1M B (shoulder)	B	10%	20%	No Limit
HMA 3M S L-4	A	0%	0%	No limit <sup>1</sup>

HMA 3M S L-3	A	0%	0%	No limit <sup>1</sup>
HMA 3M S	A	0%	0%	No limit <sup>1</sup>
HMA 3M I	A	0%	0%	No Limit
HMA 3M B	B	10%	20%	No Limit
HMA 10M S L-3	A	0%	0%	No limit <sup>1</sup>
HMA 10M I	A	0%	0%	No Limit
HMA 10M B	B	10%	20%	No Limit
HMA 30M S L-3	A	0%	0%	No limit <sup>1</sup>
HMA 30M S L-2	A	0%	0%	No limit <sup>1</sup>
HMA 30M I	A	0%	0%	No Limit
HMA 30M B	B	10%	20%	No Limit
HMA 100M S L-2	A	0%	0%	No limit <sup>1</sup>
HMA 100M I	A	0%	0%	No Limit
HMA 100M B	B	10%	20%	No Limit
Note: 1. At least 70% of the total asphalt binder in the surface mix shall be virgin. 2. Certified RAP meeting Type A quality for alumina per Section 4127 (by a lab designed by the Engineer) shall have the same maximum allowable usage as Classified RAP for all mixes, and credit for crushed particles shall be the percent of aggregate retained on the #8 (2.36 mm) sieve from Engineer's extraction test. 3. Certified RAP meeting Type B quality for alumina per Section 4127 (by a lab designated by the Engineer) shall have the same maximum allowable usage as Classified RAP for mixes allowing Type B aggregate quality.				

7. Pre-consumer or post-consumer shingles that have been processed, sized, and ready for incorporation into an asphalt mixture constitute RAS material.
8. Up to 5% RAS by weight of total aggregate may be used in the design and production of an asphalt mixture. The percentage of RAS used is considered part of the maximum allowable RAP percentage. Unless explicitly stated otherwise in this specification or Materials I.M. 505, use RAS according to the same requirements as prescribed for RAP material.
9. RAS shall be certified from an approved supplier designated in Materials I.M. 506. Material processed prior to DOT source approval will not be certified.

#### D. Flexible Paving Mixture.

1. The job mix formula (JMF) is the percentage of each material, including the asphalt binder, to be used in the HMA mixture. Ensure JMF gradation is within control points specified for particular mixture designated. Use JMF to establish a single percentage of aggregate passing each required sieve size.
2. The basic asphalt binder content is the historical, nominal mixture asphalt binder content, expressed as percent by weight (mass) of asphalt binder in total mixture. Apply values in Table 2303.03-1, based on mixture size and type.
3. If asphalt binder demand for the combination of aggregates submitted for an acceptable mix design exceeds the basic asphalt binder content (see Table 2302.02-4 2303.02-2) by more than 0.75%, include an economic evaluation with the mix design. ~~Base this evaluation on past job mix history, possible aggregate proportion changes, and aggregate availability and haul costs for any changes or substitutions considered.~~ For economic evaluation, provide an alternate mix design utilizing aggregates which results in an optimum binder content not exceeding basic asphalt binder content by more than 0.75% and documentation of costs associated with hauling both proposed aggregates and alternate aggregates to plant site. Alternate JMF shall meet requirements of Section 2303.

Table 2303.02-2: Basic Asphalt Binder Content (%)

Size	Aggregate Type	1 inch (25 mm)	3/4 inch (19 mm)	1/2 inch (12.5 mm)	3/8 inch (9.5 mm)
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Intermediate and Surface	Type A	4.75	5.50	6.00	6.00
Intermediate and Surface	Type B	5.25	5.75	6.00	6.25
Base	Type B	5.25	6.00	6.00	6.25

4. Use a mixture design meeting gyratory design and mixture criteria corresponding to the design level specified in the contract documents. The Engineer may approve the substitution of any mixture which meets requirements for a higher mixture than specified in the contract documents, at no additional cost to the Contracting Authority. When a commercial mix is specified, use a 1/2 inch (12.5 mm) 300K surface mixture or higher for JMF approval.
5. Use 1,000,000 ESAL HMA base mixture for shoulders placed as a separate operation. For outside shoulders on Interstate projects, the Contractor has the option to substitute the mainline intermediate or surface mixture for a specified base mixture, at the Contractor's expense.
6. Unless otherwise indicated on the contract documents, use a 1/2 inch (12.5 mm) or 3/4 inch (19 mm) 1,000,000 ESAL HMA Base mixture (or higher ESAL) for base widening. When an adjoining surface is designed for 300,000 ESALS or less and is paved during same project, use a base mixture at same ESAL level used in surface mixture.
7. Prepare gyratory mixture designs for base, intermediate, and surface mixtures. Follow the procedure outlined in Materials I.M. 510. Submit a mixture design complying with Materials I.M. 510. Propose both a production and a compaction temperature between 215°F (102°C) and 280°F (138°C) for WMA mixture designs.
8. Use a gyratory ~~compactor~~ compactor for design and field control meeting ~~the protocol for Superpave gyratory compactors AASHTO T 312. Compactors for which compliance with this protocol is pending may be used at the discretion of the District Materials Engineer.~~

#### E. Other Materials.

##### 1. Tack Coat.

Tack coat may be SS-1, SS-1H, CSS-1, or CSS-1H. Do not mix CSS and SS grades. RC-70 and MC-70 may also be used after October 1, at the Contractor's option.

##### 2. Anti-strip Agent.

- a. Perform a moisture sensitivity evaluation of the proposed asphalt mixture design in accordance with Materials I.M. ~~507~~ 319 for the following mixtures when placed in travelled lanes:
  - 1) Mixtures for Interstate and Primary highways designed for 30,000,000 ESALS and higher
  - 2) Mixtures for Interstate and Primary highways containing quartzite, granite, or other siliceous (not a limestone or dolomite) aggregate obtained by crushing from ledge rock in at least 40% of the total aggregate (virgin and recycled) or at least 25% of the plus No. 4 (4.75 mm).
  - ~~3) All WMA mixtures placed in travel lanes designed for 10,000,000 ESALS and higher. For the purpose of evaluating moisture sensitivity of a proposed mix design, the Contractor may test the proposed JMF from plant produced material placed off-site at no additional cost to the contracting authority.~~

For the purpose of evaluating moisture sensitivity of a proposed mix design, Contractor may test proposed JMF from plant produced material placed off-site at no additional cost to the Contracting Authority.

- b. Sample and test plant produced mixture for moisture susceptibility in accordance with Materials I.M. 204 and Materials I.M. ~~507~~ 319 for bid item plan quantities of more than 1000 tons (1000 Mg) as follows:
  - 1) For mixtures satisfying Article 2303.02, E, 2, a.
  - 2) For conditions satisfied in Article 2303.02, E, 2, g f.
- c. Moisture susceptibility testing of plant produced mixture will not be required for base repair, patching, temporary pavement, or paved shoulders. Moisture susceptibility testing for mixture bid items of 1000 tons (1000 Mg) or less is only required on the mix design for mixtures satisfying Article 2303.02, E, 2, a.
- d. Use the following minimum stripping inflection point (SIP) requirements for plant produced material:

PG High Temperature, °C	SIP, Number of Passes <sup>1,2</sup>	
	< 3,000,000 ESALS	≥ 3,000,000 ESALS
58	10,000	14,000
64	10,000	14,000
70	10,000	14,000

Note 1: If ratio between creep slope and stripping slope as defined in Materials I.M 319 is less than 2.00, the SIP is invalid.

Note 2: Minimum SIP for mixtures placed as base widening is 5000 passes.

~~A minimum tensile strength ratio (TSR) of 80.0% is required on plant produced mixture.~~ When notified of non-compliant results, the Engineer may suspend paving operations until an approved “significant mix change” is implemented.

- ~~e.~~ For mixture bid items of more than 1000 tons (1000 Mg), when the Contractor’s mix design TSR results are greater than or equal to 80% and less than 90%, an anti-strip agent will be required until the Contracting Authority’s TSR results on the plant produced mixture are equal to or exceeding 80%. Plant produced material without anti-strip shall be tested without penalty to confirm the need for an anti-strip agent. See Materials I.M. 510 Appendix C for additional information.
- ~~f e.~~ When the Contractor’s mix design TSR SIP results are below 80.0% the minimum specified in Article 2303.02, E, 2, d, an anti-strip agent will be required. Plant produced material with anti-strip shall be tested to verify the minimum TSR SIP is achieved. See Materials I.M. 510 Appendix C for additional information.
- ~~g f.~~ The Engineer may require an evaluation of the test method in Materials I.M. 507 319 for plant produced mixture as follows:
  - 1) When there is a “significant mix change” to a mix satisfying Article 2303.02, E, 2, a.
  - 2) When there is contamination and/or coating of the aggregate for any mixture placed in a travel lane.
  - 3) When aggregates are inadequately dried during production of any mixtures placed in a travel lane.
- ~~h g.~~ The following anti-strip agents may be used:
  - 1) **Hydrated Lime.**  
Meet the requirements of AASHTO M 303, Type I or ASTM C 1097, Type S. Do not apply Section 4193. Hydrated lime will not be considered part of the aggregate when determining the job mix formula and the filler/bitumen ratio.
  - 2) **Liquid Anti-strip Additives.**  
For each JMF, obtain approval for liquid anti-strip additives blended into the binder. Approval will be based on the following conditions:
    - a) The asphalt binder supplier provides test results that the additive does not negatively impact the asphalt binder properties, including short term and long term aged properties.
    - b) The design is to establish the optimum additive rate when comparing the dry strength of specimens prepared with asphalt binder not containing the anti-strip additive to conditioned specimens prepared with asphalt binder containing the anti-strip additive that produces the optimum (maximum) SIP value. See Materials I.M. 510 Appendix C for additional information.
    - ~~c) A dosage rate can be selected such that the conditioned indirect tensile strength can be improved by at least 10% while meeting all other requirements.~~
  - 3) **Polymer-based Liquid Aggregate Treatments.**  
For each JMF, obtain approval for polymer-based liquid aggregate treatments. Approval will be based on the design establishing the optimum additive rate when comparing the dry strength of specimens prepared without the anti-strip additive to conditioned specimens prepared with asphalt binder containing the anti-strip additive that produces the optimum (maximum) SIP value. See Materials I.M. 510 Appendix C 319 for additional information.

### 3. Sand for Tack Coats.

Use sand meeting the requirements of Gradation No. 1 of the Aggregate Gradation Table in Article 4109.02.

### 4. Fabric Reinforcement.

Use fabric reinforcement meeting the requirements of Article 4196.01, B, 4.

**5. WMA Technologies.**

Chemical additives, organic additives, or water injection systems approved by the Bituminous Engineer may be used at the rate established by the mixture design in the production of WMA. Once production of a bid item has begun with a WMA technology, continue its use throughout the remainder of the bid item's production unless otherwise approved by the District Materials Engineer.

**2303.03 CONSTRUCTION.****A. General.**

1. Contractor is responsible for all aspects of the project.
2. Provide quality control management and testing, and maintain the quality characteristics specified.
3. Apply Quality Management - Asphalt (QM-A) to asphalt mixture bid items when the plan quantity is greater than 1000 tons (1000 Mg) ~~and all Interstate contracts~~. Follow the procedures and meet the criteria established in Articles 2303.02 and 2303.03, B; Section 2521; and Materials I.M. 510 and 511.
4. Apply Article 2303.03, E, for asphalt mixture bid items that have a plan quantity of 1000 tons (1000 Mg) or less as well as any patching bid items. For items bid in square yards ( $m^2$ ), apply Article 2303.03, E when the plan quantity by weight (estimated with a unit weight of 145 pounds per cubic foot ( $2323 \text{ kg/m}^3$ ) unless otherwise stated on the plans) does not exceed 1000 tons (1000 Mg). Article 2303.03, E applies to Interstate patching as well as Interstate bid items of less than 1000 tons (1000 Mg), all of which are placed in a non-travel lane.

**B. Equipment.**

Provide sufficient equipment of the various types required to produce, place, and compact each layer of mixture as specified, such that the mixture is workable at the minimum placement and compaction temperature desired, regardless of storage or haul distance considerations.

Modify the asphalt mixing plant as required by the manufacturer when introducing a WMA technology. Plant modifications may include additional plant instrumentation, the installation of water injection systems and/or WMA additive delivery systems, tuning the plant burner and adjusting the flights in order to operate at lower production temperatures and/or reduced tonnage.

Use equipment meeting the requirements of Section 2001 with the following modifications:

**1. Plant Calibration.**

- a. Calibrate each plant scale and metering system before work on a contract begins. Use calibration equipment meeting the manufacturer's guidelines and Materials I.M. 508.
- b. The Engineer may waive calibration of permanent plant scales when a satisfactory operational history is available. The Engineer may require any scale or metering system to be recalibrated if operations indicate it is necessary.
- c. Make calibration data available at the plant.
- d. Calibrate each aggregate feed throughout an operating range wide enough to cover the proportion of that material required in the JMF. Make a new calibration each time there is a change in size or source of any aggregate being used.
- e. For continuous and drum mixing plants, calibrate the asphalt metering pump at the operating temperature and with the outlet under pressure equal to that occurring in normal operations.

**2. Paver.**

Apply Article 2001.19. Spreaders described in Article 2001.13, D, may be used to place paved shoulders. Spreaders used to place the final lift of paved shoulders shall meet additional requirements of Article 2001.19.

**3. Rollers.**

- a. For initial and intermediate rolling, use self-propelled, steel tired, pneumatic tired, or vibratory rollers meeting the requirements of Article 2001.05, B, C, or F. Their weight (mass) or tire pressure may be adjusted when justified by conditions.

- b. For finish rolling, use self-propelled, steel tired rollers or vibratory rollers in the static mode that meet the requirements of Article 2001.05, B, or F.

**4. Scales.**

Apply Article 2001.07, B, to paving operations regardless of the method of measurement.

**C. HMA Construction.**

**1. Maintenance of the Subgrade and Subbase.**

- a. Maintain completed subgrade and subbase to the required density, true cross section, and smooth condition, prior to and during subsequent construction activities.
- b. If rutting or any other damage occurs to the subgrade or subbase as a result of hauling operations, immediately repair the subgrade and subbase. Such repair will include, if necessary, removal and replacement, at no additional cost to the Contracting Authority.
- c. Should traffic by others authorized to do work on the project be specifically permitted by the Engineer to use loads which exceed the Contractor's established limit, the Contracting Authority will pay repair costs for repairs directed by the Engineer.

**2. Preparation of Existing Surfaces.**

**a. Cleaning.**

Clean and prepare existing surface according to Article 2212.03, B, 1.

**b. Tack Coats.**

- 1) Apply tack coats when the entire surface area on which the coat is to be applied is free of moisture. Do not apply them when the temperature on the surface being covered is less than 25°F (-4°C).
- 2) Place a tack coat to form a continuous, uniform film on the area to be covered. ~~Unless directed otherwise, spread the tack coat at an undiluted rate of 0.02 to 0.05 gallon per square yard (0.1 to 0.2 L/m<sup>2</sup>). The tack coat may be diluted with water to improve application.~~ Unless directed otherwise, spread tack coat at the following undiluted rates:
  - New HMA Surface 0.03 to 0.05 gallon per square yard (0.14 to 0.23 L/m<sup>2</sup>)
  - Milled HMA Surface 0.05 to 0.07 gallon per square yard (0.23 to 0.32 L/m<sup>2</sup>)
  - PCC/Existing HMA Surface 0.04 to 0.06 gallon per square yard (0.18 to 0.27 L/m<sup>2</sup>)
 Tack coat may be diluted with water up to 1:1 to improve application.
- 3) Allow tack coat to adequately cure prior to placement of HMA to assure bond to the underlying surface and avoid damage of the HMA being placed. If tack coat surface becomes dirty from weather or traffic, thoroughly clean and, if necessary, retack. A light application of sand cover may also be required, but this is anticipated only for excessive application rates, breakdowns, and short sections remaining at the end of a day's run.
- 4) On highways being constructed under traffic, use procedures that provide safety and convenience to the public (without soiling their vehicles) as controlling factors. Limit tack coat application lengths to minimize inconvenience to the public. Keep applications within the hot mixture placing work area that is controlled by flaggers at each end. Plan applications so they will be covered with hot mixture when the work area is opened to traffic at the end of the day's work.
- 5) Tack the vertical face of exposed, longitudinal joints as a separate operation at a rate from 0.10 to 0.15 gallon per square yard (0.5 to 0.7 L/m<sup>2</sup>). Tack before the adjoining lift is placed. Lightly paint or spray vertical surfaces of all fixtures, curbs, bridges, or cold mixture with which the hot mixture will come in contact to facilitate a tight joint with the fresh mixture.

**c. Fabric Reinforcement.**

- 1) When fabric reinforcement is required, the locations will be designated in the contract documents.
- 2) Do not place fabric on wet or damp surfaces, or when the road surface is less than 50°F (10°C).
- 3) Apply fiberglass fabric only with an adhesive recommended by the manufacturer.
- 4) Place fabrics with an adhesive backing according to the manufacturer's recommendations.
- 5) Place other fabrics with a heavy coat of asphalt binder at a rate of 0.20 to 0.25 gallons per square yard (0.9 to 1.1 L/m<sup>2</sup>). Use the same binder grade used in the asphalt concrete mixture. For binders containing a WMA technology, place at a temperature between 260°F and 315°F (127°C and 160°C), otherwise place at a temperature between 295°F and 315°F (145°C and 160°C).
- 6) Place fabric reinforcement according to the contract documents (full width or individual crack or joint treatment). Place fabric immediately following the adhesive or asphalt binder placement under the fabric. Placement may be by hand or by a mechanical method designed for this purpose.

- 7) Take precautions to avoid wrinkles in the fabric and to ensure that air bubbles are removed without breaking the fabric. Cut and lap wrinkles or folds which cannot be removed by brushing in order to provide a smooth surface.
- 8) Additional adhesive or asphalt binder may be required to produce a tight, bonded surface. When applied full lane width, use a minimum 12 inch (300 mm) transverse and longitudinal lap.
- 9) Avoid applying tack coat over longitudinally placed fabric.
- 10) To avoid damage to fabric, do not allow traffic over fabric during placement and during curing of the adhesive material. A light application of HMA mix may be hand sprinkled on the fabric to prevent damage from necessary equipment traffic.
- 11) When directed by the Engineer, repair damaged or soiled fabric prior to HMA overlay, at no additional cost to the Contracting Authority. The Engineer may also require sanding during this period, at no additional cost to the Contracting Authority.

### 3. Handling, Production, and Delivery.

Ensure plant operation complies with the following requirements:

#### a. Handling Mineral Aggregate and RAP.

- (1) Keep various aggregate products used separate from one another. Make adequate provisions to prevent intermingling.
- 2) Handle stockpiling and processing in a manner to ensure uniform incorporation of the aggregate into the mix.
- 3) Feed various aggregates separately in their proper proportions using feeders to the cold elevator. Feed them at a rate to permit correct and uniform temperature control of heating and drying operations.

#### b. Handling Asphalt Binder.

Bring asphalt binder to a temperature of 260°F to 330°F (125°C to 165°C) before being measured for mixing with the aggregates. The temperature between these limits may be further regulated according to the characteristics of the mixture, method of proportioning, and viscosity of the asphalt binder. Heat modified asphalt binder according to the supplier's recommendations.

#### c. Handling Anti-strip Agents.

##### 1) Hydrated Lime.

Accurately proportion lime using a method acceptable to the Engineer.

##### a) Added to a Drum Mixer.

- (1) Add hydrated lime at the rate of 0.75% by weight (mass) of the total aggregate (virgin and RAP) for Interstate and Primary projects. Add hydrated lime to a drum mixer using one of the following methods:
  - (a) Add to virgin aggregate on the primary feed belt, as a lime water slurry.
  - (b) Thoroughly mix with the total combined aggregate if the aggregate contains at least 3% total moisture.
  - (c) Add to the outer drum of a double drum system away from heated gas flow and prior to the addition of the virgin asphalt binder.
- (2) Alternative methods for mixing will be allowed only with the Engineer's approval. Do not introduce hydrated lime directly into a single drum mixer by blowing or by auger.

##### b) Added to a Batch Plant.

Add hydrated lime at the rate of 0.5% by weight (mass) of the total aggregate (virgin and RAP) for Interstate and Primary projects. Introduce it to a batch plant using one of the methods below. In any case, introduce the lime prior to the start of the dry mix cycle.

- (1) Place on the recycle belt which leads directly into the weigh hopper.
- (2) Add directly into the pugmill.
- (3) Add directly into the hot aggregate elevator into the hot aggregate stream.

##### c) Added to the Aggregate Stockpile.

Add hydrated lime at a rate established by the ~~AASHTO T-283 test~~ optimization of the SIP as determined by Materials I.M. 319. ~~The instructions for establishing the rate are discussed in Materials I.M. 510.~~ Add it to the source aggregates defined in Article 2303.02, E, 2, thoroughly mixed with sufficient moisture to achieve aggregate coating, and then place in the stockpile.

##### 2) Liquid.

- a) When liquid anti-strip additives are used, employ equipment complying with the anti-strip manufacturer's recommended practice to store, measure, and blend the additive with the binder.

- b) The additive may be injected into the asphalt binder by the asphalt supplier or the Contractor. If the Contractor elects to add the liquid anti-strip agent, they assume the material certification responsibilities of the asphalt binder supplier. Ensure the shipping ticket reports the type and amount of additive and time of injection.
  - c) Ensure the asphalt supplier provides the Contractor and Engineer with the shelf life criteria defining when the anti-strip additive maintains its effectiveness. Do not use binder that has exceeded the shelf life criteria.
  - d) When using polymer-based aggregate treatment, comply with the manufacturer's recommended specifications and guidelines.
- d. Production of Hot Mix Asphalt Mixtures.**
- 1) Regulate the exact proportions of the various materials to be within the limits specified to produce a satisfactory bituminous coating and mixture. First dry mix the aggregates, then add the asphalt binder.
    - a) In batch plants, add the asphalt binder in an evenly spread sheet over the full length of the mixer box.
    - b) In continuous plants, spray the asphalt binder evenly into the aggregate within the first 30% of the length of the mixer box using a positive pressure spray.
    - c) In drum mixing plants, spray the asphalt binder evenly into the aggregate using a positive pressure spray.
  - 2) Operate the mixer so that the mixture is of consistently uniform temperature, and when discharged from the mixer does not vary more than 20°F (11°C).
  - 3) Do not allow the temperature of the mixtures to fall outside the following parameters:
    - a) Keep the production temperature of WMA mixtures between 215°F (102°C) and 280°F (138°C) until placed on the grade. Maximum production temperature for WMA is 330°F (165°C) after October 1st.
    - b) Do not produce WMA mixtures more than 10°F (6°C) below the target temperature designated in the JMF without the approval of the Engineer.
    - c) Keep the production temperature of HMA mixtures between 225°F (102°C) and 330°F (165°C) until placed on the grade. Do not discharge HMA into the hopper when its temperature is less than:
      - (1) 245 °F (118°C) for a nominal layer thickness of 1 1/2 inches (40 mm) or less, or
      - (2) 225 °F (102°C) for a nominal layer thickness of more than 1 1/2 inches (40 mm).
    - d) Flexible paving mixtures not meeting these requirements will be rejected.
    - e) Production temperature limits apply starting at point of discharge from mixer.
  - 5 4) Use a rate of production that will not exceed the manufacturer's rated capacity for the mixer and will provide uniform coating. For batch mixers, use a dry mixing time of no less than 5 seconds and a wet mixing time of no less than 25 seconds. For continuous mixers, use a mixing time of no less than 30 seconds.
  - 6 5) Control handling and manipulation of the hot mixture from the mixer to the final spread on the road in order to maintain uniform composition and minimize segregation of coarser particles. Minimize segregation to the extent that it cannot be visibly observed in the compacted surface. Apply only approved release agents to trucks and equipment, as specified in Article 2001.01.
  - 7 6) Except for an unavoidable delay or breakdown, provide continuous and uniform delivery of hot HMA to any individual spreading unit. Deliver at a rate sufficient to provide as continuous an operation of the spreading unit as practical. Keep the paver hopper sufficiently full at all times to prevent non-uniform mixture flow to the screed.

#### 4. Placement.

- a. Clean the surface of each layer according to Article 2212.03, B, 1. If necessary, retack to provide bond with the succeeding course.
- b. Prior to placing the final lift, correct bumps or other significant irregularities that appear or are evident in the intermediate course or other lower course.
- c. Do not place HMA mixtures under the following circumstances:
  - 1) On a wet or damp surface.
  - 2) When road surface temperature is less than that shown in Tables 2303.03-1 and 2303.03-2.

**Table 2303.03-1: Base and Intermediate Course Lifts of Asphalt Mixtures**

Nominal Thickness - inches (mm)	Road Surface Temperature, °F (°C)
1 1/2 (40)	40 (4)
2 - 3 (50 - 80)	35 (2)

Over 3 (Over 80)	35 (2)
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**Table 2303.03-2: Surface Course Lifts of Asphalt Mixtures**

Nominal Thickness - inches (mm)	Road Surface Temperature, °F (°C)
1 (30)	HMA: 50 (10) / WMA: 40 (4)
1 1/2 (40)	HMA: 45 (7) / WMA: 40 (4)
2 and greater (50 and greater)	40 (4)

- 3)** After November 15, except with the Engineer's approval.
- d. The Engineer may further limit placement if, in the Engineer's judgment, other conditions are detrimental to quality work.
  - e. When placing the mixture, maintain a finishing machine forward speed that will provide a continuous uniform operation. Minimize stopping.
  - f. Use a wire or string line to guide finishing machine and maintain alignment. Correct edge alignment irregularities immediately.
  - g. The contract documents will show the total thickness to be placed. Spread the mixture at a rate such that, when compacted, the layer(s) will be the required thickness.
  - h. Base the minimum layer thickness on Table 2303.03-3. Minimum layer thickness does not apply to leveling/scratch courses.

**Table 2303.03-3: Minimum Lift Thickness**

Design Mix Size - inches (mm)	Minimum Lift Thickness - inches (mm)
3/8 (9.5)	1 (25)
1/2 (12.5)	1 1/2 (40)
3/4 (19)	2 (50)
1 (25)	3 (75)

- i. Ensure the compacted thickness of the top layer does not exceed 3 inches (75 mm). This restriction does not apply to HMA shoulders.
- j. The maximum compacted thickness of lower layers may exceed 4 inches (100 mm) if it is demonstrated that the thicker layers have satisfactory density. The riding characteristics of the thicker layers must be within conformance to that expected from a 3 inch (75 mm) layer.
- k. Complete each layer to full width before placing succeeding layers.
- l. While operating on the road surface, do not use kerosene, distillate, other petroleum fractions, or other solvents, for cleaning hand tools or for spraying the paver hopper. Do not carry containers of cleaning solution on or near the paver. When a solvent is used, do not use the paver for at least 5 hours after cleaning. Collect and remove all cleaning materials and cleaning residue from the project and plant site. The cleaning material and residue becomes the property of the Contractor.
- m. Whenever practical, spread mixtures using a finishing machine. Irregular areas may be spread by hand. Spread the hot mixture uniformly to the desired depth with hot shovels and rakes. Do not dump loads faster than they can be spread properly. Do not allow workers to stand on the loose mixture while spreading.
- n. After spreading, carefully smooth to remove all segregated coarse aggregate and rake marks. Use rakes and lutes designed for use on HMA mixtures.
- o. Unless stated elsewhere in the contract documents, when placing two adjacent lanes, pave no more than 1 day of rated plant production before paving the adjacent lane(s). Place the adjacent lane to match the first lane during the next day of plant production.
- p. Do not spread more mixture than can be compacted in the specified working hours of the same working day.
- q. At the close of each working day, clear all construction equipment from the roadbed.
- r. Prior to opening a lane to traffic, place fillets or full width granular shoulders according to Article 2121.03, C, 4. Place the material adjacent to and equal in thickness to the resurfacing. Fillet removal is incidental to the HMA mixture.

## 5. Compaction.

### a. General.

- 1) Promptly and thoroughly compact each layer. Use mechanical tampers for areas inaccessible to the rollers.

- 2) Use a rolling procedure and compactive effort that will produce a surface free of ridges, marks, or bumps. Obtain the Engineer's approval for the rolling procedure and compactive effort.
  - b. **Class I Compaction.**
    - 1) **Applications.**
      - a) Use Class I compaction for base, intermediate, and surface courses for the traffic lanes, ramps, and loops on all roadways.
      - b) For Class I compaction, the quality characteristic is in-place air void content and will be based on the theoretical maximum specific gravity (Gmm) obtained from the Quality Control Program for that day's mixture.
    - 2) **Test Strip Construction for Class I Compaction.**
      - a) For the purpose of evaluating properties of the HMA mixtures and for evaluating an effective rolling pattern:
        - (1) Construct a test strip of the surface mixture prior to its placement on the surface course for Interstate highways, Primary highways, and ramps connecting Interstate and Primary highways.
        - (2) Construct a test strip of the intermediate mixture at the start of its placement on the intermediate course for Interstate highways, interstate-to-interstate ramps.
        - (3) Test strips for base mixtures may be constructed, but are not required.
      - b) When the contract documents specify both intermediate and surface courses and a test strip is required, place a surface course test strip in lieu of intermediate mixture in a section of the intermediate course prior to actual surface course placement. If surface course and intermediate course are not placed the same calendar year, then place test strip at beginning of surface mix production.
      - c) Test strips are not required when the entire production of the mixture bid item is placed in a single day.
      - d) The quantity of HMA mixture subject to the test strip production, will be pre-established with the Engineer and limited to a half day's production:
      - e) Only one test strip will be allowed for each mixture and shall be declared to the Engineer prior to placement. The Engineer may require additional test strips if a complying HMA mixture or rolling pattern was not established.
      - f) Use procedures and documentation during test strip construction that allow the Engineer and Contractor to confirm mixture design properties and effectiveness of compaction procedures.
      - g) Use test strip production control that meets the requirements of Article 2303.03, D, 3, c. The test strip will be an independent lot. Determine sublots in accordance with Table 2303.03-4.
  - c. **Class II Compaction.**  
Intended for paved shoulders, temporary crossovers, onsite detours, and other situations where Class I is not specified.
    - 1) For all rollers, make initial contact with the hot mixture using the power driven wheels or drum.
    - 2) Perform initial rolling at a temperature so the mixture will compact without excessive distortion. Except on longitudinal joints and super-elevated curves, begin rolling with the initial roller at the outer edges of the pavement. With each successive pass, progress inward toward the center. For each reverse trip, lap all but 4 to 6 inches (100 to 150 mm) of the previous track. When reversing direction, stop the initial roller at an angle with the longitudinal direction.
    - 3) Following the initial rolling, give the layer an intermediate rolling with a pneumatic tired roller before the temperature falls below 225°F (110°C). Cover the area no less than six times with the intermediate roller.
    - 4) Use a finish, steel tired roller to smooth out all marks and roughness in the surface.
    - 5) For areas inaccessible to rollers, use mechanical tampers or other approved compaction methods.
6. **Joints and Runouts.**
    - a. Construct longitudinal joints for courses on resurfacing projects directly above the longitudinal joint in the existing pavement. Limit the offset distance between longitudinal joints in succeeding full depth HMA paving courses to 3 inches (75 mm) or less. Adjust hot mixture spreading along longitudinal joints to secure complete joint closure and full compression of the mixture with a smooth surface and joint after compaction.
    - b. Separate transverse construction joints in succeeding courses by at least 6 feet (1.6 m). Do not use wood or metal headers to form joint edge during rolling of the fresh mixture. Saw header to a straight line at right angles to the center line to provide a full thickness vertical edge before continuing paving. Provide a 10 foot (3 m) straightedge for checking transverse construction joints for smoothness.

Before compaction, use hand methods to correct surface variations at transverse construction joints indicated by the straightedge.

- c. When a transverse construction joint is open to traffic, install a temporary runout 10 feet (3 m) long per 1 inch (25 mm) of lift thickness. Use suitable paper or burlap (not sand, dirt, or wood) under the taper to prevent adhesion.
- d. When required to end paving for winter shutdown, locate runouts adjacent to each other. Install a winter shutdown runout 25 feet (8 m) long per 1 inch (25 mm) of lift thickness.
- e. For temporary runouts open to traffic for periods greater than 4 weeks or winter shutdown runouts, the Contractor may reduce the amount of top size aggregate in the transition taper. Remove temporary runouts and winter shutdown runouts before commencing paving. Runout removal is incidental to the HMA mixture.

## **7. Miscellaneous Operations.**

### **a. Leveling and Strengthening Courses.**

- 1) The contract documents will show course thickness. Place strengthening and leveling courses as indicated in the contract documents. Use the same mixture specified for the base or intermediate course.
- 2) When the width of strengthening or leveling course is 8 feet (2.4 m) or more, spread using a finishing machine.
- 3) Compact leveling courses and intermediate mixtures placed as leveling/scratch courses (less than or equal to 1 inch (25mm) plan thickness) using Class II compaction, except make all passes with a pneumatic roller.

### **b. Wedge Courses.**

- 1) Use the base or intermediate mixture to construct wedge courses used to secure desired curve super-elevation. When possible, spread using a finishing machine.
- 2) Place wedge courses in compacted layers no thicker than 3 inches (75 mm). Avoid crushing the coarse aggregate. Place wedge courses to the full width of the pavement.
- 3) On super-elevated curves which require wedge course placement, stage the shoulder construction. After completing each day's wedge placement operations and prior to suspending that day's construction activities, construct a full width shoulder on the high side up to the completed wedge course elevation. Shoulder construction staging will be considered incidental to shoulder construction.
- 4) The Engineer may waive field void sampling for wedge courses provided compaction has been thorough and effective.

### **c. Fixtures in the Pavement Surface.**

- 1) Adjust manholes, intakes, valve boxes, or other fixtures encountered within the area to be covered by HMA to conform to the final adjacent finished surface. Payment for adjustment of manholes or intakes will be per Section 2435. Payment for adjustment of valve boxes and other fixtures will be per Section 2554. Unless specified otherwise in the plans, adjust fixtures:
  - Between placing the surface course and the layer preceding the surface course, or
  - After placing the surface course using a composite patch or PCC patch.
- 2) Use PCC and HMA patch material complying with the requirements of Section 2529. Make patches large enough to accommodate the structure being adjusted.
- 3) Construct patches to be square. Orient them diagonally to the direction of traffic flow. Ensure the elevation of the adjusted fixture and patch does not differ from the elevation of the surrounding pavement surface by more than 1/4 inch (6 mm).
- 4) When shaping and compacting resurfacing near inlets to storm sewer intakes, shape to ensure maximum drainage into intakes.

### **d. Fillets for Intersecting Roads and Driveways.**

- 1) Shape, clean of loose material, and tack coat the surface adjacent to the pavement being surfaced when fillets are designated in the contract documents for driveways to homesteads and commercial establishments and at intersecting roads. On the tack coated surface, place and compact the hot mixture in layers equal to the adjacent layer. Extend from the edge of the pavement as shown on the plans.
- 2) Place and compact fillets at intersecting roads at the same time as the adjacent layer.
- 3) Entrance fillets that are 8 feet (2.4 m) or wider may be placed as a separate operation. Pave fillets which are 8 feet (2.4 m) or wider with a self propelled finishing machine described in Article 2001.19.
- 4) The Engineer may approve other equipment for placement of fillets, based on a demonstration of satisfactory results.

**e. Stop Sign Rumble Strips.**

If the plans include the bid item Rumble Strip Panel (In Full Depth Patch), apply Section 2529. To meet the requirements of placing Stop Sign Rumble Strips before opening roadway sections to traffic, the Contractor may construct temporary rumble strip panels meeting the final pattern and location of the Stop Sign Rumble Strip indicated in the plans

**f. Paved HMA Shoulders.**

- 1) Compact paved HMA shoulders using one of the following methods:
  - a) Class II compaction (Article 2303.03, C, 5, c),
  - b) Rolling pattern established during the first day of shoulder placement to achieve Class I compaction (Article 2303.03, C, 5, b), or
  - c) Same rolling pattern established for adjoining mainline or ramp driving lane, as determined by density coring.
- 2) Shoulder area will not be included in Percent Within Limits (PWL) calculations for field voids on adjoining mainline or ramp driving lane. A price adjustment may be applied to shoulder areas that do not adhere to the established roller pattern.

**D. Quality Assurance Program.**

~~For interstate mixtures placed in a travel lane and~~ each mixture bid item that has a plan quantity of more than 1000 tons (1000 Mg) (patching excluded) apply requirements of this article.

For items bid in square yards ( $m^2$ ), apply the requirements of this article when the plan quantity by weight (estimated with a unit weight of 145 pounds per cubic foot ( $2323 \text{ kg/m}^3$ ) unless otherwise specified in the plans) exceeds 1000 tons (1000 Mg).

HMA mixture bid items with plan quantities of 1000 tons (1000 Mg) or less and patching bid items are both defined as small quantities. For those bid items, meet the requirements of Article 2303.03, E. For items bid in square yards ( $m^2$ ), when the plan quantity by weight (estimated with a unit weight of 145 pounds per cubic foot ( $2323 \text{ kg/m}^3$ ) unless otherwise specified in the plans) does not exceed 1000 tons (1000 Mg), meet the requirements of Article 2303.03, E.

**1. General.**

Follow the procedures and meet the criteria established in Articles 2303.02 and 2303.03, B, Section 2521, and Materials I.M. 510 and 511.

**2. Mix Design - Job Mix Formula.**

- a. The Contractor is responsible for the JMF for each mixture.
- b. Submit a completed JMF, using the computer format of Form 956, for approval to the materials lab designated by the Contracting Authority. Submit supporting documentation demonstrating the design process was followed and how the recommended JMF was determined. Include an economic evaluation when required. Include trial and final proposed aggregate proportions (Form 955) and corresponding gyratory data. In addition, submit sufficient loose mixture and individual material samples for approval of the design.
- c. Personnel preparing the JMF shall be Iowa DOT certified in bituminous mix design.
- d. If the JMF is not satisfactory, submit another JMF for review. An approved JMF will be required prior to beginning plant production. The Contractor will be charged \$1000 for each JMF approval requested and performed which exceeds two per mix size, type, and proposal item on any individual project or group of tied projects.

**3. Plant Production.****a. General.**

- 1) Perform sampling and testing to provide the quality control of the mixture during plant production. Certified Plant Inspection according to Section 2521 is required.
- 2) Personnel performing production quality control testing shall be Iowa DOT certified for the duties performed.
- 3) Provide easy and safe access for Iowa DOT staff to the location in the plant where samples are taken.
- 4) All of the following qualify as a "significant mix change":
  - A single occurrence of an aggregate interchange of greater than 5%.
  - An aggregate interchange of greater than 5% from last approved JMF.
  - A single occurrence of an asphalt content change greater than 0.2%.

- An asphalt content change greater than 0.2% from last approved JMF.
- A deletion or introduction of a new material into the mix.
- A change of additive dosage rate.
- A change of binder, aggregate, or additive source.

**b. Sampling and Testing.**

Submit a testing plan meeting the requirements of Materials I.M. 511, Appendix D prior to the preconstruction meeting.

**1) Asphalt Binder**

Sample and test asphalt binder to verify the quality of the binder grade. Take asphalt binder samples at random times as directed and witnessed by the Engineer according to Materials I.M. 204.

**2) Aggregate Gradation**

- Use cold feed or ignition oven gradation for aggregate gradation control to assure materials are being proportioned according to the specifications. Take aggregate quality control samples at random times in accordance with Materials I.M. 204.
- Take a minimum of one aggregate gradation for each day's production that exceeds 100 tons (Mg). ~~Higher testing frequencies may be used when defined by a pre-determined quality control plan approved by the Engineer.~~ When more than one sample in a day's production is tested, use the average gradation to determine compliance of the daily lot.
- Engineer will verify Contractor gradation with an ignition oven or a split cold feed sample. When cold feed quality control is verified with the ignition oven, ~~Split~~ a cold feed sample with the Engineer on the first day's production of each mixture. The Engineer will determine the need for a correction factor for the cold feed gradation based on the Engineer's cold feed gradation and ignition oven results. The Engineer may require additional cold feed split samples to evaluate the need or value of a correction factor for the cold feed and ignition oven gradation.
- Secure aggregate gradation samples transported to the agency lab for ~~determination of the ignition oven correction factor~~ testing in accordance with Materials I.M. 511.

**3) Uncompacted Asphalt Mixture**

- Sample the hot HMA mixture at random locations as directed and witnessed by the Engineer according to Materials I.M. 322. Secure and test the samples according to Materials I.M. 511. Modify sampling location to include placement with mix stored from a prior day's production.
- Sampling frequency will be determined by the estimated daily production of each mixture placed. The number of sublots is defined in Table 2303.03-4:

**Table 2303.03-4: Uncompacted Mixture Sublot Size**

Estimated Daily Production, Tons (Mg)	Number of Sublots
101-500	1
501-1250	2
1251-2000	3
2001-4500	4
Over 4500	5

- The Contractor may request to have a quality control plan that indicates a higher testing frequency if pre-approved by the Engineer at the preconstruction meeting.
- Assist the Engineer with material sampling for verification testing. When the Engineer provides notification that a sample is to be taken, initiate sampling within 15 minutes. Sampling should normally be completed within 30 minutes of notification.
- Do not take paired samples from the first 100 tons (100 Mg) of mix produced each day or the first 100 tons (100 Mg) of mix following a significant mix change. When paving operations are staged so each day of placement is less than 100 tons (100 Mg) for the entire production of the bid item, establish a sampling plan with the Engineer that includes a minimum of one sample per 2500 tons (2500 Mg).
- For PWL analysis of laboratory voids, each mixture bid item will constitute a lot. Lot size is defined as follows:
  - No less than 8 and no more than 20 sequential tests will constitute a lot (exceptions stated below).
  - After the 8<sup>th</sup> test, all subsequent samples collected over the remainder of that week will also be included in the lot up to a maximum of 20.
  - Once a lot has been established with at least 8 tests, a new lot will begin at the start of the following week or the day following the 20<sup>th</sup> sample, whichever occurs first. Lots shall

not contain partial days. When the 20<sup>th</sup> sample is reached, include all samples taken that day in the lot.

- (4) When determining PWL lot size for lab voids, Sunday through Saturday defines a week.
  - (5) If the bid item's production has ended and fewer than 8 tests are available, those tests may be combined with the previous lot provided the maximum lot size has not already been reached. When combining results, if the day to be combined contains the 20<sup>th</sup> sample, include all samples for that day. Do not combine partial day's results.
  - (6) If samples cannot be combined with the previous lot due to maximum lot size restrictions or if fewer than 8 tests are available for the entire production of a bid item, combine those tests into a single lot and use the AAD analysis in Materials I.M. 501.
  - (7) Test strips will be considered a separate lot.
  - (8) When the same mix type is produced for multiple bid items in one day, assign all box samples to each bid item's existing PWL lot for lab voids. Assign the quantity of each bid item produced to its respective lot.
- g) Test the quality control sample of each production paired sample as follows:
- (1) Prepare and compact two gyratory specimens according to Materials I.M. 325G. Compact loose WMA field samples, transported to the laboratory, at 240°F (115°C).
  - (2) Determine the bulk specific gravity of compacted mixture ( $G_{mb}$ ) at  $N_{design}$  for each specimen according to Materials I.M. 321.  $G_{mb}$  will be determined by compacting specimens to  $N_{design}$ . Average the results.
  - (3) Determine the Theoretical Maximum Specific Gravity of the uncompacted mixture according to Materials I.M. 350.
  - (4) Determine laboratory air voids for each sample according to Materials I.M. 501.
- h) Use the target laboratory voids listed in Materials I.M. 510 Appendix A unless otherwise specified in the contract documents.
- i) Use the following methods of acceptance for laboratory voids:
- (1) For base widening, non-high speed ramps, ~~non-interstate~~ shoulders, recreational trails, and other mixture bid items not placed in travel lanes of a permanent pavement, acceptance for laboratory voids will be based on a moving average absolute deviation (AAD) from target as defined in Materials I.M. 501. Use the production tolerance in Table 2303.03-5. At any time, if more than 100 tons (100 MG) of the bid item is placed in an area not listed above, apply Article ~~2303.03, D, 3, b, 3, ix, b~~ 2303.03, D, 3, b, 3, i, 2, for entire production of bid item.
  - (2) For all other mixture bid items, determine PWL for each lot as defined in Materials I.M. 501. Use 1.0% below the target air voids as the lower specification limit and 1.0% above the target air voids as the upper specification limit. Lot size is defined in Article ~~2303.03, D, 3, b, 3, vi~~ 2303.03, D, 3, b, 3, f. When the same mix type is placed in both PWL and AAD areas in a single day, include all samples for that day in the PWL lot as well as the quantity of the mixture bid item produced and placed in the PWL area.
  - (3) When same mix type is produced for multiple bid items in a single day from a single plant, apply all samples for that day to the lot for each bid item.
- j) For mixture bid items in a PWL lot, determine the pay factor using the average absolute deviation (AAD) procedure described in Materials I.M. 501 for proportions of a mixture bid item which are produced in irregular intervals and placed in irregular areas. The following items qualify as such and shall be combined into a single lot:
- Asphalt mixture produced and placed on gores, detours, cross-overs, temporary pavements, turning lanes, and fillets,
  - Asphalt mixture produced and placed on ramps that are not high-speed ramps,
  - Asphalt mixture produced and placed on ~~non-interstate~~ shoulders.
- To be considered irregular, the production rate for mixture bid items described above is not to exceed 1000 tons (1000 Mg) (~~10,000 square yards (8400 m<sup>2</sup>)~~) for items bid in square yards in a single day.
- 4) **Moisture Susceptibility**
- a) The Engineer may obtain plant produced samples for moisture susceptibility testing in accordance with Materials I.M. ~~507~~ 319 at any time for mixtures identified in Article 2303.02, E, 2, A a or Article 2303.02, E, 2, ~~G~~ f, to verify the minimum ~~TSR~~ requirement in Article 2303.02, E, 2, d, has been achieved.
  - b) When liquid anti-strip additives are added by the Contractor at the plant, satisfy one of the following methods to regulate the quantity of additive:

- (1) Present certification that the equipment used to measure and blend the liquid anti-strip additive:
  - Meets the anti-strip supplier's recommended practice,
  - Is directly tied to the asphalt binder supply system, and
  - Has been calibrated to the equipment manufacturer's guidelines.
- (2) Test the binder to measure the quantity of liquid anti-strip additive in the binder for every 5000 tons (5000Mg) of HMA production. Obtain the Engineer's approval for the supplier's test method prior to use of the test.
- (3) Run the test method in Materials I.M. 507 319 during production. If unable to certify or test for the presence and quality, run the test method in Materials I.M. 507 319 each 10,000 tons (10,000 Mg) of production to measure the effectiveness of the additive. Ensure test results satisfy 80% TSR when compared to the dry strength of specimens prepared with asphalt binder containing the additive the minimum requirement in Article 2303.02, E, 2, d.

**c. Production Control.**

- 1) After the JMF is established, the combined aggregate furnished for the project, the quantity of asphalt binder, and the laboratory air voids should consistently comply with the JMF, as target values. Control them within the production tolerance given in Table 2303.03-5.

**Table 2303.03-5: Production Tolerances**

Measured Characteristic	Target Value (%)	Specification Tolerance (%) <sup>(a)</sup>
Cold feed gradation No. 4 (4.75 mm) and larger sieves	by JMF	± 7.0
Cold feed gradation No. 8 (2.36 mm)	by JMF	± 5.0
Cold feed gradation No. 30 (600 µm)	by JMF	± 4.0
Cold feed gradation No. 200 (75 µm)	by JMF	± 2.0 <sup>(b)</sup>
Field laboratory air voids absolute deviation from target <sup>(c)</sup>	0.0	≤ 1.0
Daily asphalt binder content	by JMF	± 0.3
VMA <sup>(e)</sup>	by JMF	± 1.0 <sup>(f)</sup>
(a) Based on single test unless noted otherwise. (b) Maintain the filler/bitumen ratio of the plant produced mixture between 0.6 and 1.4. (c) When lab voids acceptance is not based on PWL. (e) Restricted to an asphalt film thickness as specified for the level of HMA mixture. May be waived per Materials I.M. 510, Appendix A. (f) Based on the daily lot average.		

- 2) Control plant production so that the plant produced HMA mixture will meet mixture design criteria (within the test tolerances given in Table 2303.03-5) for Air Voids and VMA at  $N_{\text{design}}$  gyrations of the gyratory compactor. Monitor the slope of the gyratory compaction curve of plant produced material. Slope variations in excess of  $\pm 0.40$  of the mixture design gyratory compaction curve slope may indicate potential problems with uniformity of the mixture.
- 3) The gyratory mix design gradation control points for the size mixture designated in the project plans will not apply to plant production control.
- 4) Strive for the target value of the percent air void and asphalt binder by adjusting gradation and asphalt binder content.
- 5) Produce a uniform composition mixture complying with the JMF.
- 6) Adjustments to the JMF target gradation and asphalt binder content values may be made.
  - a) The Contractor determines from quality control testing that adjustments are necessary to achieve the specified properties.
  - b) Consult with the Engineer regarding adjustments to the JMF.
  - c) Notify the Engineer if the average daily gradation for a mixture bid item is outside the production tolerances. If other production tolerances and mixture requirements of Materials I.M. 510 Appendix A are acceptable, a change in gradation target can be requested.

- d) If filler/bitumen ratio exceeds the limits listed in Table 2303.03-5, change the JMF at the start of the next day's production for that mixture.
- e) The Contractor's adjustment recommendations prevail, provided all specifications and established mix criteria are being met for plant production.
- 7) Measure estimated film thickness and voids in the mineral aggregate (VMA) for specification compliance every day of HMA production.
- 8) Prepare quality control charts according to Materials I.M. 511. Keep the charts current and available showing both individual sample results and moving average values for both lab voids and absolute deviation from target. Base moving average values on four consecutive sample results. The moving average absolute deviation from target may restart only in the event of a mandatory plant shutdown for failure to maintain the average within the production tolerance. Include the target value and specification tolerances on control charts.
- 9) Calculate laboratory voids for individual samples according to Materials I.M. 501. Use the individual density and individual maximum specific gravity determined for each sample. To determine the moving average of laboratory voids, use the average of the last four individual sample laboratory voids. Calculate absolute deviation from target lab voids according to Materials I.M. 501 of this specification. To determine the moving average absolute deviation from target laboratory voids, use the average of the last four individual sample absolute deviations from target laboratory voids.
- 10) Monitor the test results and make mix adjustments, when appropriate, to keep the mixture near the target values. Notify the Engineer whenever the process approaches a specification tolerance limit. When acceptance for lab voids is not based on PWL, cease operations when the moving average point for absolute deviation from target lab voids is outside the specification tolerance limit. Assume responsibility to cease operations, including not incorporating material which has not been placed. Do not start the production process again until notifying the Engineer of the corrective action proposed.

#### 4. Construction.

##### a. Field Voids for Class I Compaction.

- 1) Take samples to determine field voids from the compacted mixture and test no later than the next working day following placement and compaction.
- 2) A lot is considered to be one layer of one mixture bid item placed during a day's operation. The Engineer may approve classifying multiple layers of construction placed during a single day as a lot provided only one mixture was used.
- 3) For the following situations sampling for field voids may be waived by the Engineer provided compaction has been thorough and effective, or sampling may be modified by mutual agreement to include more than one day's production provided samples are taken prior to trafficking:
  - When the day's operation is not more than 2500 square yards (2500 m<sup>2</sup>) excluding areas deducted from the field voids lot,
  - When the day's operation is not more than 500 tons (500 Mg) excluding quantities deducted from the field voids lot,
  - When the mixture is being placed in irregular areas, or
  - When placing wedge or strengthening courses.
- 4) The Engineer will obtain and test samples for each lot according to Materials I.M. 204 Appendix F. The Contractor may request to have a quality control plan that indicates a higher testing frequency at no additional cost to the Contracting Authority if pre-approved by the Engineer at the preconstruction meeting. The Engineer will determine the core locations. The length laid in each lot will be divided into approximately equal sublots. Obtain one sample at a random location, as directed and witnessed by the Engineer, in each subplot. Determine a new random location for the subplot when the designated core location falls on a runout taper at an existing pavement, bridge, or bridge approach section where the thickness is less than the design thickness.
- 5) If a sample is damaged or measures less than 70% or more than 150% of the intended thickness, an alternate sampling location will be determined and used. Take samples from no less than 1 foot (300 mm) from the edge of a given pass of the placing equipment, from run-outs, or from day's work joints or structures.
- 6) Use the following methods of acceptance for field voids:
  - a) For mixture bid items placed in the following areas:
    - Base widening placed in a travel lane,
    - Non high-speed ramps,
    - Bridge approaches placed as a separate operation,

- Non-interstate travel lanes intended to be in service for fewer than 12 months,
- State Park and Institutional roadways,
- Recreational trails,
- Irregular areas identified by the Engineer that may include areas not suitable for continuous paving, and
- Wedges,

the Engineer will accept the field voids lot based on the average test results or an established effective rolling pattern when approved by the Engineer. Do not exceed 8% average field voids. The Engineer may modify the sample size and frequency provided compaction is thorough and effective. The Engineer may apply the pay schedule in 2303.05, A, 3, b, 3 to areas where thorough and effective compaction is not achieved.

- b) For all other areas of Class I compaction, determine PWL, as defined in Materials I.M. 501, for each lot using a lower specification limit (LSL) of 3.5% voids (96.5% of  $G_{mm}$ ) and an upper specification limit (USL) of 8.5% voids (91.5%  $G_{mm}$ ).
- 7) When the PWL falls below 80.0, use the procedure outlined in Materials I.M. 501 to identify outliers with 1.80 as the quality index criterion. Only one core may be considered an outlier in a single lot. If an outlier is identified, recalculate the PWL with the results of the remaining cores and determine whether the PWL is improved. Use the larger of the original and recalculated PWL to determine the pay factor.
- 8) When the PWL falls below 50.0, the Engineer may declare the lot or parts of the lot deficient or unacceptable.
- 9) Use maximum specific gravity ( $G_{mm}$ ) results in field voids calculations as follows:
  - a) When cores represent one day's production and more than one  $G_{mm}$  test result is available, use the average  $G_{mm}$  in the field voids calculation for all cores.
  - b) When cores represent one day's production and only one  $G_{mm}$  test result is available, use the single  $G_{mm}$  test result in the field voids calculation for all cores.
  - c) When the cores represent more than one day's production, use the average of all  $G_{mm}$  test results from all days corresponding with the cores.

**b. ~~Longitudinal Joint Compaction.~~**

- ~~1) When PWL is used for Class I field voids acceptance and placement of lot results in the formation of a longitudinal joint(s) matching one or more lanes, obtain and test samples taken directly on each joint created from the centerline joint using a nominal 6 inch (150 mm) diameter bit as follows:
 
  - a) ~~When two lanes forming a centerline joint are paved in separate operations (cold joint present):~~
    - ~~(1) Unconfined Edge: Sample so entire core is within 6 inches (150 mm) of unconfined edge.~~
    - ~~(2) Confined Edge: Sample so entire core is within 6 inches (150 mm) of visible line between the two lanes.~~
  - b) ~~When two lanes forming a centerline joint are paved concurrently (cold joint eliminated), take samples centered directly on the visible line between the two lanes.~~~~
- ~~2) Using random core locations determined for field voids lot, Engineer will randomly select four of these locations to be sampled for joint density. At each of the four locations (longitudinal station/milepost), obtain one sample for each longitudinal joint being formed as directed and witnessed by the Engineer. Take samples using a 6 inch (150 mm) diameter bit centered on top of the visible line between the two lanes.~~
- ~~3) Do not sample when matching new paving to pre-existing lanes. Informational joint cores may be waived by Engineer when conditions are not ideal or conditions are not suitable for continuous paving.~~
- ~~4) Use average of all validated  $G_{mm}$  test results from all days corresponding with the cores, when calculating field voids of the joint(s).~~
- ~~5) Include results on daily plant report.~~

**e b. Thickness.**

- 1) The Engineer will measure cores, exclusive of sealcoat, according to Materials I.M. 337. ~~All areas of uniform thickness and width for the project will be divided into lots.~~ Sampling frequency and lot definitions are as follows:
  - a) Thickness cores sampled from completed course shall be taken full depth and divided into lots based on areas of uniform thickness and width. Use frequency specified for taking density samples from surface lift.

- b) Density cores sampled as part of a field voids lot will be combined into daily lots based on cores' intended thickness.
- 2) ~~Use the frequency specified for taking  $G_{mb}$  samples from the surface lift when measuring for completed thickness.~~ Samples for thickness not tested for  $G_{mb}$ , because they are less than 70% of the intended thickness, are included for thickness. In these particular instances, do not measure the thickness of additional sufficiently thick samples used to determine field voids. ~~Take thickness samples full depth of the completed course. After measurement, remove the  $G_{mb}$  samples for the top layer from the core.~~ When measuring density of top lift from a full depth core, measure thickness before trimming core for density testing.
- 3) For full depth cores taken from completed course, intended thickness is designated in the contract documents. For all other cores, intended thickness is established by the Contractor meeting requirements in Articles 2303.03, C, 4, h through j. If any of the measurements for a lot is less than the designated thickness, the quality index for thickness of that lot will be determined by the following formula:

(English)

$$QI_{\text{Thickness}} = \frac{\text{Average Thickness}_{\text{Measured}} - (\text{Thickness}_{\text{Plan Intended}} - 0.5)}{\text{Maximum Thickness}_{\text{Measured}} - \text{Minimum Thickness}_{\text{Measured}}}$$

(Metric)

$$QI_{\text{Thickness}} = \frac{\text{Average Thickness}_{\text{Measured}} - (\text{Thickness}_{\text{Plan Intended}} - 12.7)}{\text{Maximum Thickness}_{\text{Measured}} - \text{Minimum Thickness}_{\text{Measured}}}$$

- 4) Provided there is reasonable assurance that the pavement complies with the required thickness, the Engineer may waive sampling for thickness for the following situations:
- When the day's operation is 2500 square yards (2500 m<sup>2</sup>) or less.
  - When the mixture is being placed in irregular areas.
  - When the mixture is being placed next to structures.
- 5) When the quality index falls below 0.00 and final lift of the course has been placed, the Engineer may declare the lot or parts of the lot defective.

**d c. Smoothness.**

Construct pavement to have a smooth riding surface according to the following:

- Apply Section 2317 to HMA surface mixture bid items of a Primary project if any individual HMA mixture bid item is 1000 tons (1000 Mg) or greater or 5000 square yards (4200 m<sup>2</sup>) or greater. Apply Section 2316 to all other Primary projects with a surface course and when specifically required for other projects.
- When neither Section 2316 nor Section 2317 is applied to a project, periodically check the riding surface longitudinally with a 10 foot (3 m) straightedge. The surface shall not deviate from a straight line by more than 1/8 inch in 10 feet (3 mm in 3 m). If a deviation is present, correct the area according to Article 2316.03, B, 2, or the Engineer may assess a price adjustment in the amount of \$2500 for each deviation.

**5. Sampling and Testing.**

**a. General.**

- Maintain and calibrate the quality control testing equipment using prescribed procedures. Sample and test according to the specified procedures as listed in the applicable Materials I.M. and Specifications. When the results from a Contractor's quality control lab are used as part of product acceptance, the Contractor's quality control lab is required to be qualified.
- Identify, store, and retain all quality control samples and field lab gyratory specimens used for acceptance until the lot is accepted. The Contracting Authority will prescribe the method of securing the identity and integrity of the verification samples according to Materials I.M. 511. Store verification samples for the Contracting Authority until delivery to the Contracting Authority's lab.
- Identify all samples using a system the Engineer approves.

**b. Individual Materials and Uncompacted Mixture.**

- Complete the following as designated by the Engineer:
  - Identify samples of asphalt binder, aggregate, and tack coat material.

- Secure and promptly deliver the samples to the appropriate laboratory.
  - 2) Take paired samples of uncompacted HMA mixture (each box of the pair weighing at least 30 pounds (14 kg)) according to Materials I.M. 322.
  - 3) Conduct quality control tests for mixture properties using representative portions of the mix from the quality control sample of each subplot.
  - 4) Split samples for specimen preparation according to Materials I.M. 357.
  - 5) Paired sampling may also be accomplished by taking a bulk sample and immediately splitting the sample according to Materials I.M. 322 on the grade.
  - 6) Record and document all test results and calculations on data sheets approved by the Contracting Authority. Record specific test results on the Daily Plant Report the Contracting Authority provides. Also include a description of the quality control actions taken (adjustment of cold feet percentages, changes in JMF, and so forth) on the Daily Plant Report.
  - 7) ~~Facsimile, or deliver by other methods the Engineer approves,~~ Deliver the Daily Plant Report to the Engineer and designated laboratory daily as directed in Materials I.M. 511. At project completion, provide Engineer a copy of electronic file(s) containing project information generated during the progress of the work.
  - 8) When sampling for moisture susceptibility testing, obtain ~~a 70-pound (35 kg)~~ samples according to Materials I.M. 204, Appendix F and 322. ~~If the Contractor's TSR results from the mixture design are less than 90%, sample at a minimum frequency of 1/10,000 tons of plant production until a complying test result is achieved, after which the minimum frequency may be reduced to 1/50,000 tons.~~ Each sample shall constitute a separate lot and include all quantities placed from beginning of bid item's production (or previous sampling point) to next sampling point (or 10,000 tons, whichever is less). The Engineer will select, at random, the sample location. Split the sample and deliver half to the Central Materials Laboratory.
- c. Compacted Pavement Cores.**
- 1) Cut and trim samples under the direction of and witnessed by the Engineer for tests of  $G_{mb}$ , thickness, or composition by using a power driven masonry saw or by drilling a minimum 4 inch (100 mm) nominal diameter core.
  - 2) Restore the surfaces the same day. Dry, fill with the same material, and properly compact core holes.
  - 3) Pavement core samples will be identified, taken possession of by the Engineer, and delivered to the Contractor's quality control field laboratory.
  - 4) The Engineer may either:
    - Transport the cores directly to the lab, or
    - Secure the cores and allow the Contractor to transport the cores to the lab.
  - 5) The compacted HMA pavement will be tested in a timely manner by the Engineer's personnel who are Iowa DOT Certified to perform the test.
  - 6) Prepare and test the cores according to Materials I.M. 320, 321, and 337.
- d. Verification and Independent Assurance Testing.**
- 1) The Contractor's quality control test results will be validated by the Engineer's verification test results on a regular basis using guidelines and tolerances set forth in Materials I.M. 216 and 511.
  - 2) If the Engineer's verification test results validate the Contractor's test results, the Contractor's results will be used for material acceptance. Disputes between the Contractor's and Engineer's test results will be resolved according to Materials I.M. 511.
  - 3) The Engineer will randomly select one or more of the daily production verification samples. Some or all of the samples selected will be tested in the materials laboratory designated by the Engineer. The Engineer will use the verification test results to determine if the Contractor's test results can be used for acceptance.
  - 4) The Engineer will test each lot of cores at the Contractor's field quality control laboratory. Cores may also be tested by the Contractor; however, the Contractor's test results will not be used for material acceptance.
  - 5) Personnel and laboratories performing tests used in the acceptance of material are required to have participated in the statewide Independent Assurance Program according to Materials I.M. 208.

## **E. Quality Control for Small HMA Paving Quantities.**

### **1. Mix Design.**

Prepare the JMF. Prior to HMA production, obtain the Engineer's approval for the JMF. Comply with Article 2303.02 and Materials I.M. 510.

For mixtures meeting the criteria in Article 2303.02, E, 2, a:

- a. An anti-stripping agent is required when ~~TSP on mix design is less than 90%~~ the optimum dosage is greater than 0%.
- b. Use Materials I.M. 507 319 to optimize the design dosage rate.
- c. When prior-approved designs have demonstrated acceptable field TSP SIP values, the anti-stripping agent and dosage from the JMF may be used in lieu of optimization testing.

## 2. Plant Production.

- a. Ensure HMA production plant calibration for the JMF is current and no more than 12 months old.
- b. Use certified asphalt binder and approved aggregate sources meeting the JMF. Ensure the plant maintains an asphalt binder log to track the date and time of binder delivery. Ensure HMA delivery tickets identify the JMF.
- c. Monitor the quality control test results and make adjustments to keep the mixture near the target JMF values.

## 3. Construction.

- a. Take compacted mixture  $G_{mb}$  measurements, except when Class II compaction is specified, no later than the next working day following placement and compaction. Use the field quality control laboratory compaction for field  $G_{mb}$  control, as specified in Article 2303.03, D. The Engineer may accept the void content of the compacted layer based on cores or calculations from density gauge measurements. The Engineer may waive field void sampling provided the compaction has been thorough and effective.
- b. For small quantities, a lot will be the entire quantity of each HMA mixture bid item.
- c. The PWL for field voids will not apply to small quantities.

## 4. Sampling and Testing.

- a. Material sampling and testing is for production quality control only. Acceptance of mixture is based on Contractor certification. Perform a minimum of one aggregate cold-feed and one uncompacted HMA test per lot. Sampling and testing of uncompacted HMA mixture is only required for mechanically placed mixture. Sample and test according to the Standard Specifications and Materials I.M.s using certified technicians and qualified testing equipment. The Engineer may approve alternative sampling procedures or may waive sampling of uncompacted mix and gradation if Contractor can provide plant reports from other recent project(s) demonstrating the JMF has been produced within specification. Take the sample between the first 100 to 200 tons (100 to 200 Mg) of production. No split samples for agency verification testing are required.
- b. Asphalt binder will be accepted based on the asphalt supplier's shipment certification. No binder sampling or testing is required.
- c. Material sampling or testing is not required for daily HMA production of less than 100 tons (100 Mg) of any small quantity mixture ~~on any project~~ bid item.
- d. Moisture susceptibility testing on plant produced mixture is not required.

## 5. Certification.

- a. Provide a certification for the production of any mixture in which the requirements in this article are applied. Place the test results and the following certification statement on the Daily HMA Plant Report (Form 800241).  
 "The HMA mixture contains certified asphalt binder and approved aggregate as specified in the approved mix design and was produced in compliance with the provisions of Article 2303.03, E."
- b. The Daily HMA Plant Report for certified HMA may be submitted at the end of the project for all certified HMA quantities, or submitted at intervals for portions of the certified quantity.

## 2303.04 METHOD OF MEASUREMENT.

### A. Hot Mix Asphalt Mixture.

#### 1. General.

- a. Removal of fillets is incidental to the contract unit price for the mixture.
- b. If the Contractor chooses to place intermediate or surface mixture in lieu of base for the outside shoulders, the quantity will be calculated from the pavement and shoulder template. If placed as a separate operation, the quantity will be calculated from scale tickets. If the substitute mixture placed

on the shoulder is for an intermediate course fillet only, include the quantity in the fillet for payment in the quantity placed in the adjacent intermediate course.

- c. Payment for the quality control requirements for small quantities will not be measured separately.
- d. Unless stated otherwise, equivalent WMA mixtures may be substituted for specified HMA mixtures.

**2. Measurement by Weight (Mass).**

- a. The quantity of the type specified, expressed in tons (megagrams), will be determined from the weight (mass) of individual loads, including fillets, measured to the nearest 0.01 tons (0.01 Mg).
- b. Loads may be weighed in trucks, weigh hoppers, or from the weight (mass) from batch plants computed by count of batches in each truck and batch weight (mass). Article 2001.07 applies. Segregate the weights (mass) of various loads into the quantities for each pay item.

**3. Measurement by Area.**

- a. The quantity of the type specified, expressed in square yards (square meters), will be shown in the contract documents to the nearest 0.1 square yard (0.1 m<sup>2</sup>). The area of manholes, intakes, or other fixtures will not be deducted from the measured pavement area.
- b. When constructing shoulders on a basis of payment of square yards (square meters), inspection of the profile and elevation will be based on the completed work relative to the pavement edge. The Contractor is responsible for the profile and elevation of the subgrade and for thickness.

**B. Asphalt Binder.**

- 1. Measure the amount of asphalt binder used from batch plants, continuous plants, or drum mixing plants by stick measurement in the Contractor's storage tank or in-line flow meter reading, according to Article 2001.07, B.
- 2. Compute the asphalt binder quantity added to the storage tank using a supplier certified transport ticket accompanying each load.
- 3. The quantity of asphalt binder not used in the work will be deducted.
- 4. When the quantity of asphalt binder in a batch is measured by weight (mass) and is separately identified by automatic or semi-automatic printout, the Engineer may compute the quantity of asphalt binder used from this printout. By mutual agreement, this method may be modified when small quantities or intermittent operations are involved.
- 5. The Engineer will calculate and exclude the quantity of asphalt binder used in mixtures in excess of the tolerance specified in Article 2303.03, D, 3, c.
- 6. When payment for-HMA is based on area, the quantity of asphalt binder used will not be measured separately for payment.

**C. Recycled Asphalt Pavement.**

- 1. A completed Daily HMA Plant Report with the certification statement is required for measurement and payment for Contractor Certified HMA. The quantity of asphalt binder will be based on the approved JMF and any plant production quality control adjustments.
- 2. The quantity of asphalt binder in RAP incorporated into the mixture, will be calculated in tons (megagrams). This quantity shall be based on the actual asphalt binder content determined for the mix design from the results of the Engineer's extraction tests.
- 3. The quantity of asphalt binder in RAP, which is incorporated into the mix, will be included in the quantity of asphalt binder used.

**D. Anti-strip Agent.**

Will not be measured separately. The quantity will be based on tons (megagrams) of HMA mixture with anti-strip agent added.

**E. Tack Coat.**

Will not be measured separately.

**F. Fabric Reinforcement.**

The quantity, in square yards (square meters) to the nearest 0.1 square yard (0.1 m<sup>2</sup>), will be shown in the contract documents.

**G. Hot Mix Asphalt Pavement Samples.**

Will not be individually counted for payment if furnished according to Article 2303.03, D, 5, or required elsewhere in the contract documents,

**H. Recycled Asphalt Shingles.**

67% of the asphalt binder from RAS which is incorporated into the mixture will be included in the quantity of asphalt binder used.

**2303.05 BASIS OF PAYMENT.**

The costs of designing, producing, placing, and testing bituminous mixtures and the cost of furnishing and equipping the QM-A field laboratory will not be paid for separately, but are included in the contract unit price for the HMA mixes used. The application of tack coat and sand cover aggregate are incidental and will not be paid for separately. Pollution testing is at the Contractor's expense. The installation of temporary Stop Sign Rumble Strips will not be paid for separately, but is incidental to the price bid for the HMA course for which it is applied.

The quality control requirements for small quantities are incidental to the items of HMA mixtures in the contract.

**A. Asphalt Concrete Mixture.**

1. Payment will be the contract unit price for Hot Mix Asphalt Mixture of the type specified per ton (megagram) or square yard (square meter). Unless stated otherwise, equivalent WMA mixtures may be substituted for specified HMA mixtures with no change in the contract unit price.
2. Payment for test strips will be the contract unit price for the test strip mixture bid item per ton (megagram) regardless of lift placement.
3. Payment will be adjusted by the following Pay Factor for field voids and laboratory voids determined for the lot.

Multiply the unit price for the HMA bid item by the Pay Factor rounded to 3 decimal places.

**a. Laboratory Voids**

- 1) Payment when PWL is used for acceptance:

PWL	Pay Factor
95.1 – 100.0	PF = 0.006000*PWL + 0.430
80.0 – 95.0	1.000
50.0 – 79.9	PF = 0.008333*PWL + 0.3333
Less than 50.0	0.750

When PWL is less than 50.0, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

- 2) Payment when ~~AAD is used for acceptance~~ PWL lots are incomplete:

AAD from Target Air Void	Pay Factor
0.0 to 1.0	1.000
1.1 to 1.5	0.900
1.6 to 2.0	0.750
Over 2.0	0.500 maximum

When the AAD is more than 2.0, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

- 3) Use the following payment schedule when a test strip is constructed:

AAD from Target Air Void	Pay Factor
0.0 to 1.5	1.000
1.6 to 2.0	PF = 2.5 - AAD
Over 2.0	0.500 maximum

When the AAD is more than 2.0, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

**b. Field Voids**

- 1) Payment when PWL is used for acceptance:

PWL	Pay Factor
95.1 – 100.0	$PF = 0.008000 * PWL + 0.240$
80.0 – 95.0	1.000
50.0 – 79.9	$PF = 0.008333 * PWL + 0.3333$
Less than 50.0	0.750

When PWL is less than 50.0, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

- 2) Payment when a test strip is constructed:

Average Field Voids (Pa), %	Pay Factor
0.0 to 9.0	1.000
9.1 to 9.5	$PF = 10 - Pa$
Over 9.5	0.500 maximum

When the average air void content from a test strip exceeds 9.5%, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

- 3) Payment when PWL is not used for acceptance:

Average Field Voids (Pa), %	Pay Factor
0.0 to 8.0	1.000
8.1 to 9.5	$PF = (11 - Pa) / 3$
Over 9.5	0.500 maximum

When the average air void content exceeds 9.5%, the Engineer may declare the lot or parts of the lot deficient or unacceptable.

4. When the basis of payment is by area, payment will be further adjusted by the appropriate percentage in Table 2303.05-2 below according to the quality index for thickness determined for that lot:

**Table 2303.05-2: Payment Adjustment (by Area) for Thickness**

Quality Index (Thickness) 8 Samples	Percent of Payment (Previously Adjusted for Field Voids)
Greater than 0.34	100
0.14 to 0.34	95
0.00 to 0.13	85
Less than 0.00	75 maximum

5. Payment for courses for which quality index (thickness) is not determined because of size or shape, and courses which are found to be deficient in average width, will be according to Article 1105.04.
6. ~~When moisture susceptibility testing in accordance with Materials I.M. 507 is performed on plant produced mixture, the payment for asphalt mixture will be adjusted according to Table 2303.05-3:~~

**Table 2303.05-3: Asphalt Mixture Payment Adjustment for Moisture Susceptibility**

Contracting Authority's Results (Percent TSR)	Pay Factor
$TSR \geq 80$	1.00
$70 < TSR < 80$	$PF = 0.025 * TSR + 1$
$TSR \leq 70$	0.75 maximum

**B. Asphalt Binder.**

1. Payment will be the contract unit price per ton (megagram) for the number of tons (megagrams) of asphalt binder used in the work.

2. Payment for asphalt binder will be for new asphalt binder the asphalt binder in the RAP which is incorporated in the mixture, and 67% of the asphalt binder from RAS which is incorporated into the mixture. The quantity of asphalt binder in RAM, which is incorporated into the mix, will be calculated in tons (megagrams) of asphalt binder in the RAM. This will be based on the actual asphalt binder content determined for the mix design from the results of the Engineer's extraction test.
3. When the basis of payment for HMA is in square yards (square meters), compensation for asphalt binder will be included in the contract unit price per square yard (square meter).

**C. Recycled Asphalt Pavement.**

RAP owned by the Contracting Authority will be made available to the Contractor for the recycled mixture at no cost to the Contractor other than loading, hauling, and processing as required for incorporation into the mix.

**D. Anti-strip Agent.**

1. When anti-strip agent is required, the incorporation of the anti-strip agent into the asphalt mixture will be considered as extra work ordered by the Engineer if the Contracting Authority's TSR test results from the field produced mixture meet or exceed the minimum requirement ~~and the conditioned indirect tensile strength is improved by at least 10% over that from the plant mixture without anti-strip (or original JMF conditioned strength when plant mix without anti-strip is not available)~~ established in Article 2303.02, E, 2, d. Payment will be made at the rate of \$2.00 per ton (megagram) of asphalt mixture in which the anti-strip agent is incorporated. ~~WMA mixtures designed for 10,000,000 ESALS and higher must satisfy Articles 2303.02, E, 2, a, 1 or 2 to be eligible for anti-strip payment. For mix designs (small quantities excluded) with a TSR greater than or equal to 80%, payment will stop when the Contracting Authority's TSR results of the field produced mixture without the agent are greater than or equal to 80% and any remaining asphalt binder containing the agent in the current tank is consumed.~~
2. Payment will be full compensation for designing, adding, and testing for anti-strip agent.

**E. Tack Coat.**

Incidental to HMA.

**F. Fabric Reinforcement.**

1. Payment will be the contract unit price for Fabric Reinforcement per square yard (square meter).
2. Payment is full compensation for furnishing all materials, labor, and equipment necessary for installing the fabric as required, including the adhesive or heavy tack coat of asphalt binder used as the adhesive.

**G. Hot Mix Asphalt Pavement Samples.**

1. Payment will be the lump sum contract price for cutting and delivery of HMA Pavement Samples to determine field voids or thickness according to the specifications, when either of these is the responsibility of the Contractor, and elsewhere when required by the contract documents.
2. Payment is full compensation for furnishing all such samples for all courses or items of work, and for delivery of samples as specified in Article 2303.03, D, 5, c.

**Section 2304**

**2304.02, B, 3.**

**Replace** the second sentence of the Article:  
Apply compaction per Section 2303.

## Section 2310

### 2310.01, Description.

**Replace** Articles B and C:

**B. Unbonded overlay:** a PCC overlay over an existing pavement where a stress relief layer is placed on top of the existing PCC pavement or ~~an existing PCC pavement that has been overlaid with HMA (composite pavement)~~ a PCC overlay over an existing composite pavement (flexible pavement over PCC).

**C. Whitetopping:** a PCC overlay over an existing, full depth ~~asphalt~~ flexible pavement.

### 2310.02, Materials.

**Add** the Article:

**C. Seal Coat Bond Breaker.**

Meet the requirements of Article 2307.02.

### 2310.03, Construction.

**Replace** the Article:

Apply the requirements of Section 2301 to this work with the modifications ~~for each type of work~~ identified below.

**A. Scarifying, ~~or~~ Shotblasting, or Waterblasting Equipment.**

Use power operated equipment capable of uniformly scarifying or removing the existing surface in a satisfactory manner and to depths required. Other types of removal devices may be used if their operation is suitable and if they can be demonstrated to the satisfaction of the Engineer. The contract documents will include a pay item for such work.

**B. Preparation of Surface.**

**1. General.**

- a. If full depth base repair is included in the project, complete it prior to preparation of the existing pavement surface.
- b. When required, include the entire area to be resurfaced in preparation of the existing pavement surface. Materials removed in the preparation operation may be placed in the shoulder area unless specified otherwise in the contract documents.

**2. ~~Bonded Overlays~~ Surface Preparation.**

- a. When required for bonded overlays, ~~P~~prepare the surface by shot blasting, waterblasting, or scarifying. Scarify to a nominal depth of 1/4 inch (5 mm).
- b. Ensure preparation removes all dirt, oil, foreign materials, laitance, or loose material from the surface and edges against which new concrete will be placed.

**3. ~~Unbonded Overlays and Whitetopping~~ Pavement Scarification.**

- a. When required, ~~P~~prepare surface by scarifying per Section 2214.
- ~~b. When placement of HMA stress relief layer is included as part of the contract for unbonded overlays, pavement scarification will not be required.~~
- ~~c~~ **b.** At the direction of the Engineer, trim high spots found in the existing HMA flexible pavement. This work will be accomplished during the scarification operation, only at isolated locations, and will be considered incidental to the pavement scarification.
- ~~d. Work covered by Article 2310.03, B, 3, will be paid for according to Article 2310.05, D, Pavement Scarification.~~
- c. Seal Coat Bond Breaker.**  
Prior to placement of the PCC overlay, place two applications of a seal coat bond breaker to scarified PCC surfaces per Article 2307.03 and as modified per Article 2316.03, B, 2, b. Do not allow traffic on bond breaker before it has set.

**4. Hot Mix Asphalt Stress Relief Course.**

Construct in accordance with Article 2303.03. Use Class II Compaction, except use only static steel wheeled rollers. Article 2303.04 shall also apply.

**C. Placing and Finishing Overlay.****1. General.**

- a. Apply Section 2317 to all PCC Pavement bid items of a Primary project if any individual PCC Pavement bid item for that project is 5000 square yards (4200 m<sup>2</sup>) or greater. Apply Section 2316 to all other Primary projects and when specifically required for other projects.
- b. ~~Control the placing equipment to the proper elevation by string line. Take cross sections and establish a grade line. The Engineer will review and approve the new grade lines. Information detailing the pavement design thicknesses at the various survey points and material quantities will also be provided. During construction, do not alter these grades solely to account for concrete overruns. Some overrun is normal, and only with the Engineer's approval will they be adjusted.~~ Clean existing surface of loose or adhering foreign material prior to and during placement of PCC.
- c. Ensure existing pavement surface is free of standing water during PCC placement.
- d. Ensure temperature of existing pavement surface does not exceed 120°F (50°C) during PCC placement. Water may be applied to cool existing pavement surface provided standing water is not present during PCC placement.

**2. Bonded Overlays.****a. Surface Cleaning.**

~~Clean the entire surface with an air blast prior to placing concrete. After cleaning, no traffic will be permitted on the cleaned surface except that necessary for overlay construction.~~

**b. Surface Condition.**

~~Ensure the prepared surface is dry in order to allow some absorption of the concrete mortar.~~

**c. Joints.**

~~1) Use a reliable method to exactly locate and identify on both sides of the road:~~

- ~~a) Each contraction and expansion joint in the existing pavement.~~
- ~~b) The joint to be sawed at each full depth patch.~~

~~2) Saw joints in the resurfacing directly over existing joints. Saw joints to the full depth of new resurfacing concrete, including depressions created in the existing surface and as specified in the widening areas. Saw joints as soon as possible without causing excessive raveling.~~

**3. Unbonded Overlays.****a. Hot Mix Asphalt Stress Relief Course.**

~~Construct in accordance with Article 2303.03. Use Class II Compaction, except use only static steel wheeled rollers. Article 2303.04 shall also apply.~~

**b. Surface Cleaning.**

~~Clean the existing surface of all loose or adhering foreign material prior to placement of the PCC over HMA pavement. Normally this will be accomplished with a power broom. Make this broom available during paving operations to clean any loose material that the construction equipment may track onto the surface.~~

**c. Surface Condition.**

~~Ensure the prepared surface is dry when concrete is placed on the surface of the HMA pavement in order to allow some absorption of the concrete mortar. If the surface of the HMA is above 110°F (40°C), the Contractor may apply water to the surface of the HMA ahead of the paving operation in order to cool the surface. Apply water far enough in advance of the paving operation so that the surface will dry from evaporation before concrete is placed. Do not apply water to the surface of the pavement when the HMA surface temperature is below 100°F (38°C).~~

**d. Joints.**

~~When jointing is specified in which panels are smaller than a normal lane width, construct the joints to be 1/8 inch (3 mm) wide. No cleaning or sealing is required.~~

**4. Whitetopping.****a. Surface Cleaning.**

~~Clean existing surface of loose or adhering foreign material prior to placement of the PCC over HMA pavement. Normally this will be accomplished with a power broom. Make this broom~~

~~available during paving operations to clean any loose material that the construction equipment may track onto the surface.~~

**~~b. Surface Condition.~~**

~~Ensure the prepared surface is dry when concrete is placed on the surface of the HMA pavement in order to allow some absorption of the concrete mortar. If the surface of the HMA is above 110°F (40°C), the Contractor may apply water to the surface of the HMA ahead of the paving operation in order to cool the surface. Apply water far enough in advance of the paving operation so that the surface will dry from evaporation before concrete is placed. Do not apply water to the surface of the pavement when the HMA surface temperature is below 100°F (38°C).~~

**~~c. Joints.~~**

~~When jointing is specified in which panels are smaller than a normal lane width, construct joints 1/8 inch (3 mm) wide. No cleaning or sealing is required.~~

**2. Joints.**

**a. Unbonded Overlays and Whitetopping.**

Place joints as shown in the contract documents.

**b. Bonded Overlays.**

- 1) Place joints directly over joints and cracks in the existing pavement.
- 2) Saw joints to the full depth of the overlay.
- 3) Ensure joints are at least as wide as the joint or crack in the existing pavement.

**D. Limitation of Operations.**

1. At forecasted air temperatures below 55°F (13°C) use the maturity method to determine the opening time. Do not place resurfacing concrete when the air or pavement temperature is below 40°F (4°C).
2. The Contractor may use the shoulders for construction activities. It will be the Contractor's responsibility to repair the shoulders, as the Engineer deems necessary, to restore the shoulders to a condition acceptable for shoulder work. This work shall be done at no additional cost to the Contracting Authority. The Contractor may elect to limit the use and vehicle loadings to minimize this work and its cost.
3. Place bonded concrete overlays between June 1 and September 30.
4. ~~Do not place unbonded overlay or whitetopping materials on HMA when the pavement surface temperature exceeds 120° F (50°C).~~

**2310.04, D, 1, Measurement by Weight (Mass).**

**Replace the Article:**

The quantity of Pavement Scarification will be determined in accordance with Article 2214.06 4, A, 1.

**2310.04, D, 2, Measurement by Area.**

**Replace the Article:**

The quantity of Pavement Scarification will be determined in accordance with Article 2214.06 4, A, 2.

**2310.04, Method of Measurement.**

**Add the Article:**

**F. Seal Coat Bond Breaker.**

**1. Aggregate.**

Cover aggregate will be measured according to Article 2307.04, A.

**2. Binder Bitumen.**

Binder Bitumen will be measured according to Article 2307.04, B.

**2310.05, D, 1, Measurement by Weight (Mass).****Replace** the Article:

The Contractor will be paid the contract unit price for Pavement Scarification in accordance with Article 2214.07 5, A, 1.

**2310.05, D, 2, Measurement by Area.****Replace** the Article:

The Contractor will be paid the contract unit price for Pavement Scarification in accordance with Article 2214.07 5, A, 2.

**2310.05, Basis of Payment.****Add** the Article:**F. Seal Coat Bond Breaker.****1. Aggregate.**

Payment for cover aggregate will be in accordance with Article 2307.05, A.

**2. Binder Bitumen.**

Payment for binder bitumen will be in accordance with Article 2307.05, B.

**Section 2316****2316.05, H, 2, Schedule B Smoothness Requirements.****Replace** Note (a) of Table 2316.05-4, Price Reduction for Pavement Smoothness:

For segments with an initial index of 30.1 (476) and over, grind the surface to a finish index of 22.0 (345) or better. In lieu of ~~accepting a price reduction and~~ grinding the surface to a final index of 22.0 (345) or better, the Contractor may elect to replace part or all of the segment.

**Section 2318****2318.02, A, Asphalt Stabilizing Agent.****Replace** Articles 1 and 2:

1. Standard Asphalt Emulsion (HFMS-2s) meeting the requirements of Section 4140 shall be used on Primary and Interstate projects. Other projects may use CSS-1 or HFMS-2s emulsions meeting the requirements of Section 4140 ~~may be used in place of HFMS-2s on other projects~~ or an engineered emulsion when specified on the contract documents. Do not use emulsions as a stabilizing agent for cold in place recycling during nighttime operations.
2. Foamed Asphalt using PG 52-34 or PG 46-34 asphalt binder meeting the requirements of Section 4137 may be used on Interstate, Primary, Secondary, and local projects. For projects using PG 52-34 as the cold in-place stabilizing agent, meet the following requirements:
  - Minimum  $G^*/\sin\delta$  of 0.70 kPa for the original asphalt binder,
  - Minimum  $G^*/\sin\delta$  of 1.5 kPa for RTFO aged binder, or
  - Maximum  $G^*\sin\delta$  of 5000 kPa for PAV aged binder.

**2318.03, Construction.****Replace** the first paragraph:

Except in specific cases when permitted by the Engineer, CIR will only be allowed between May 1 and October 1. Do not perform recycling operations when:

- The ambient daytime temperature is below 60°F (15°C),
- For night work, the following day's forecasted high is below 60°F (15°C),
- The weather is foggy or rainy, or
- Weather conditions are such that proper mixing, placing, and compacting of the recycled material cannot be accomplished.

**2318.03, H, Placement of Surface Course.**

**Replace** the first sentence:

Subsequent HMA overlay or surface treatment will not be allowed until moisture content of the CIR layer is no more than 0.3% above the residual moisture content or ~~2.0~~ 2.5%, whichever is greater.

**Section 2320****2320, Polymer-Modified Microsurfacing.**

**Add the Section:**

**2320.01 DESCRIPTION.**

Applying a properly proportioned, mixed, and uniformly spread mixture of polymer-modified emulsified asphalt, mineral aggregate, mineral filler, water, and necessary additives on existing roadway surfaces.

**2320.02 MATERIALS.****A. Polymer-Modified Emulsified Asphalt.**

1. Use a blend of emulsified quick-set polymer-modified CSS-1H asphalt and latex-based polymer.
2. Use a polymer material milled or blended into asphalt or blended into emulsifier solution prior to emulsification process.
3. The laboratory performing the mix design is to determine the amount and type of latex-based polymer modifier based on the percent of asphalt by weight (mass) of asphalt, with 3% polymer solids as the minimum. Provide the Engineer, at the time of delivery, a certification from the emulsion manufacturer that 3% minimum polymers have been added to the emulsion.
4. Use CSS-1H polymer-modified emulsified asphalt complying with the requirements of AASHTO M 208, with the following modifications and additions:
  - a. The storage stability and cement mixing test is not required for this emulsion.

<u>TEST</u>	<u>QUALITY</u>	<u>REQUIREMENTS</u>
AASHTO T 59	Residue after distillation	62% minimum

- b. Modify the standard distillation procedure as follows: Slowly bring the temperature on the lower thermometer to 350°F +/- 10°F (177°C +/- 5°C) and maintain at this level for 20 minutes. The total distillation shall be completed in 60 minutes +/- 5 minutes from the first application of heat.

	<u>TEST ON RESIDUE</u>	
AASHTO T 53	Ring and Ball Softening Point	135°F (57°C) minimum

**B. Aggregate.**

1. Use mineral aggregate composed of a combination of crushed stone and mineral filler meeting the following requirements based on the friction classification specified in the contract documents. Aggregate source frictional classifications can be found in Materials I.M. T-203.
  - a. **Friction Classification L-2.**  
Use Friction Type 2 crushed stone (for non-Interstate mixes steel slag may also be used) complying with the following:
    - Table 4124.03-1 with the following exceptions:
      - Maximum abrasion loss of 30%, and
      - Sand equivalence of not less than 60.
    - Objectionable materials limits in Table 2320.02-01.
  - b. **Friction Classification L-4.**  
Use Friction Type 4 or better crushed stone complying with the following:
    - Table 4124.03-1, and

- Objectionable materials limits in Table 2320.02-01.
- c. **No Special Friction Requirement.**  
Use Friction Type 5 or better crushed stone complying with the following:
- Table 4124.03-1, and
  - Objectionable materials limits in Table 2320.02-01.

**Table 2320.02-01: Maximum Permissible Amounts of Objectionable Material**

Objectionable Materials	Maximum Percent Allowed	Test Method
Unsound chert particles retained on No. 4 (4.75 mm) sieve	0.5	Materials I.M. 372
Total of all unsound chert, shale, coal, and iron combined	1.0	Materials I.M. 372
Clay Lumps/Friable Particles	0.5	Materials I.M. 368
Organic Materials, except coal	0.1	Office of Materials Test Method No. Iowa 215

2. The job mix (target) gradation within the gradation band specified below. The percent passing shall not go from the high end to the low end of the range for any two consecutive screens.

**Table 2320.02-2: Job Mix (Target) Gradation**

	Sieve Size - Percent Passing							
	3/8" (9.5 mm)	No. 4 (4.75 mm)	No. 8 (2.36 mm)	No. 16 (1.18 mm)	No. 30 (600 µm)	No. 50 (300 µm)	No. 100 (150 µm)	No. 200 (75 µm)
Quartzite/Granite/Slag	100	90-100	65-90	45-70	30-50	18-30	10-21	5-15
Limestone/Dolomite	100	70-90	45-70	25-50	15-35	10-25	5-20	5-15

**C. Mineral Filler.**

Free of lumps and meeting the requirements for Type I Portland Cement according to Section 4101.

**D. Water.**

Comply with Section 4102.

**E. Additives.**

Additives may be added to the emulsion mix or any of the component materials to provide control of the quick-set properties and increase adhesion. Additives must be included as part of the mix design and be certified as to their compatibility with other components of the mix.

**F. Composition and Quality of Mixture.**

- An approved mix design will be required prior to beginning placement of the microsurfacing mixture. Designing and proportion the mixture. Comply with the following:
  - Mix design prepared by a laboratory having three or more years experience in designing microsurfacing.
  - Microsurfacing mixture designed according to the International Slurry Surfacing Association (ISSA) guidelines.
  - Submit the proposed mix design to the ~~Materials Bituminous Engineer in the Central Laboratory~~ District Materials Engineer for approval with a copy to the District Materials Engineer. The Central District Laboratory will review the mix design within 14 calendar days. Use DOT MICROMIX spreadsheet when submitting designs.
  - Along with the proposed mix design include all test results, proportions of all ingredients of the mixture, and gradation of the aggregate proposed for use.
- Ensure the mix design designates the proportions to be used within the following limits:
  - Mineral aggregate for microsurfacing: 10-20 pounds per square yard (dry weight) (5-11 kg/m<sup>2</sup> (dry mass)).

- Polymer-Modified Emulsified Asphalt, P.M. CSS-1H: residual asphalt 6% to 12% by dry weight (mass) of aggregate.
- Mineral Filler: 0.5% to 3.0% by dry weight (mass) of aggregate.
- Water: as needed to provide proper consistency.

3. For the microsurfacing mixture, meet the following requirements:

**Table 2320.02-2 3: Microsurfacing Mixture Requirements**

<b>TEST</b>	<b>DESCRIPTION</b>	<b>REQUIREMENTS</b>
ISSA TB-139	WET COHESION @ 30 minutes (set) @ 60 minutes (traffic)	10 lb-in (12 kg-cm) minimum 17 lb-in (20 kg-cm) minimum
ISSA TB-109	Excess Asphalt by LWT	50 g/ft <sup>2</sup> (538 g/m <sup>2</sup> ) maximum
ISSA TB-114	Wet Stripping	Pass (90% minimum)
ISSA TB-100	Wet Track Abrasion Loss One hour soak Six Day Soak	50 g/ft <sup>2</sup> (538 g/m <sup>2</sup> ) maximum 75 g/ft <sup>2</sup> (807 g/m <sup>2</sup> ) maximum
ISSA TB-147A	Lateral Displacement	5% maximum
	Specific Gravity after 1000 cycles of 125 lbs. (57 kg)	2.10 maximum
ISSA TB-144	Classification	(AAA, BAA)
	Compatibility	11 grade points minimum
ISSA TB-113	Mix Time @ 77°F (25°C)	Controllable to 120 sec. minimum

### 2320.03 CONSTRUCTION.

#### A. Equipment.

1. Use a spreading machine designed and manufactured to perform microsurfacing work, including prewetting the surface. To mix the material, use an automatic sequenced, self-propelled microsurfacing mixing machine, able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, control setting additive and water to a revolving multi-blade double shafted mixer, and discharge the mixed product on a continuous flow basis. Use a mixing machine with sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, control additive and water to ensure a constant flow of a homogeneous slurry mixture.
2. Use equipment providing individual volume or weight controls for proportioning each material to be added to the mix. Calibrate and properly mark each material control device.
3. Equip the aggregate feed to the mixer with a revolution counter or similar device so that the amount of aggregate used may be determined at any time.
4. Use equipment with a positive displacement type emulsion pump equipped with a revolution counter or similar device so that the amount of emulsion used may be determined at any time.
5. Use a mixing machine equipped with a pressurized water system and a nozzle-type spray bar to provide water spray to the roadway surface immediately ahead of and outside the spreader box.
6. Use a mixing machine equipped with fines feeder that delivers a uniform, positive, accurately-metered, predetermined amount of mineral filler at the same time and location that the aggregate is fed.
7. Calibrate the mixing unit in the presence of the Engineer prior to the start of construction.
8. Provide nurse trucks to ensure that legal axle loads are maintained and a steady rate of progress in the laying of the microsurfacing is made.

**B. Weather Limitations.**

1. Spread microsurfacing material only when the temperature on a shaded portion of the existing surface is 50°F (10°C) and rising and when the weather is not foggy or rainy.
2. Do not place Microsurfacing material after October 1 without the Engineer's written permission.

**C. Materials Handling.**

Furnish samples of individual materials and the microsurfacing mixture as specified in the contract documents.

**1. Stockpiling of Aggregate.**

Screen and weigh the mineral aggregate at the stockpile prior to job site delivery. Do not allow stockpiles to become contaminated with oversized rock, clay, and silt. Excess moisture which would interfere with the amount of asphalt required in producing the desired homogeneous mixture will not be permitted. Keep the stockpile in areas that drain readily. Segregation of the aggregate will not be permitted.

**2. Storage of Emulsion.**

Weigh the polymer-modified emulsified asphalt on approved scales. As an option, polymer-modified emulsified asphalt may be measured by volume. Provide suitable storage facilities for the polymer-modified emulsified asphalt that meet the following requirements:

- Equipped to prevent water from entering the emulsion.
- Adequately heated to prevent freezing of the polymer-modified emulsified asphalt.

**D. Preparation of Surface.**

Immediately before placing microsurfacing, thoroughly clean the area to be microsurfaced of all vegetation, loose aggregate, soil tracked onto the roadway, and other objectionable material.

**E. Test Strip.**

Prior to commencing paving operations:

- Construct a minimum 300 foot (100 m) test section (a portion of which is at least 0.75 inch (19 mm) thick) to determine surface characteristics and set time.
- Obtain the Engineer's approval for the test section.

**F. Spreading.****1. General.**

- a. When required by local conditions, prewet the surface at a rate to dampen the entire surface without any free-flowing water ahead of the spreader box. Adjust the rate of application of the fog spray during the day to suit temperatures, surface texture, humidity, and dryness of the pavement.
- b. Use a mechanical type spreader box (normally 10 to 13 feet (3 to 4 m) wide, equipped with rotating paddles or spiral augers to agitate and spread the material uniformly throughout the box) to spread the microsurfacing mixture homogeneously and uniformly. Meet the following requirements:
  - Flexible seals are in contact with the road to prevent loss of the mixture from the box.
  - A secondary strike off is provided to improve the surface texture.
  - The spreader is maintained to prevent the loss of the microsurfacing mixture during the surfacing of superelevated curves.
  - The mixture is spread to fill all crack and minor surface irregularities and leave a neat appearing uniform non-skid application of the aggregate and asphalt on the surface.
- c. Remove all excess material that overruns in gutters, or squeegee the material back onto the surface. Immediately remove all excess material from ends of each day's run.

**2. Application Rate.**

Place surface treatment at a minimum application rate of 20 pounds per square yard (11 kg/m<sup>2</sup>).

**3. Finished Surface.**

The Engineer will make inspections of the finished surface at any time. On any 30 square yards (25 m<sup>2</sup>) of surface area inspected, comply with the following:

- No more than four tear marks greater than 0.5 inch (13 mm) wide and/or 4 inches (100 mm) long.
- No tear marks greater than 1 inch (25 mm) wide and 3 inches (75 mm) long.
- No transverse ripples or longitudinal streaks of 0.25 inch (6 mm) or more in depth.

**4. Joints.**

Construct longitudinal and transverse joints without any buildups, uncovered areas or unsightly appearance, complying with the following requirements:

- Longitudinal joints on lane lines are placed with less than 2 inches (50 mm) overlap on adjacent passes and no more than 0.25 inch (6 mm) difference in elevation between the adjacent passes.
- Transverse joints are constructed with no more than 0.125 inch (3 mm) difference in elevation across the joint.

**5. Edges.**

Place edges in the following manner:

- Neatly and uniformly along the roadway lane, shoulder, and curb lines.
- Flush with curbs.
- No more than +/- 2 inches (50 mm) horizontal variance in any 100 foot (30 m) segment along roadway lane and shoulder (at locations where feathered microsurfacing is identified in the contract documents, +/- 2 inches (50 mm) edge variance is not required).

**G. Opening to Traffic.**

1. Allow microsurfacing to cure sufficiently so that it will not deform or be picked up by vehicle tires. Provide signs, barricades, and flaggers necessary to control traffic around the areas under construction. Repair damage to the microsurfacing due to premature opening to traffic at no additional cost to the Contracting Authority.
2. Place microsurfacing treatment to sustain traffic within 1 hour after placement. Schedule microsurfacing placement to ensure traffic lanes are opened to traffic 30 minutes before sundown of the same working day. When traffic is maintained, keep the entire roadbed is free of construction equipment during non-working hours.

**2320.04 METHOD OF MEASUREMENT.**

Measurement will be as follows:

**A. Aggregate for Microsurfacing.**

Weight (mass) of the individual loads in tons (megagrams) of aggregate, of the frictional classification specified, used in accepted portions of work. No deductions will be made for moisture naturally occurring in the aggregate. The quantity of mineral filler will be included with the aggregate quantity.

**B. Preparation of Surface for Microsurfacing.**

Plan quantity for the length of pavement prepared according to the contract documents.

**C. Emulsified Asphalt for Microsurfacing.**

Volume of emulsified asphalt including polymer latex modifier used in accepted portions of work. No deductions will be made for water in approved emulsion. The volume will be corrected for temperature to 60°F (16°C).

Materials wasted after being used for calibration purposes will be included in quantities measured for payment, not to exceed 5 tons (5 mg) of aggregate and 100 gallons (375 L) of emulsified asphalt. The quantities of materials used for construction of a test strip will be included in the quantities of the respective bid items.

**2320.05 BASIS OF PAYMENT.**

Payment will be the contract unit price as follows:

**A. Aggregate for Microsurfacing.**

Per ton (megagram) for the number of tons (megagrams) of aggregate, of the frictional classification specified, used. Payment is full compensation for furnishing all labor, equipment, and materials (except emulsified asphalt) to complete the work and construction of the test strip.

**B. Preparation of Surface for Microsurfacing.**

Per mile (kilometer) for the length of pavement shown in the contract documents prepared for microsurfacing according to the contract documents.

**C. Emulsified Asphalt for Microsurfacing.**

Per gallon (liter) for the number of gallons (liters) of emulsified asphalt used. Payment is full compensation for furnishing the emulsified asphalt.

**Division 24. Structures.****Section 2401****2401.05, B.**

**Replace** the third bullet:

If the existing structure will become the property of the Contracting Authority, payment for proper storage, salvage, and delivery of the structure shall will be according to Section 2555.

**Section 2402****2402.04, B, 3.**

**Replace** the first sentence:

For roadway pipe culverts, the amount of excavation measured for payment will be computed from an excavation centered on the center line of the pipe, to the required depth, length, and a width of ~~42 inches~~ 4 feet (1.2 m) plus the specified inside diameter of the pipe in inches (millimeters).

**2402.04, B, 4.**

**Replace** the first sentence:

For cast-in-place culverts, the amount of excavation measured for payment will be computed from an excavation centered on the center line of the culvert, to the required depth, length, and a width ~~2 4 feet (0.6 1.2 m)~~ greater than the inside width of the ~~footing~~ culvert.

**2402.04, B, 5.**

**Delete** the Article:

~~5. When moisture control is required by the contract documents, the amount of excavation measured for payment will be computed for an excavation to the required depth and length and a width extending 6 feet (2 m) beyond the limits of the structure.~~

**Section 2403****2403.02, A, 3, c.**

**Replace** the second sentence:

Refer to Article ~~2412.02~~ 2412.03 for concrete used for one course bridge floors and the first course of two course bridge floors.

**2403.02, B, 2, a.**

**Add** to the end of the Article:

When Type A Mid Range water reducing admixture is used, the slump, measured according to Materials I.M. 317, may be increased to between 1 inch (25 mm) and 4 inches (100 mm) as a target range, allowing a maximum of 5 inches (125 mm).

**2403.02, B, 3, Entrained Air Content.**

**Replace** the fourth sentence:

To allow for loss during placement, use a target value of 6.5%, with a maximum variation of -1.0% and +4.5 2.0%, for the air content of fresh, unvibrated structural concrete.

**2403.03, B, 5, c.**

**Replace** the first sentence:

Design forms for strength as specified in Article 2403.03, ~~Q~~ L.

**2403.03, C, 2, h.**

**Replace** the Article:

Protect concrete placed when the air temperature is at or below 40°F (4°C) as provided in Article 2403.03, ~~†~~ F.

**2403.03, E, 4.**

**Replace** the first sentence.

Unless concrete is protected as specified in Article 2403.03, ~~†~~ F, protect exposed surfaces, including surfaces from which forms have been removed less than 60 hours after the concrete has been placed, in the following manner for at least 4 calendar days after concrete is placed:

**2403.03, E, 7.**

**Replace** the Article:

Cure barrier railing as provided in Article ~~2414.03, A~~ 2513.03, D.

**2403.03, F, 1.**

**Replace** the Article:

Do not place concrete, without ~~notifying~~ permission from the Engineer, when the air temperature is 40°F (4°C) or less.

**2403.03, L, Design and Construction of Forms and Falsework.**

**Replace** Articles 4 and 5:

**4. Design Loads.**

Design formwork and falsework for the following loads:

- a. Vertical load of concrete with a density of 150 pounds per cubic foot (2400 kg/m<sup>3</sup>).
- b. Horizontal load of fresh concrete as a liquid with a density of 150 pounds per cubic foot (2400 kg/m<sup>3</sup>) for the depth of plastic concrete, except when lesser pressures are permitted by AASHTO Guide Design Specifications for Temporary Works.
- c. Vertical dead load of forms and falsework.
- d. Vertical dead load of rail and walkway applied at edge of deck form equal to 75 pounds per linear foot (1.1 kN/m)
- ~~d~~ e. Construction live load equal to 50 pounds per square foot (2.4 kPa) of horizontal projection
- f. Live load equal to 6 kips (26.69 kN) of finishing machine located along the edge of the deck form to maximize the design condition.
- ~~e~~ g. Wind loads ~~on walls and columns according to the requirements of the ACI~~ equal to 50 pounds per square foot (24 kPa) for elevations to 30 feet (10 m) above the ground, increased for elevations above 30 feet (10 m).

- h. Other applicable loads such as horizontal loads due to equipment or construction sequence, additional live load, impact, stream flow, and snow loads specified in AASHTO Guide Design Specification for Bridge Temporary Works.

## 5. Design Stresses.

- a. Design formwork and falsework using load groups specified in AASHTO Guide Design Specifications for Bridge Temporary Works and material working stresses ~~and a normal duration of load, as for a permanent structure~~. For structural steel and reinforced concrete use the allowable stress percentages given with load groups. For lumber and timber use appropriate load and duration factors instead of percentages. Calculate lumber strength on the basis of dressed size ~~and, except for sheathing, a dry condition~~. Publications of the APA – The Engineered Wood Association, ACI, and the ~~National Forest Products Association~~ American Forest & Paper Association, American Wood Council will be considered standard references for design and analysis of plywood, lumber, and timber formwork and falsework.
- b. Do not exceed 50 times the dimension of the least side for the unsupported length of wooden columns and compression members. ~~Analyze the member as a column.~~
- c. Unless the Contractor certifies a higher stress grade or value as allowed by AASHTO Guide Design Specification for Temporary Works, adequacy of falsework material will be ~~checked~~ reviewed on the basis of the following values:
  - 1) Structural steel stresses ~~per AASHTO~~ for 30,000 36,000 psi (207 248 MPa) yield strength and 22,500 22,000 psi (155 151 MPa) maximum working stress.
  - 2) Plywood sheathing stresses ~~per American Plywood Association~~ APA – The Engineered Wood Association for ~~concrete form grade~~ Plyform, Class I, wet use, ~~permanent loading~~ 7 day duration of load, span-perpendicular-to-face grain. Orientation of plywood panels must be shown on drawings if advantage is taken of greater strength with span-parallel-to-face grain.
  - 3) ~~Stresses~~ Design values for lumber in good condition and 4 inches (100 mm) or less in thickness, in psi (MPa) as follows:
 

$f_b$ , bending	= 1000 875 ( <del>6.90</del> 6.03)
$f_t$ , tension	= <del>625</del> 450 ( <del>4.30</del> 3.10)
$f_v$ , shear	= 120 135 ( <del>0.83</del> 0.93)
$f_c$ , perpendicular to grain	= 345 425 ( <del>2.40</del> 2.93)
$f_c$ , parallel to grain	= 1050 1150 ( <del>7.20</del> 7.93)
E, modulus	= <del>1,500,000</del> 1,400,000 ( <del>40,300</del> 9650)

These design values are to be modified for seven-day duration of load (except for  $f_c$ , perpendicular to grain and E, modulus) and other applicable adjustment factors when determining allowable stresses.
  - 4) ~~Stresses~~ Design values for ~~lumber~~ timber in good condition and 5 inches (125 mm) thick and thicker in psi (~~MPs~~ MPa) as follows:
 

$f_b$ , bending	= 1200 850 ( <del>8.30</del> 5.86)
$f_t$ , tension	= 1000 450 ( <del>6.90</del> 3.10)
$f_v$ , shear	= 120 125 ( <del>0.83</del> 0.86)
$f_c$ , perpendicular to grain	= 390 425 ( <del>2.70</del> 2.93)
$f_c$ , parallel to grain	= 1000 625 ( <del>6.90</del> 4.31)
E, modulus	= <del>1,600,000</del> 1,300,000 ( <del>41,000</del> 8960)

These design values are to be modified for seven-day duration of load (except for  $f_c$ , perpendicular to grain and E, modulus) and other applicable adjustment factors when determining allowable stresses.
  - 5) Safe bearing value of coarse sand, gravel, very firm clay, and other similar confined soils in thick beds at 1500 pounds per square foot (72 kPa) unless recommended otherwise by a Professional Engineer licensed in the State of Iowa. Safe bearing value of compacted berms at 2000 pounds per square foot (96 kPa).

## 2403.03, L, 1, General.

### Add the Article:

- c. Design values for lumber and timber vary considerably depending on size and or use, species, and grade. For each type of structural member, list on the falsework plans specifications for the following if known: size or use category, species group, and minimum grade.

**2403.03, L, 2, a.****Replace** the Article:

Use materials, and construct forms that will be in direct contact with concrete, as specified in Article 2403.03, B, 5.

**2403.03, L, 3, c.****Add** as the first sentence of the Article:

To ensure stability for pile bents 10 feet (3 m) or less in height that are not sway braced, show pile type, size, and minimum embedment length on plans.

**2403.03, M, 2, a.****Replace** the second sentence of the Article:

When Maturity Method (according to Materials I.M. 383) for strength determination is used, the flexural strength of ~~550~~ 575 psi (~~3.8~~ 4.0 MPa) will be required.

**2403.03, N, 2, a.****Replace** the second sentence of the Article:

Unless otherwise indicated in the contract documents, concrete may be subjected to loads due to placing backfill material or to legal traffic when the concrete has reached the minimum age stipulated in Table 2403.03-2 and developed a flexural strength of at least ~~550~~ 575 psi (~~3.8~~ 4.0 MPa).

**2403.03, O, 1, a.****Replace** the Article:

Place construction joints between successive layers of concrete as provided in Article 2403.03, K H.

**2403.03, P, 2.****Replace** the first paragraph:

Provide a Class 1, finish to horizontal surfaces not cast against a form and not subject to wear (for example, bridge seats, tops of backwalls, piers, abutments, wingwalls, retaining walls, spandrel walls, struts between pedestal piers, and horizontal surfaces of curbs and sidewalks of the bridge). Bridge beam seats shall be finished to the plan elevation with a tolerance of +/- 0.02 feet (6 mm). For all other surfaces required to be finished, provide a Class 2, finish to low water line or 1 foot (0.3 m) below the finished ground line. ~~Provide a Class 3, finish to those areas designated in the contract documents.~~

**2403.03, P, 2, c.****Delete** the article:**~~c. Class 3, Special Surface Finish.~~**

~~This operation shall obtain a surface reasonably smooth and uniform in texture and appearance.~~

~~1) Apply a bonding agent mixed with standard or commercially packaged mortar. More than one application may be necessary. Use the same materials and methods for all surfaces to be given a Class 3 finish.~~

~~2) The Class 3 finish requirements do not relieve the Contractor of the responsibility for performing the Class 2 finish as specified prior to commencing Class 3 finish operations.~~

~~3) Do not commence application of the Class 3 finish until:~~

~~All other work which may mar the surface finish has been completed, or  
Finishing operations can be carried on continuously from beginning to completion on any one bridge or structure.~~

**2403.05, A, 2.****Replace** the Article:

For concrete placed within the contract period ~~between November 15 and April 1~~, additional payment will be made for heating or protecting or both; ~~however, no payment will be made when winter work is specified in the contract documents.~~

**2403.05, A, 3.****Delete** the last sentence of the Article:

~~Heating, protection, or both, required outside the above dates, will be paid for when approved by the Engineer.~~

**2403.05, A, 4.****Replace** the Article:

Payment for protection will be made when heated housing or insulated forms are used to meet requirements of Article 2403.03, † F. The additional payment for protection will be \$7.00 per cubic yard (\$9.25 per cubic meter). If a footing is protected by flooding with water, no payment will be made. If footings are protected with coverings of burlap, hay, straw, plastic, insulation, and/or other materials sufficient to meet the temperatures and time specified in Article 2403.03, † F, payment for protection will be made.

**Section 2405****2405.03, H, 1, General.****Replace** the Article:

- a. Use bolts, nuts, and washers; galvanized according to ASTM A-153 F 2329, ~~Class C~~; with zinc bath temperature not to exceed 850°F (455°C) or ASTM B 695, Class 50 55, Type I.
- b. Use full-length galvanized anchor bolts that:
  - Meet the requirements of ASTM F 1554, Grade 36.
  - Are Unified Coarse Thread Series, and
  - Have Class 2A tolerance.
- c. Color code in blue the end of each anchor bolt intended to project from the concrete in order to identify the grade. Use galvanized washers that meet the requirements of ASTM F 436, Type 1. Use heavy hex, galvanized nuts that meet the requirements of ASTM A 563, DH, Class 2B. Threads are to comply with Unified Coarse Thread Series, and have Class 2B tolerance. Nuts may be over-tapped in accordance with the allowance requirements of ASTM A 563.

**Section 2407****2407.01, Description.****Replace** Articles C and D:

- C. Apply the provisions of this section to production and construction of prestressed precast concrete bridge units and nonprestressed precast concrete ~~as defined in Section 1104~~ bridge units.
- D. Unless modified elsewhere in the contract documents, all fabrication is required to be done only in precast fabrication plants that are approved prior to the letting as per Materials I.M. 445 570 and 570 LRFD.

**2407.02, A, 1.****Replace** the Article:

Apply Sections 4110, 4111, and 4115, except the gradation requirements of Articles 4110.02, 4111.02, and 4115.03. If high performance concrete (HPC) is being used for prestressed concrete beams, use a coarse aggregate consisting of crushed limestone, quartzite, or granite meeting class 3 durability or better.

**2407.03, B, 4.****Replace** the Article:

If using HPC for prestressed concrete beams, use a mix design that has been evaluated according to ASTM C 1202 or AASHTO TP 95, and approved by the Engineer. To obtain mix design approval either:

- a. Submit to the Engineer ASTM C 1202 results from mix samples taken and tested by an independent laboratory. The results shall be 1500 coulombs or less when cured using accelerated moist curing.
- b. Submit to the Engineer AASHTO TP 95 results from mix samples taken and tested by an independent. The results shall be 30 kilohm-cm or more when cured for 28-day moist curing.
- b c.** Contact the Engineer and arrange for a trial batch. The producer certified technician shall cast 4 inch 8 inch cylinders for testing by the Materials Laboratory. The ASTM C 1202 results shall be 1500 coulombs or less when cured using accelerated moist curing or the AASHTO TP 95 results shall be 30 kilohm-cm or more on samples moist cured for 28 days.
- e d.** When silica fume, class F fly ash, or GGBFS is used in the mix, the Engineer may waive ASTM C 1202 or AASHTO TP 95 testing.

**2407.03, J, 1, Precast Nonprestressed Units.****Rename** the Article:

Precast Nonprestressed Bridge Units.

**2407.03, J, 2, Precast Prestressed Units.****Rename** the Article:

Precast Prestressed Bridge Units.

**Section 2408****2408.02, Materials Requirements, Identifications, and Fabrication.****Replace** the first sentence:

Unless modified elsewhere ~~modified~~ in the contract documents, all fabrication to which this section applies shall be done in the ~~states, territories, and possessions of the United States and in other locations within the geographic limits of North America~~ and in steel fabrication shops and plants that are approved prior to the letting according to Materials I.M. 557.

**2408.03, Q, Assembling Steel.****Add** the Article:

5. Do not weld on any steel during or after assembly unless welding is specified in the contract documents and with prior approval of the Engineer.

**2408.03, S, 5, c, 4.****Replace** the Article:

Establish the job inspecting torque value(s) at least once prior to each day's inspection. Have an approved testing agency verify ~~calibrate~~ calibration of the tension measuring device at least every ~~6~~ 12 months and if found to be out of tolerance, have it calibrated.

**2408.03, S, Bolting.****Add** the Article:**6. Installing Stainless Steel Fasteners.**

Install stainless steel fasteners using the following:

- a. Install stainless steel fasteners to a snug tight condition. Snug tight is defined as the tightness attained with a few impacts (3-5) of an impact wrench or full effort with an ordinary spud wrench.
- b. Tightening of bolts shall be performed in a manner that brings faying surfaces up evenly.
- c. Do not use compressible materials such as gaskets, insulation, or metal shims between any bolted connections or flanges.
- d. Visually ensure that plies of connected elements have been brought into firm contact.
- e. Verify torque values as noted in Table 2408.03-4.

- f. When in storage, protect bolts, nuts, and washers from the elements.

**Table 2408.03-4: Minimum Bolt Torque**

<b>Bolt Dia. inches (mm)</b>	<b>Min. Bolt Torque, Type 304 ft-lb (N-m)</b>	<b>Min. Bolt Torque, Type 316 ft-lb (N-m)</b>
1/4 (6.4)	6.0 (8.1)	7.0 (9.5)
5/16 (7.9)	11.0 (14.9)	12.0 (16.3)
3/8 (9.5)	20.0 (27.1)	21.0 (28.5)
7/16 (11.1)	31.0 (42.0)	33.0 (44.7)
1/2 (12.7)	43.0 (58.3)	45.0 (61.0)
9/16 (14.3)	57.0 (77.3)	59.0 (80.0)
5/8 (15.9)	93.0 (126.1)	97.0 (131.5)
3/4 (19.0)	128.0 (173.5)	132.0 (179.0)
7/8 (22.2)	194.0 (263.0)	203.0 (275.2)
1 (25.4)	287.0 (389.1)	333.0 (451.5)
1 1/8 (28.6)	413.0 (560.0)	432.0 (585.7)
1 1/4 (31.8)	480.0 (650.8)	504.0 (683.3)
1 1/2 (38.1)	703.0 (953.1)	732.0 (992.5)

### **2408.03, Construction.**

**Add the Article:**

#### **Y. Shear Connector Studs.**

1. When required by the contract documents, provide shear connector studs according to Article 4152.03. Achieve uniform quality and condition of completed studs, free of injurious laps, fins, seams, cracks, twists, bends, or other discontinuities. Replace studs that have radial cracks or bursts in the head of a stud. Use automatically timed stud welding equipment. Welding shall not be performed when base metal temperature is below 0°F (-20°C) or when surface is wet or exposed to falling rain or snow. Set-up shall include stud gun, power source, total welding lead length, and stud diameter.
2. Test completed studs in accordance with Materials I.M. 558 and Section 7 of the latest ANSI/AWS Welding Code D1.5/D1.5M.

## **Section 2412**

### **2412.01, Description.**

**Add to the end of Article:**

For continuous concrete slab bridges apply Section 2406.

### **2412.02, Materials.**

**Renumber** Article E and **Add** the Article:

- E.** When Type A Mid Range water reducing admixture is used, the slump, measured according to Materials I.M. 317, may be increased to between 1 inch (25 mm) and 4 inches (100 mm) as a target range, allowing a maximum of 5 inches (125 mm).

**E F.** Use a single source of cement during an individual placement. Drain all aggregate for at least 24 hours after washing and before batching.

### **2412.03, C, Placing Concrete.**

**Add to the end of Article 1:**

For prestressed concrete beam bridges, beams shall be at least 28 days old before the concrete deck is placed, to allow time for beam creep and camber development to occur.

**Replace** Article 2:

When cold weather protection is necessary, do not place concrete without the Engineer's ~~written~~ permission.

**Add** as the second sentence of Article 4:

Do not place concrete, without permission from the Engineer, when the forecast wind velocity (maximum steady wind or gusts) will be 25 mph (40 km/h) or greater.

**2412.03, D, 4, a, 3, b.****Replace** the Article:~~1/8 inch + 1/32 inch or 1/16 inch (3 mm + 0.8 mm or 1.6 mm)~~ 1/8 inch to 1/4 inch (3 mm to 6 mm) deep, and**2412.03, D, 4, a, Interstate and Primary Projects.****Add** the Article:

- 8) Continuously remove slurry or residue resulting from grooving operations. Do not deposit on deck or approach pavement. Leave deck and approach pavements in a clean condition. Ensure residue from grooving operations does not flow across lanes occupied by public traffic or into gutters or other drainage facilities. This residue may be spread on foreslope or removed according to Article 1104.08.

**2412.03, E, 1, b, Other Projects.****Add** to the end of the Article:

Burlap placement beyond 30 minutes may be allowed, up to an additional 30 minutes, if approved by the Engineer based upon environmental conditions at time of deck placement.

**Section 2413****2413.02, D, 2, b.****Replce** the first sentence:

Use a mid-range water reducing admixture ~~meeting the requirements of~~ listed in Materials I.M. 403, Appendix C and a retarder listed in Materials I.M. 403, Appendix G.

**2413.03, A, 2, c, 2.****Delete** the Article:

- ~~2) Do not operate jack hammers or mechanical chipping tools at an angle exceeding 45 degrees measured from the surface of the deck.~~

**2413.03, C, 2, b.****Replace** the Article:

Concrete may be removed by using a jack hammer, chipping hammer, shot blasting, hydro blasting, or by a combination of these. Concrete removal beneath reinforcing bars shall be accomplished using a 15 pound (7 kg) chipping hammer. Complete final cleanup at the periphery and base of Class A repair using a 15 pound (7 kg) chipping hammer or hand tools.

**2413.03, C, 3, c.****Replace** the second sentence of the Article:

Accomplish final removal at the periphery and base (if not full depth) of Class B repair using a 15 pound (7 kg) ~~jack hammer~~, chipping hammer, or hand tools.

**2413.03, D, 2, Stationary Mixer.****Replace** the Article and title:**Stationary Mixer and Ready Mixed Concrete.**

~~When a construction or stationary mixer is used, p~~Proportion and mix according to applicable provisions of Article 2403.02, D.

**2413.03, F, 1.****Replace** the Article:

Place ~~the first~~ a single layer of prewetted burlap on the concrete as follows:

- a. **Interstate and Primary Projects.**

Place within 10 minutes after finishing. If Class O PCC is revibrated because of failure to meet density requirements with initial vibration, place the prewetted burlap within 10 minutes after finishing of the revibrated area.

**b. Other Projects.**

Immediately after final finishing, cover the area finished with white pigmented curing compound meeting the requirements of Article 4105.05, applied at a rate of no more than 135 square feet per gallon (3.3 square meters per liter). Place the ~~first layer of~~ prewetted burlap on the concrete within 30 minutes after the concrete has been deposited on the deck. If Class O PCC is revibrated because of failure to meet density requirements with initial vibration, this time limit will be extended by 15 minutes.

**2413.03, F, 2, a, 1.**

**Delete** the second sentence of the Article:

~~When Class HPC-O is used on projects with a deck overlay quantity greater than 1800 square yards (1500 m<sup>2</sup>), allow the surface to cure for 168 hours.~~

**2413.03, G, Sealing the Deck Overlay.**

**Replace** the Article and title:

**Sealing for Deck Overlay Existing Concrete.**

Seal the tops and traffic sides of curbs, retrofit barrier rails, and concrete barrier rails according to Article 2403.03, P, 3. In addition, for Class O PCC overlay or Class HPC-O overlay, also apply the sealer along each gutter line, extending 1 foot (0.3 m) onto the roadway. The Engineer or the contract documents may designate other areas requiring concrete sealer.

**2413.03, H, 9.**

**Replace** the third sentence:

~~If this work is started before the end of the 72 hour curing period or 168 hour curing period for Class HPC-O projects with greater than 1800 square yards (1500 m<sup>2</sup>) or the cure period specified in the contract documents, the work will be restricted as follows:~~

**Section 2415**

**2415, Concrete Box, Arch, and Circular Culverts.**

**Replace** the Section:

**2415.01 DESCRIPTION.**

**A. Cast-in-place.**

Construct a cast-in-place concrete box, arch, or circular culvert.

**B. Precast.**

- ~~1. Precast box culverts may be accepted when shown in the contract documents. Apply Section 2419.~~
2. Use culvert sections that meet the requirements of ASTM 1433 C 1577 or Iowa DOT Single Precast RCB Culvert Standards.
3. The contract documents will designate the culvert span, rise, and ~~either the design earth cover, or the design loading, both defined in ASTM 1433 C 1577.~~
4. ~~Apply section 2407 to the aggregates used in the concrete.~~ Use coarse aggregate in concrete mixture from an approved source meeting requirements of Section 4115, with Class 2 or better durability rating.
- ~~5. Apply the appropriate requirements of Section 2407 to manufacturing process inspection.~~
- 5. Concrete strength will be based on cylinder tests.**

6. Shop drawing submittal required as per the contract documents.

## **2415.02 MATERIALS.**

### **A. Cast-in-Place.**

Use Class C structural concrete meeting the requirements of Section 2403, unless specified otherwise.

### **B. Precast.**

1. Apply Section 2419.

### **2. Culvert Connectors.**

Apply Article 2416.02, B.

## **2415.03 CONSTRUCTION.**

### **A. Cast-in-Place.**

Apply the requirements of Sections 2401, 2402, 2403, 2404, and 2414.

#### **A 1. Footings.**

- 1 a.** Construct footings to the elevations shown in the contract documents, unless directed otherwise by the Engineer.
- 2 b.** Footing depths may be increased when necessary to prevent undermining or scour or to secure adequate bearing. In general, decrease footing depth only when solid rock is encountered at elevations above those shown.
- 3 c.** Use suitable wood or metal forms according to Section 2403 to enclose all footing concrete.

#### **B 2. Placing Concrete.**

##### **1 a. Footings.**

- a- 1)** Do not allow dirt, mud, or other foreign material to become mixed with concrete which is being placed in the footing.
- b- 2)** Monolithically construct footings, pavements, and curtain walls between construction joints if practical.
- c- 3)** Provide a key notch of the form shown in the contract documents between the walls and footings to insure proper anchorage.
- d- 4)** Remove all dirt, dust, shavings, or other foreign material from the key notch and wall forms before placing concrete.

##### **2 b. Barrels of Culverts.**

- a- 1)** The sidewalls and top slab may be constructed as a monolith between construction joints, or the concrete in sidewalls may be placed and allowed to harden before the top slab is placed, at the discretion of the Contractor.
- b- 2)** If the sidewalls and top slab are constructed as a monolith, all necessary construction joints are to be vertical and at right angles to the axis of the culvert. If the sidewalls are placed and allowed to harden before the top slab is placed, leave appropriate keys in the sidewalls for anchoring the cover slab.
- c- 3)** Place forming and reinforcement for the entire barrel section between construction joints before concrete is placed in the sidewalls or headwalls.

##### **3 c. Headwalls.**

- a- 1)** In general, construct headwalls monolithically. However, when construction joints are unavoidable, place them in a horizontal or vertical position and locate them so no joint is visible above the roadbed.
- b- 2)** Place triangular fillet strips in the forms to avoid sharp edges and corners.

##### **4 d. Placing Concrete in Arch Culverts.**

Place concrete in arch culverts as provided in Section 2403.

### **C 3. Surface Finish.**

Surface all exposed parts of the wingwalls, headwalls, and railings according to Article 2403.03, P.

### **D 4. Placing Backfill Material.**

Place backfill material according to Article 2402.03, H.

**5. Protection Railings.**

**1 a.** Furnish and install protection railings shown in the contract documents.

**2 b.** Paint protection railings, other than aluminum or galvanized railings, as provided in Section 2508.

**B. Precast.**

1. Apply Section 2419.

2. Place backfill material according to Article 2402.03, H.

**2415.04 METHOD OF MEASUREMENT.**

**A.** Excavation for structures, structural concrete, steel reinforcement, and other items in the contract documents will be the quantity shown in the contract documents.

**B.** Protection railing (when specified in the contract documents) will be the quantity shown in the contract documents.

**C.** Items for precast box culverts will be measured as noted in the contract documents.

**2415.05 BASIS OF PAYMENT.**

**A.** Payment for all cast-in-place concrete box, arch, or circular culverts will be the contract unit price for excavation for structures, structural concrete, steel reinforcement, and other items included in the contract documents.

**B.** Payment for protection railings will be the contract unit price for the railing material.

**C.** Payment for precast box culverts items will be as noted in the contract documents.

**D.** Payments are full compensation for furnishing all materials, equipment, and labor and for performance of all work necessary to complete the structures in conformance with the contract documents or as ordered by the Engineer.

**Section 2416**

**2416.02, Materials.**

**Replace** the Article:

~~Meet the requirements of Section 4145 for the type and strength (class) of pipe specified in the contract documents.~~

**A.** Apply Section 2419.

**B. Culvert Connectors.**

**a.** Use either grade 40 or grade 60.

**b.** Unless otherwise specified, provide coarse thread series in accordance with the requirements of ASME B 1, Class 1A or 2A tolerance.

**c.** Galvanize and or metalize after fabrication by one of the following:

- ASTM A 153,
- ASTM F 2329, or
- ASTM B 633, Class Fe/Zn 25 or Fe/Zn 12

**2416.03, A.**

Replace Table 2416.03-1:

**Table 2416.03-1: Minimum and Maximum Allowable Pipe Sizes**

Culvert Use	Minimum Pipe Size in. (mm)	Maximum Pipe Size in. (mm)
Roadway Culvert	18 (450)	108 (2700)
Entrance Culvert	<del>15 (375)</del> 18 (450)	108 (2700)

**2416.03, D, 5, d.**

Replace the second sentence of the Article:

Use Class C structural concrete as specified in Section ~~2404~~ 2403.

**Section 2417****2417.03, A, 1.**

Replace Table 2417.03-1:

**Table 2417.03-1: Minimum Allowable Pipe Sizes**

Culvert Use	Minimum Pipe Size in. (mm)
Roadway Culvert	18 (450)
Entrance Culvert	<del>15 (375)</del> 18 (450)

**Section 2418****2418, Temporary Stream Diversion.**

Add the Section:

**2418.01 DESCRIPTION.**

Construct, maintain, and remove temporary stream diversion according to the contract documents.

Temporary stream diversion involves diverting flow of a perennial stream around the construction site by use of either a diversion channel, pipe, or hose. Temporary stream diversion applies to projects involving installation or extensions of reinforced box culverts 6 feet by 6 feet (1800 mm by 1800 mm) or larger, precast box culverts 6 feet by 6 feet (1800 mm by 1800 mm) or larger, or arch pipe culverts 102 inches by 62 inches (2590 mm by 1575 mm) or larger.

**2418.02 MATERIALS.****A. Impervious Dike.**

- Use one of the following:
- Impervious fabric with earth, stone, or other fill material,
- Revetment stone meeting the requirements of Section 4130 with impervious soil or fabric behind the dike,
- Sandbags,
- Sheet piles, or
- Other as approved by the Engineer.

**B. Temporary Energy Dissipation.**

Revetment stone meeting the requirements of Section 4130.

**C. Sediment Control.**

Meet the requirements of Section 2602 for silt fence or perimeter and slope sediment control devices.

**2418.03 CONSTRUCTION.**

Unless stated otherwise in the contract documents, the Contractor may choose which type of temporary stream diversion to construct. Construct temporary stream diversion according to Standard ~~Reed~~ Road Plan ~~RL-20~~ EW-402.

**A. Temporary Stream Diversion by use of a Pipe or Hose.**

This method may include bypass pumping.

1. Set up bypass pump (if used) and temporary pipe or hose. Provide temporary energy dissipation measures at discharge point of temporary outlet pipe or hose. Firmly anchor bypass pump and pipe or hose.
2. Construct impervious dike upstream of work area. When constructing dike, place revetment or impervious fabric prior to placing soil or earth.
3. Construct impervious dike or sediment control device downstream to isolate work area.
4. Routinely inspect bypass pump and temporary pipe or hose to ensure proper operation. Inspect impervious dike(s) for leaks and repair damage. Inspect discharge point for erosion. Install additional temporary energy dissipation material as needed. Ensure flow is adequately diverted through pipe or hose and maintain all elements of the temporary stream diversion throughout period of construction.
5. Immediately after completion of construction in the work area, remove impervious dike(s), bypass pump, temporary pipe or hose, temporary energy dissipation material, and sediment control materials in the stream.

**B. Temporary Stream Diversion by use of a Diversion Channel.**

1. Excavate diversion channel without disturbing existing channel. Install sediment control along top of diversion channel.
2. Connect downstream diversion channel into downstream existing channel. Install temporary energy dissipation measures at discharge point into existing channel.
3. Connect upstream diversion channel into existing channel at upstream side to divert flow into diversion channel.
4. Construct impervious diversion dike in existing channel at upstream side to divert flow into diversion channel. When constructing dike, place revetment or impervious fabric prior to placing soil or earth.
5. Construct impervious dike or other sediment control in existing channel at downstream side to isolate work area.
6. Routinely inspect diversion channel for scour/erosion and sediment loss at channel discharge location. Install rock checks in channel and additional temporary energy dissipation material at outlet as needed. Inspect impervious dikes for leaks and repair damage. Ensure flow is adequately diverted through diversion channel and maintain all elements of temporary stream diversion throughout the period of construction.
7. Immediately after completion of construction in the work area, remove impervious dike(s), temporary energy dissipation material, and sediment control materials in the stream. Divert channel back into existing channel. Backfill and compact diversion channel in accordance with Article 2107.03, E.

**2418.04 METHOD OF MEASUREMENT.**

- A.** Each Temporary Stream Diversion will be counted.
- B.** Sediment control and sediment control removal will be measured according to Article 2602.04 for type of device used.

**2418.05 BASIS OF PAYMENT.**

- A. Payment will be at contract unit price for each Temporary Stream Diversion. If there is no bid item for temporary stream diversion, it will be paid for according to Article 1109.03, B. Payment is full compensation for labor, equipment, and materials necessary to construct and remove Temporary Stream Diversion. Payment of 50% of item will be made upon completion of installation of temporary stream diversion and remaining 50% will be paid upon completion of removal of temporary stream diversion and restoration of work site.
- B. Sediment control and sediment control removal will be paid for according to Article 2602.05 for type of device used.

**Section 2419****2419, Precast Concrete Units.**

Add the Section:

**2419.01 DESCRIPTION.**

- A. Provide precast concrete units produced in a plant for which equipment, procedures, and quality of concrete have been approved by the Contracting Authority.
- B. Provide, or have fabricator provide, technical personnel experienced and skilled in application of precast system being used. Ensure technical personnel cooperate with Engineer in technical aspects of the work.
- C. Apply provisions of this section to production and construction of precast concrete as defined in Section 1101.
- D. Unless modified elsewhere in the contract documents, perform fabrication in precast fabrication plants that are approved prior to letting.
- E. Requirements for specific precast units are found in the Materials I.M. 445 series, Materials I.M. 571, and in the following specification sections:  
 Section 4145: Concrete Culvert Pipe  
 Section 2415: Concrete Box, Arch, and Circular Culverts  
 Section 2416: Rigid Pipe Culverts  
 Section 2430: Modular Block Retaining Wall  
 Section 2431: Segmental Retaining Wall  
 Section 2432: Mechanically Stabilized Earth (MSE) Retaining Wall  
 Section 2513: Concrete Barrier (Precast)  
 Section 2435: Sanitary and Storm Sewer Structures  
 Section 2503: Storm Sewers  
 Section 2504: Sanitary Sewers  
 Section 4149: Sanitary and Storm Sewer Pipe and Structures Materials

**2419.02 MATERIALS.**

Use materials meeting requirements of Division 41 for respective material, and the following:

**A. Aggregates.**

- 1. Apply Sections 4110, 4111, 4115, and 4117, except gradation requirements of Articles 4110.02 and 4115.03.
- 2. Submit aggregate gradations and proportions with mix design to District Materials Engineer for approval.
- 3. Use aggregates similar to Class V only when 30% or more of total weight (mass) of aggregate is limestone.

**B. Admixtures.**

When authorized by Engineer, approved admixtures complying with Section 4103 may be used and shall be from an approved source identified in Materials I.M. 403.

**C. Reinforcing Steel and Wire Fabric.**

Comply with requirements of Section 4151 and ensure materials are from an approved source identified in Materials I.M. 451. Precast fabricator shall accept reinforcing steel with certified mill test reports for each heat delivered.

**D. Cement.**

Apply Section 4101, unless otherwise specified. If the use of Type III Portland cement has been authorized, use it in same proportions as specified for Type I Portland cement. Cement with total equivalent sodium oxide between 0.61% and 0.75% may be used, provided it is non-reactive with proposed aggregate when tested according to ASTM C 1260, C 1567, or C 1293.

**E. Supplementary Cementitious Materials.**

1. Apply Section 4108.
2. Fly ash may be substituted for Portland cement. Use a substitution rate of no more than 25% by weight (mass) for wet cast concrete only. Fly ash shall be from an approved source identified in Materials I.M. 491.17.
3. GGBFS may be substituted for Portland cement. Use a substitution rate of no more than 35% by weight (mass) for GGBFS as a mineral admixture. GGBFS shall be from an approved source identified in Materials I.M. 491.14.
4. The maximum total supplementary cementitious materials substitution shall not exceed 50%.

**2419.03 Construction.****A. Equipment.**

Use equipment meeting requirements of Section 2001 and the following:

1. Forms: Use forms for precast concrete true to dimensions shown in contract documents, true to line, mortar tight, and of sufficient rigidity to not sag or bulge out of shape under placement and vibration of concrete. Ensure inside surfaces are smooth and free of projections, indentations, or offsets that might restrict differential movements of forms and concrete.
2. Weighing and Proportioning Equipment.  
Apply Article 2001.20, except that a vibrator will not be required on cement batch hopper.
3. **Mixing Equipment.**  
Article 2001.21.
4. **Bins.**  
Article 2001.06

**B. Concrete.**

1. For precast construction, use at least 610 pounds (360 kg) of total cementitious material per cubic yard (cubic meter) of concrete. Do not exceed maximum water-cementitious ratio, including free moisture in aggregate, of 0.450 pound per pound (0.450 kg/kg).
2. Intended air entrainment of finished wet cast concrete is 6%. To allow for loss during placement, use a target value of 6.5% for air content of fresh unvibrated concrete, with a maximum variation of  $\pm$  plus 1.5% and minus 1.0%.

**C. Proportioning, Mixing, and Placing Concrete.**

1. Proportion and mix concrete according to applicable requirements of Article 2403.02, D, 3.
2. Do not place concrete when ambient temperature is below 35°F (2°C) unless Engineer has approved plant for cold weather concrete placement. When necessary, heat aggregate or water, or both, so temperature of concrete when deposited in forms is 40°F to 90°F (4°C to 32°C). Do not use frozen material in concrete.
3. When a series of units is cast in a line, cast entire series in one continuous operation, or as directed by Engineer. Place successive batches before preceding batch has perceptibly hardened or dried. Do not allow more than 45 minutes to pass between placement of successive batches of concrete in a unit. Do not retemper concrete or add water to interface of the concrete between batches.
4. Carefully work and consolidate concrete around reinforcement without displacing it. Ensure formation of honeycomb, stone pockets, or similar defects have not occurred. Consolidate concrete using small diameter vibrators or by other means approved by Engineer. Overfill forms during consolidation. Screed off excess concrete and finish surface to desired texture.

**D. Curing.**

1. Use a method of curing that prevents loss of moisture and maintains an internal concrete temperature at least 40°F (4°C) during curing period. Obtain Engineer's approval for this method.
2. In all cases, cover concrete and leave covered until curing is completed. Side forms and pans forming underside of channel shapes may be removed during this period if cover is immediately replaced. Do not, under any circumstances, remove units from casting bed until strength requirements are met.
3. When accelerated heat is used to obtain temperatures above 100°F (38°C):
  - a. Record temperature of interior of concrete using a system capable of automatically producing a temperature record at intervals of no more than 15 minutes during entire curing period.
  - b. Space systems at a minimum of one location per 100 feet (30 m) of length per unit or fraction thereof, with a maximum of three locations along each line of units being cured.
  - c. Ensure all units, when calibrated individually, are accurate within  $\pm 5^\circ\text{F}$  (3°C).
  - d. Do not artificially raise temperature of concrete above 100°F (38°C) for a minimum of 2 hours after units have been cast. After 2 hour period, temperature of concrete may be raised to a maximum temperature of 160°F (71°C) at a rate not to exceed 25°F (15°C) per hour.
  - e. Hold maximum temperature for a period sufficient to develop strength required for release of prestress or for post tensioning, as the case may be.
  - f. Lower temperature of concrete at a rate not to exceed 40°F (22°C) per hour by reducing amount of heat applied until interior of concrete has reached the temperature of surrounding air.

**E. Placing Reinforcement.**

Place reinforcement carefully, accurately, and secure in proper position according to contract documents. Apply Article 2404.03.

**F. Removal of Forms.**

If forms are removed before concrete has attained strength which will permit units to be moved or stressed, remove protection only from immediate section from which forms are being removed. Immediately replace protection and resume curing following form removal. Do not remove protection any time before units attain specified compressive strength when surrounding air temperature is below 20°F (-7°C).

**G. Tolerances.**

Limit variation from dimensions shown in contract documents to no more than 1/8 inch (3 mm). For overruns, greater deviation may be accepted if, in Engineer's opinion, it does not impair suitability of member for its intended use.

**H. Handling and Storage.**

During fabrication, storage, handling, and hauling take care to prevent cracking, twisting, unnecessary roughness, or other damage. In particular, do not allow tiedowns to come in direct contact with concrete surfaces. Do not subject units to excessive impact. Replace, at no additional cost to Contracting Authority, units that are, in Engineer's opinion, damaged in a way to impair their strength or suitability for their intended use.

**I. Finish.**

Finish surfaces which will be exposed in finished structure as provided in Article 2403.03, P, 2, b.

**2419.04 METHOD OF MEASUREMENT.**

For precast units, Engineer will determine quantity of each of the various respective sizes, lengths, and types per the sections listed in Article 2419.01, E.

**2419.05 BASIS OF PAYMENT.**

Payment will be per the sections listed in Article 2419.01, E.

**Section 2426****2426.01, A.**

**Replace** the Article:

Repair spalled or deteriorated structural concrete as specified in the contract documents. This work may include the installation of concrete anchors, reinforcing bars, or wire mesh.

**1. General.**

Repairs shall be placed against sound concrete.

**2. Shallow Repair.**

~~a.~~ Repair that:

- Is 3/4 inch to 1 1/2 inch (20 mm to 40 mm) in depth, and
- ~~Is placed against sound concrete, and~~
- ~~Requires a bonding grout, but~~ Does not use forms to support the patching material-, except

~~b.~~ Forms may be needed in areas of shallow repair where the patching material cannot support itself. ~~In these areas bonding grout will not be required.~~

**3. Regular Repair.**

~~a.~~ Repair that:

- Is a minimum depth of 1 1/2 inch (20 40 mm), or 3/4 inch (40 20 mm) behind an unbonded reinforcing bar, and
- ~~Is placed against sound concrete.~~
- ~~b.~~ Uses Forms are used, but bonding grout is not required.

**2426.02, B.**

**Replace** the Article:

~~Mix proportions are as follows:~~ **Patching Materials.**

**1. Bonding Grout.**

~~Use equal parts by weight (mass) of Type I cement and sand with enough water to form a slurry with a consistency such that it can be applied with a stiff brush in a thin even coating that will not run or puddle.~~

**2. Concrete.****a 1. Shallow Repair.**

**Table 2426.02-1: Proportions**

<b>Materials</b>	<b>by weight (mass)</b>
Type I Portland cement	4 parts
Concrete sand (Section 4110)	5 parts

Coarse aggregate (Article 4115.05)	5 parts
Add enough water to the mixture to form a consistency that will permit placement and consolidation by hand compaction without slumping.	

Use approved material from Materials I.M. 491.08 in accordance with manufacturer's recommendations.

### **2. Regular Repair.**

Furnish Class O concrete. Use 3 inches (75 mm) as the target slump, with a variation not to exceed  $\pm 1$  inch (25 mm). For placements requiring higher slump, a mid range water reducer may be used with a target slump of 5 inches (125 mm) or a high range water reducer may be used with a target slump of 7 inches (175 mm).

### **2426.03, C, 1, Shallow Repair.**

**Replace** the Article:

#### **a. Bonding Grout.**

Apply bonding grout to the properly cleaned, dry surface of the old concrete with a stiff bristle brush. Do not prewet the concrete surface before placing grout. Prepare concrete surface in accordance with manufacturer's recommendations.

#### **b. Repair Concrete.**

Place and compact repair concrete, before the grout dries. If the grout dries prior to concrete placement, remove the grout by sandblasting and reapply. Strike off and finish repair concrete to the correct lines.

### **2426.03, D, Curing.**

**Replace** the Article:

For Class O concrete, Apply white pigmented curing compound to the concrete immediately following concrete finishing or immediately after removing forms, if used. Apply curing compound according to Article 2403.03, E, except use an application rate of 100 square feet per gallon (2.5 m<sup>2</sup>/L). Use manufacturer's recommendations for curing products from Materials I.M. 491.08.

## **Section 2427**

### **2427.01, Description.**

**Replace** the Article:

Unless otherwise specified in the contract documents:

- A.** Remove all accumulated foreign material from the entire bridge, including the bridge deck, sidewalk, curbs, pier tops, trusses, interior of truss members, and lower flanges of beams or girders.
- B.** Clean expansion joints, wind links, and drains.

## **Section 2430**

### **2430.02, B, 1, Concrete Units.**

**Add** the Article:

- f.** Apply Section 2419.

## **Section 2431**

### **2431.02, B, 1, Concrete Units.**

**Add** the Article:

- j.** Apply Section 2419.

**2431.02, B, 4, b.****Replace the Article:**

Provide Standard Road Plan ~~RF-19F~~ DR-305 Type A outlets and fit with Standard Road Plan ~~RF-19E~~ DR-304 rodent guards.

**Section 2432****2432.02, B, 1, Concrete Units.****Add the Article:**

n. Apply Section 2419.

**2432.02, B, 1, a, 1****Replace the Article:**

Type I-Cement meeting requirements of Section 4101.

**2432.02, B, 1, a, 2****Delete the Article:**

~~2) Cement content per cubic yard (cubic meter) of concrete for face panels and precast coping sections no less than 600 pounds(360kg) nor more than 700 pounds(420kg).~~

**2432.02, B, 1, b, 4****Replace the Article:**

Test ~~two~~ three specimens at 7 days and ~~two~~ three at 28 days. A test will be average compressive strength of ~~2~~ three cylinders.

**2432.02, B, 4, b.****Replace the Article:**

Provide a Standard Road Plan ~~RF-19F~~ DR-305 Type A outlet fitted with a Standard Road Plan ~~RF-19E~~ DR-304 rodent guard.

**Section 2433****2433.02, B, Concrete.****Replace Article 4:**

4. Portland cement: meet the requirements of ASTM C 150 Type I / or II and Section 4101.

**Replace Article 8:**

8. ~~Do not use GGBFS.~~ Limit total mineral admixture substitution rate to 40%. Between October 15 and March 15, do not substitute GGBFS with Type I or Type II cement; or fly ash with Type IP or IS cement.

**2433.03, D, 1, General.****Add the Articles:**

- f. Do not excavate a shaft within a distance of three shaft diameters of a previously constructed shaft within 24 hours of completing concrete placement, unless approved by the Engineer.
- g. The dry method of construction will not be allowed for drilled shafts with shale identified in the bearing strata of the soil profile.

**2433.03, L, 1, a, Confirmation Boring and Sampling.**

**Replace** the Article:

- 1) Prior to installation of the test shaft, complete a confirmation boring at the test shaft location to a depth 10 feet (3 m) below the bottom elevation as shown in the contract document or a minimum of 30 feet (10 m) into the bedrock, whichever is greater.
- 2) Perform standard penetration tests according to ASTM D 1586 in the soil overlying bedrock. Perform the tests on 5 foot (1.5 m) centers. Use sample retainers in cohesionless soils to ensure recovery of material for classification and direct shear tests.
- 3) Determine moisture contents on the soil samples. Continue soil sampling and testing with split barrel (spoon) sampling, according to ASTM D 1586, until the top of bedrock is encountered.
- 4) For each cohesive soil layer exceeding 2 feet (0.6 m) in thickness, obtain 3 inch (76 mm) diameter Shelby tube samples according to ASTM D 1587. For uniform cohesive soil layers greater than 10 feet (3 m) thick, collect Shelby tube samples from at least three different elevations. Shelby tubes shall be at least 30 inches (762 mm) in length and not overdriven.
- 4 5) Core the rock using double barrel diamond coring methods producing a minimum 1.75 inch (44.4 mm) core according to ASTM D 2113, or other approved sampling method. Keep records, including Percent Core Recovery and Rock Quality Designation, according to ASTM D 2113 and D 6032. Preserve rock samples at their natural moisture content and condition. Transport them to the laboratory for classification by a Professional Engineer licensed in the State of Iowa.
- 5 6) Test representative samples of intact rock for unconfined compressive strength according to ASTM D 2938, except record stress and strain according to ASTM D 2166, up to 20% strain or failure, whichever occurs first. Prepare a stress-strain plot. In addition, list the unconfined compressive strength.
- 6 7) Perform one unconfined compression test for every 3 feet (1.0 m) of rock core. The Engineer will select test samples.
- 8) Deliver soil samples to the Engineer.
- 7 9) Do not install test shafts until the results of the confirmation boring have been submitted and reviewed and incorporated in the proposed load test program to be submitted according to Materials I.M. 388.
- 8 10) Engineer will complete the review of the confirmation boring report within 7 calendar days after submittal and the proposed load cell test program report within 7 calendar days after submittal.

**Section 2435****2435.03, A, General Requirements for Installation of Manholes and Intakes.**

**Add** the Article:

- 13. Bedding and Backfill Under Interstate and Primary Roads.**  
Place and compact the material according to Article 2552.03, E.

**2435.03, A, 11, Chimney Seal.**

**Rename and Replace** the Article:

- 11. Chimney Seal Infiltration Barrier.**

For sanitary sewer manholes, install an ~~internal or external rubber chimney seal~~ infiltration barrier.

- a. Internal or External Chimney Seal.**

- ~~a.1)~~ Do not use external chimney seal if seal will be permanently exposed to sunlight.
- ~~b.2)~~ Extend seal 3 inches (75 mm) below the lowest adjustment ring.
- ~~c.3)~~ Extend seal to 2 inches (50 mm) above the flange of the casting for a standard two piece casting, or 2 inches (50 mm) above the top of the base section of the casting for an adjustable three piece casting.
- ~~d.4)~~ Use multiple seals, if necessary.
- ~~e.5)~~ Install compression bands (external chimney seal) or expansion bands (internal chimney seal) to lock the rubber sleeve or extension into place and to provide a positive watertight seal. Once tightened, lock bands into place. Use only manufacturer recommended installation tools and sealants.

- b. Molded Shield.**

- 1) Clean surface of structure cone section.
- 2) Apply sealant to top surface of cone section. Use sufficient sealant to accommodate flaws in surface of cone section.

- 3) Cut molded shield to height by adding dimensions of adjustment rings and casting height. Be sure not to interfere with seating of lid into casting frame.
- 4) Seat molded shield against sealant on cone section.
- 5) Add adjustment rings and casting to meet final grade.

**2435.03, D, 2, d.****Replace the Article:**

Replace ~~chimney seal~~ infiltration barrier for sanitary sewer manhole using only new materials.

**2435.03, D, 3, e.****Replace the Article:**

Replace ~~chimney seal~~ infiltration barrier for sanitary sewer manhole using only new materials.

**2435.03, F, 4, b, 7.****Replace the first sentence:**

Evacuate the manhole to 5 psi (35 kPa) or 10 inches (250 mm) mercury (Hg).

**2435.03, F, 4, b, 9.****Replace the first sentence:**

Test failure is indicated by vacuum loss greater than 0.5 psi (4 kPa) or 1 inch (25 mm) mercury (Hg) within the minimum test time indicated in Table 2435.03-1 below for the depth and diameter of the manhole being tested.

**2435.05, A, 2.****Replace the Article:**

Payment is full compensation for excavation, furnishing (if required) and placing bedding and backfill material, compaction, base, structural concrete, reinforcing steel, precast units (if used), inverts, pipe connections, ~~chimney seals~~ infiltration barriers, castings, and adjustment rings.

**2435.05, B, 2.****Replace the Article:**

Payment is full compensation for excavation, furnishing (if required) and placing bedding and backfill material, compaction, base, structural concrete, reinforcing steel, precast units (if used), inverts, pipe connections, castings, and adjustment rings.

**2435.05, E, 2.****Replace the fourth bullet:**

Installing new ~~chimney seal~~ infiltration barrier (sanitary sewer manholes only).

**2435.05, F, 2.****Replace the fifth bullet:**

Installing new ~~chimney seal~~ infiltration barrier (sanitary sewer manholes only).

**Section 2436****2436, Precast Noise Wall.****Add new Section:****2436.01 DESCRIPTION.**

- A. Construct and install precast noise wall units according to this specification and the contract documents.

- B. Noise walls** are precast concrete panels held in place by columns placed on concrete drilled shafts used to reduce noise pollution.

#### **2436.02 MATERIALS.**

##### **A. Concrete Drilled Shafts.**

- 1. Slurry.**  
Comply with Article 2433.02, A.
- 2. Concrete.**  
Comply with Article 2433.02, B.
- 3. Reinforcing Steel.**  
Shall be epoxy coated and comply with Section 4151.

##### **B. Precast Noise Wall Panels and Columns.**

Construct according to Materials I.M. 445.06. Manufacturer must be approved per Materials I.M. 445.06, Appendix A.

##### **C. Neoprene Bearing Pads and Shims.**

Neoprene for bearing pads shall be sized as shown in the contract documents and shall have a hardness of 70 durometer. Shims shall provide contact area equal to the neoprene bearing pad. Shims shall have a compressive strength of 5075 psi (35 MPa) or greater and shall not rust or rot. Shim material shall be approved by the Engineer.

#### **2436.03 CONSTRUCTION.**

##### **A. Concrete Drilled Shafts.**

- 1. Construction Tolerances.**  
Comply with Article 2433.03, A, of the Standard Specifications, with the following exceptions:
  - a.** Set reinforcing steel as detailed in the contract documents.
  - b.** The top elevation of the shaft may have a tolerance of plus 1 inch (25 mm) or minus 2 inches (50 mm) from the plan top of shaft elevation. Ensure sufficient reinforcement bar splice length for splices above the shaft.
- 2. Control and Disposal of Materials.**  
Comply with Article 2433.03, C.
- 3. Shaft Excavation.**  
Comply with Article 2433.03, D, with the following exceptions:
  - a.** A drilling log will not be required.
  - b.** Shaft construction need not immediately follow shaft excavation.
- 4. Final Cleaning.**
  - a.** Comply with Articles 2433.03, F, 1; 2; and 3.
  - b.** For slurry shafts, the Engineer will check the cleanliness of the bottom of the shaft with a weighted tape.
- 5. Excavation Inspection.**  
Comply with Article 2433.03, G.
- 6. Reinforcing Steel Cage Construction and Placement.**  
Comply with Article 2433.03, H.
- 7. Concrete Placement.**  
Comply with Article 2433.03, I, except that rock sockets shall not apply.

**B. Precast Noise Wall.****1. Concrete Columns.**

Place concrete columns as follows:

- a. Set plum, unless otherwise shown in the contract documents.
- b. Set and secured in place to the dimensions shown in the contract documents, prior to concrete placement, unless temporary casing is used.
- c. Final vertical and horizontal position of the concrete columns shall be within a 1/2 inch (13 mm) of that shown in the contract documents.
- d. The wall panel seat area shall be level and within 1/4 inch (6 mm) of the elevation shown in the contract documents.
- e. If temporary casing is used, concrete columns can be pushed into plastic shaft concrete a maximum of 5 feet (1.5 m). Confirm correct location of reinforcing steel cage after removal of temporary casing and before setting the concrete column in the plastic shaft concrete. Vibrate around embedded concrete columns to consolidate the plastic concrete without causing segregation.

**2. Wall Panels.**

Place wall panels on neoprene bearing pads between concrete columns as shown in the contract documents. Do not trim precast wall panels for fit.

**2436.04 METHOD OF MEASUREMENT.**

Quantity of Precast Noise Wall will be the quantity, in square feet (square meters), shown in the contract documents.

**2436.05 BASIS OF PAYMENT.**

- A. For the number of square feet (square meters) of Precast Noise Wall shown in the contract documents, Contractor will be paid the contract unit price per square foot (square meter). This payment is full compensation for furnishing and erecting precast noise wall, including panels, columns, and concrete drilled shafts according to the contract documents.
- B. Any additional length of drilled shaft required by Engineer due to unsuitable conditions at proposed shaft tip elevations will be paid according to Article 1109.03, B.

**Division 25. Miscellaneous Construction.****Section 2501****2501.03, A, 4, b.****Replace the Article:**

Control production pile installation with vibratory hammers according to power consumption, rate of penetration, specified tip elevation, or other means acceptable to the Engineer. Assure the pile capacity equals or exceeds the design nominal bearing resistance. Use an approved hammer to retap piles driven to full penetration with a vibratory hammer. Nominal bearing resistance will be determined by an applicable wave equation analysis.

**2501.03, A, 10, b, 1, b.****Replace the second bullet:**

The pile could not be driven to the required nominal bearing resistance.

**2501.03, A, 10, b, 2, Alternate Approval Method.****Replace the last sentence of the Article:**

This approval does not relieve the Contractor of the basic obligation to provide equipment suitable for driving the specified pile to the required nominal bearing resistance without damage.

**2501.03, C, 2.**

**Replace** the first sentence of the Article:

Determine the ~~load-carrying capacity~~ nominal bearing resistance of test piles as provided in Article 2501.03, M.

**2501.03, E, 3, a.**

**Replace** the Article:

After the piles have been cut off, remove water in the piles.

**2501.03, I, 3.**

**Replace** the last sentence of the Article:

After being moved, drive the pile a sufficient amount to assure the specified minimum nominal bearing ~~value~~ resistance.

**2501.03, M, Determination of Bearing Value of Piles.**

**Replace** the Article and title:

**Determination of Nominal Bearing Value Resistance of Piles for Load and Resistance Factor Design.**

When load tests are not specified in the contract documents or are not directed by the Engineer, determine the nominal bearing ~~value~~ resistance of piles determined using one of the following methods:

**1. Wave Equation Analysis.**

- a. Wave equation analysis will be used on all Interstate and Primary projects, on other projects when specified in the contract documents, or as directed by the Engineer.
- b. Drive piles to full penetration using approved driving equipment.
- c. Retaps or pile extensions may be necessary to obtain the required pile nominal bearing ~~capacity~~ resistance, including potential adjustments for scour or downdrag conditions.
- d. Do not continue driving beyond a depth at which acceptable pile stress is exceeded. With the Engineer's approval, driving may be stopped when the rate of driving exceeds 160 blows per foot (0.3 m).

**2. Nominal Bearing Resistance Determinations by Formula.**

- a. When wave equation analysis is not required, compute the nominal bearing ~~value~~ resistance of piles using the following formulas:

For Gravity Hammers with Wood, Steel H, or Steel Pipe Piles:

**English**

$$P = \frac{312WH}{S+0.35} \times \frac{W}{W+M}$$

**Metric**

$$P = \frac{2.510WH}{S+8.9} \times \frac{W}{W+M}$$

For Gravity Hammers with Concrete Piles:

**English**

$$P = \frac{4.518WH}{S+0.2} \times \frac{W}{W+M}$$

**Metric**

$$P = \frac{3.714.8WH}{S+5.1} \times \frac{W}{W+M}$$

Set the height of fall to no less than 5 feet (1.5 m) or more than 8 feet (3 m), and the rate of driving to no less than 8 blows per minute.

Diesel Hammers with Wood, Steel H, or Steel Pipe Piles and (Construction) Steam Hammers for all Piles:

**English**

$$P = \frac{312E}{S+0.1} \times \frac{W}{W+M}$$

**Metric**

$$P = \frac{0.25E}{S+2.5} \times \frac{W}{W+M}$$

## Diesel Hammers with Concrete Piles:

**English**

$$P = \frac{728E}{S+0.1} \times \frac{W}{W+M}$$

**Metric**

$$P = \frac{0.582.32E}{S+2.5} \times \frac{W}{W+M}$$

Where, for the above equations:

P = The nominal bearing ~~value~~ resistance in tons (kN),

W = The weight (mass) of the gravity hammer, or the ram of an air hammer or diesel hammer in tons (kilograms),

H = The height of free fall of the hammer or ram in feet (meters),

M = The weight (mass) in tons (kilograms) of the pile plus the weight (mass) in tons (kilograms) of the cap plus (for diesel hammers) the weight (mass) of the anvil in tons (kilograms),

E = The energy per blow in foot-tons (joules) (for single acting steam hammers  $E = W \times H$  ( $E = 9.81 \times W \times H$ )),

S = The average penetration in inches (millimeters) of the pile per blow for the last 5 blows for gravity hammers and the last 10 blows for air or diesel hammers.

- b. Apply the following conditions in the use of the above formulas:
  - 1) Unless the hammer has free fall, substitute a value for "W" that is less than the weight (mass) of the hammer by an amount sufficient to compensate for all friction and drag tending to retard its fall.
  - 2) With approval from the Engineer, driving may be stopped when the rate of driving exceeds 160 blows per foot (0.3 m).
  - 3) There is no excessive bounce to the hammer after the blow.
  - 4) For the computation of the nominal bearing ~~value~~ resistance for battered piles driven with gravity hammers, multiply the value obtained from the formulas by the following factor:  
(Cosine a) minus (f sine a), where "a" equals the angle the leads make with the vertical and "f" equals the coefficient of friction between the hammer or ram and the surface on which it slides. For gravity hammers sliding on greased steel surfaced leads, assume the value of "f" to be 0.1.
- c. The Engineer may modify the above formulas on the basis of load tests. At the Engineer's discretion, the Wave Equation Analysis may be used to evaluate the driving system, as well as determine pile nominal bearing resistance.

### 3. Static Load Test.

- a. When directed by the Engineer, nominal bearing ~~value~~ resistance of piles will be determined by actual load test in which the entire load is applied concentric with the pile.
- b. Careful measurements will be made to determine the amount and rate of settlement.
- c. Gages reading in thousandths of an inch (0.001  $\mu$ m) will be used to determine the settlement.
- d. The designated test pile(s) shall stand, after being driven, at least ~~40 hours~~ 3 calendar days before the test load may be applied.
- e. ~~This method is~~ The Quick Test Procedure outlined in Section 5.6 and 6.4 of ASTM D 1143 will be followed unless otherwise directed by the Engineer. ~~The procedure in ASTM D 1143 will be followed except as modified below:~~
  - 1) ~~Apply the test load in increments of 10% of the proposed design load.~~
  - 2) ~~Apply the load at 2.5 minute intervals. Record readings of time, load, and settlement immediately before and after the application of each load. The test is to continue by adding load increments until continuous jacking is required to maintain the test load (i.e., failure by settlement), or the load limit of the jacking equipment is reached.~~
  - 3) ~~When the maximum load has been applied, take pile settlement readings immediately, and at 2.5 minutes and 5 minutes, after jacking has ceased. Remove the test load and immediately record pile rebound readings. Take additional rebound readings 2.5 minutes and 5 minutes later.~~

- ~~4) Use the data obtained to plot a load (tons (kilonewtons) versus settlement in inches (millimeters)) curve~~
- f. Use the data obtained to plot a load displacement curve (load in tons (kilonewtons) versus settlement in inches (millimeters)).
- ~~f g.~~ Davisson's Method will be used to determine the nominal bearing resistance of the pile. The failure load nominal resistance is defined as the intersection between the ~~tangent of the linear portion of the load settlement curve and a line with a slope of 0.05 inches per ton (0.14 mm/kN) from the yield point~~ Davisson Line and the load displacement curve.
- ~~g h.~~ The yield point is defined as the intersection between the load settlement curve and a line which is parallel to the linear portion of the load settlement curve at 0.25 inches (6 mm) of settlement. The Davisson Line is a line parallel to the elastic compression line on the load displacement curve which is offset by a specified amount of displacement depending on the pile size.
- ~~h i.~~ The safe bearing value will be 50% of the load at the failure point. When dynamic testing with signal matching is used in conjunction with the static load test, the factored bearing resistance will be 80% of the nominal bearing resistance, otherwise it will be 75%.

#### 4. Dynamic Pile Analyzer Tests.

- a. The Engineer will take dynamic measurements during the driving of piles designated as dynamic load test piles, or as directed by the Engineer. Instruments for dynamic analysis will be:
- Attached near the top of the pile with bolts placed in approved masonry anchors, or
  - Bolted through drilled holes in the web of steel piles, or
  - Bolted with wood lag screws for timber piles.
- b. The Engineer will furnish the instruments, material, and labor necessary for drilling the holes and mounting the instruments.
- c. When specified in the contract documents, or ordered by the Engineer, furnish a shelter to protect the dynamic test equipment from the elements. Maintain the inside temperature of the shelter above 45°F (7°C). Locate the shelter within 100 feet (30 m) of the test location.
- d. **Pretest, Pile Calibration.**
- 1) Predriving wave speed measurements will be required for concrete or wood piles. Make each designated pile available for this measurement prior to placement of the pile in the leads.
  - 2) When predriving wave speed measurements are required, block the piling up off the ground in a horizontal position and locate it to not contact other piling. Predriving wave speed measurements will not be required for steel piles.
- e. **Prior to Driving.**
- 1) Prior to placing the designated pile in the leads, provide access to the pile and allow the Engineer time to predrill instrument mounting holes or conduct predriving wave speed measurements, or both, if required.
  - 2) When the designated test pile is placed in the leads and is ready to drive, provide the Engineer reasonable access to the pile for testing purposes.
  - 3) Attach the instruments and associated test cables to the top of the pile as directed by the Engineer, unless there is an acceptable personnel platform (minimum size of 4 feet x 4 feet (1.2 m x 1.2 m) designed to be raised to the top of the pile) provided for the Engineer.
  - 4) Allow time to attach or reattach and check the instruments as needed before beginning to drive.
- f. **Driving.**
- 1) Drive the designated pile to at least the depth at which the dynamic test equipment indicates that the ~~capacity~~ nominal bearing resistance shown in the contract documents has been achieved, unless the Engineer directs otherwise. The stresses in the pile will be monitored during driving with the dynamic test equipment to ensure that damage, as determined by the Engineer, does not occur.
  - 2) If an over-stress condition is indicated, the Engineer will suspend driving and determine if plan ~~capacity~~ nominal bearing resistance has been achieved. If necessary, in order to maintain monitored stresses below the accepted values, reduce the driving energy transmitted to the pile by:
    - Using additional cushion thickness,
    - Reducing the energy output of the hammer, or
    - Changing hammers.
  - 3) If nonaxial driving is indicated by the dynamic test equipment measurements, immediately realign the driving system.
  - 4) When the Engineer orders, wait a minimum of 24 hours and retap the dynamic load test pile after the instruments are reattached. Do not use a cold hammer for the retap. Warm up the hammer

before the retap by applying at least 20 blows to another pile. The maximum amount of penetration required during a retap is 6 inches (150 mm). After retapping, the Engineer will determine if desired nominal bearing resistance has been achieved or if additional pile penetration is required.

#### 5. Retaps.

- a. When piles do not achieve the specified driving resistance during driving, the Engineer may require one retap per 10 piles or a minimum of 2 piles in each foundation at no additional cost to the Contracting Authority. Only piles with the lowest driving resistance will be considered for retap.
- b. Perform the retap by allowing the pile to set up for 24 hours, or as directed by the Engineer.
- c. Warm up hammers (other than gravity) by applying a minimum of 20 blows to another pile before the retap driving begins. Take the nominal bearing resistance for the retap within the first 6 inches (150 mm) of penetration.
- d. The first two blows of a retap are for seating the cap and assuring proper operation of the hammer. Do not use the first two blows as part of bearing evaluation.
- e. Measure the penetration of the next ten blows, or record the number of blows it takes to drive the pile 6 inches (150 mm). Correct to the appropriate measurement and check for nominal bearing resistance.
  - 1) If nominal bearing resistance is achieved, driving may be halted. However, if the Engineer approves, driving may be continued to cut-off as long as acceptable pile stress is not exceeded.
  - 2) If penetration is less than 1 inch (25 mm) for the first ten blows, discontinue driving. Record the bearing as refusal.
- f. Have the Engineer evaluate piles not achieving the specified driven resistance after a retap and, if so ordered, extend as required following the procedures of Article 2501.03, P.

#### 2501.03, N, Bearing Required.

**Replace** the Article and title:

##### **Nominal Bearing Resistance Required.**

Unless modified by the Engineer, drive all piles to the ~~design~~ nominal bearing resistance specified in the contract documents. Ensure the specified ~~design~~ nominal bearing resistance is obtained below scour elevation for substructure subject to scour.

#### 2501.03, O, Penetration.

**Replace** the Article:

1. Unless provided otherwise in the contract documents, drive all piles until the ~~design~~ nominal bearing resistance, determined as provided in Article 2501.03, M, is at least equal to that specified in Article 2501.03, N.
2. Drive all piling for piers and abutments of stream crossings, and the piling for piers and abutments of other structures, when ordered by the Engineer, until the following requirements for penetration have been met:
  - a. The length of all piles specified in the contract documents, or ordered by the Engineer, for any specific structure is to be construed as indicating the desired penetration. Continue the effort to secure this penetration as long as the pile can be driven without damage to the pile.
  - b. When the pile cannot be driven to the required length without damage, the Engineer will determine if additional penetration is required. If full penetration is required, advance the pile by jetting, preboring to a maximum depth of 20 feet (6 m), or other approved methods which will secure the required penetration and nominal bearing resistance without damage to the pile.
  - c. The driving of wood piling in excess of 40 160 ton (350 1420 kN) nominal bearing resistance will not be permitted.
  - d. If soil conditions permit auguring, perform the auguring according to Article 2501.03, Q, except drill the holes to the approximate size of the pile measured at mid length. Do not use Bentonite slurry in prebored holes to gain additional penetration.
  - e. Drive piles which do not carry superimposed vertical loads, such as wingwall piles, fender piles, wing dam piles, and revetment piles, to the penetration shown in the contract documents without regard to nominal bearing resistance values.

**2501.03, P, Extension and Splices.**

**Replace** the first sentence of the Article:

Follow Article 2501.03, M, 5, when piles driven to the specified depth fail to develop the required ~~design~~ nominal bearing resistance.

**2501.03, Q, 1.**

**Replace** the last sentence of the Article:

Drive piles through the holes to at least the specified ~~design~~ nominal bearing resistance.

**Section 2502****2502.03, A, 6.**

**Replace** the first sentence:

When subdrains are placed beneath a highway or driveway or are placed within 5 feet (1.5 m) of the edge of an existing or proposed pavement ~~of or~~ base course, place backfill material in layers no thicker than 6 inches (150 mm).

**2502.03, C, 10.**

**Replace** the Article:

Use trench rollers with a ~~maximum~~ minimum trench wheel weight (mass) of 6000 pounds (2700 kg).

**2502.03, C, 17.**

**Delete** the Article:

~~17. Cover subdrain outlets with a rodent guard described in Article 4143.01, B.~~

**2503.03, Construction.**

**Replace** Articles E, F, G, and H with Articles E, F, G, H, and I:

**E. Tolerances.**

~~The following tolerances apply to utilities installed by open trench construction. For trenchless construction, apply Section 2553.~~

1. Ensure horizontal and vertical alignment of gravity sewer lines does not vary from design line and grade at any point along the pipe structure by more than 1% of the inside diameter of the pipe or 1/4 inch (6 mm), whichever is larger.
2. ~~Tolerance is allowed only if design line and grade is sufficient to prevent backslope when tolerance limits are reached.~~ Do not allow horizontal alignment of pipe to vary from design line at any point along pipe by more than 1% of the inside diameter of the pipe.
3. ~~Reverse slope on pipe is prohibited. Remove and reinstall to proper grade.~~ Low spots holding water exceeding the following depths for each pipe size will be considered unacceptable and shall be removed and reinstalled to proper grade.

**Table 2504.03-1: Gravity Main Tolerance**

Pipe Diameter	Maximum Low Spot Depth
8" (200 mm)	1/2" (13 mm)
10" (250 mm)	1/2" (13 mm)
12" (300 mm)	3/4" (19 mm)
15" (375 mm)	3/4" (19 mm)
18" (450 mm) and larger	5% of Pipe Diameter*

\* Measured to the nearest 1/2" (13 mm)

**F. Conflicts.**

Apply Article 2554.03, A, 7.

**F G. Storm Sewer Abandonment.****1. Plug.**

- a. Prior to placing the sewer plug, the Engineer will verify the sewer line is not in use.
- b. Construct sewer plug by completely filling the end of the pipe with concrete. Force concrete into the end of the pipe for a distance of 16 inches (400 mm), or one-half the pipe diameter, whichever is greater.

**2. Fill.**

- a. Prior to filling sewer, Engineer will verify sewer line is not in use.
- b. If specified in the contract documents, fill the line to be abandoned with flowable mortar or CLSM, according to Article 2552.02, E G, by gravity flow or pumping.

**G H. Connection to Existing Manhole or Intake.**

Apply Article 2435.03, E.

**H I. Cleaning, Inspection, and Testing.**

Apply Articles 2504.03, L, 1; 2; 3; and 5. Video inspection of storm sewers is not required on Interstate, Primary, State Park, and Institutional Road Projects.

**Section 2503****2503.03, E, Tolerances.****Replace the Article:**

~~The following tolerances apply to utilities installed by open trench construction. For trenchless construction, apply Section 2553.~~

1. ~~Ensure horizontal and vertical alignment of gravity sewer lines does not vary from design line and grade at any point along the pipe structure by more than 1% of the inside diameter of the pipe or 1/4 inch (6 mm), whichever is larger.~~
2. ~~Tolerance is allowed only if design line and grade is sufficient to prevent backslope when tolerance limits are reached.~~ Do not allow horizontal alignment of pipe to vary from design line at any point along pipe by more than 1% of the inside diameter of the pipe.
3. ~~Reverse slope on pipe is prohibited. Remove and reinstall to proper grade.~~ Low spots holding water exceeding the following depths for each pipe size will be considered unacceptable and shall be removed and reinstalled to proper grade.

**Table 2504.03-1: Gravity Main Tolerance**

Pipe Diameter	Maximum Low Spot Depth
8" (200 mm)	1/2" (13 mm)
10" (250 mm)	1/2" (13 mm)
12" (300 mm)	3/4" (19 mm)
15" (375 mm)	3/4" (19 mm)
18" (450 mm) and larger	5% of Pipe Diameter*

\* Measured to the nearest 1/2" (13 mm)

**2503.03, F, 2, b.****Replace the Article:**

If specified in the contract documents, fill the line to be abandoned with flowable mortar or CLSM, according to Article 2552.02, E G, by gravity flow or pumping.

**2503.03, H, Cleaning, Inspection, and Testing.****Replace the Article:**

Apply Articles 2504.03, L, 1; 2; 3; and 5. Video inspection of storm sewers is not required on Interstate, Primary, State Park, and Institutional Road Projects.

**2503.04, D, Connection to Existing Manhole or Intake.****Replace the Article:**

Connections to existing manhole or intake will be measured according to Article 2435.04, G.

**2503.05, D, Connection to Existing Manhole or Intake.****Replace the Article:**

Connections to existing manhole or intake will be paid according to Article 2435.05, G.

**Section 2504****2504.03, H, 2, b.****Replace the Article:**

If specified in the contract documents, fill the line to be abandoned with flowable mortar or CLSM, according to Article 2552.02, E, G, by gravity flow or pumping.

**2504.03, K, Conflicts.****Replace the Article:****1. ~~Horizontal Separation of Gravity Sewers from Water Mains.~~**

- ~~a. Separate gravity sewer mains from water mains by a horizontal distance of at least 10 feet (3 m) unless:
 
  - The top of a sewer main is at least 18 inches (450 mm) below the bottom of the water main, and
  - The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet (1 m) from the water main.~~
- ~~b. When it is impossible to obtain horizontal clearance of 3 feet (1 m) and vertical clearance of 18 inches (450 mm) between sewers and water mains, the sewers shall be constructed of water main materials meeting the requirements of Article 4149.02, B; however, provide a linear separation of at least 2 feet (600 mm).~~

**2. ~~Separation of Sewer Force Mains from Water Mains.~~**

~~Separate sewer force mains and water mains by a horizontal distance of at least 4 linear feet (1.2 m).~~

**3. ~~Separation of Sewer and Water Main Crossovers.~~**

- ~~a. Vertical separation of sanitary sewers crossing under any water main should be at least 18 inches (450 mm) when measured from the top of the sewer to the bottom of the water main. If physical conditions prohibit the separation, the sewer may be placed not closer than 6 inches (150 mm) below a water main or 18 inches (450 mm) above a water main. Maintain the maximum feasible separation distance in all cases.~~
- ~~b. Where the sewer crosses over or less than 18 inches (450 mm) below a water main, locate one full length of sewer pipe of water main material so both joints are as far as possible from the water main. The sewer and water pipes shall be adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet (3 m) of the point of crossing.~~

Apply Article 2554.03, A, 7.

**2504.03, J, 1, Gravity Main.****Replace the Article:**

- ~~a. Do not allow horizontal and vertical alignment of trenched gravity sewer lines to vary from design line and grade at any point along the pipe by more than 1% of the inside diameter of the pipe or 1/4 inch (6 mm), whichever is larger.~~
  - ~~b. This tolerance is allowed for trenched gravity sewer lines only if design line and grade is sufficient to prevent backslope when tolerance limits are reached.~~
  - ~~c. Reverse slope on gravity pipe is prohibited. Remove and reinstall pipe to proper grade.~~
- Apply Article 2503.03, E.

**2504.03, L, 3, a, General.****Replace** the Article:

- 1) Unless otherwise specified in the contract documents, ~~Conduct~~ video inspection of all new and rehabilitated sanitary and storm sewers after all backfill and compaction operations are completed, but prior to paving.
- 2) Notify the Engineer the day prior to inspection so the Engineer may be present during the inspection.
- 3) ~~Low spots holding water in excess of 1 inch (25 mm) or 5% of the pipe diameter, whichever is less, will be considered unacceptable.~~ Notify Engineer of extent of noncompliance with the low spot depth tolerances.
- 4) ~~If unacceptable low spots exist, as indicated by standing water during video inspection, remove and replace sewer as necessary and re-inspect.~~ Re-inspect sewers after corrective action has been completed.

**Section 2505****2505.03, A, 1, Steel Beam Guardrail.****Add** the Articles:

- h. Tighten bolts by a method approved by the Engineer to obtain specified torque requirements for each bolt size. If no torque requirements are specified by the manufacturer, use the following guidelines:

<u>Bolt Size</u>	<u>Torque</u>
1/2"	100 ft.-lbs. (135 Nm)
5/8"	180 ft.-lbs. (245 Nm)
3/4"	320 ft.-lbs. (435 Nm)
7/8"	470 ft.-lbs. (635 Nm)

- i. Plate cuts may be saw cuts or flame cuts with prior approval of the Engineer. Grind cut edges smooth. Leave no metal projection beyond the plane of the plate face.

**Section 2506****2506.02, C, Fine Aggregate.****Replace** the Article:

1. Use natural sand consisting of mineral aggregate particles or foundry sand from the castings of ferrous material. Use the gradation shown in Table 2506.02-1:

**Table 2506.02-1: Fine Aggregate Gradation**

<b>Sieve Size</b>	<b>Percent Passing</b>
3/4 3/8 inch (9.5 mm)	100
No. 200 (75 µm)	0-10

2. It is intended that the sand be a fine sand that will stay in suspension in the mortar to the extent required for proper flow. For the Contractor's information, ~~uniformly~~ a well graded sand in the gradation range shown in Table 2506.02-2 has generally shown good flow characteristics when using the normal amount of fly ash (300 pounds per cubic yard (180 kg/m<sup>3</sup>)). Concrete sand ~~normally does not~~ may require a higher amount of fly ash (400 pounds per cubic yard (240 kg/m<sup>3</sup>)) and air entrainment to produce the desired flowability.

**Table 2506.02-2: Informational Gradation Limits**

<b>Sieve Size</b>	<b>Percent Passing</b>
3/8 inch (9.5 mm)	100
No. 8 (2.36 mm)	80-100
No. 16 (1.18 mm)	60-100
No. 30 (600 µm)	45-80
No. 50 (300 µm)	12-40
No. 100 (150 µm)	1.5-25
No. 200 (75 µm)	0-5

- ~~3. Fine aggregate meeting the above informational gradation limits may be used in the basic proportions shown in Article 2506.02, E, without initial mix design, provided the flowable mortar is used in noncritical fluidity locations described in Article 2506.02, F. The Engineer reserves the right to reject the intended sand if a flowable mortar cannot be produced using the specified proportions.~~
- ~~4 3. The Contractor is not responsible for certified aggregate testing. The Engineer will provide appropriate inspection (normally, source approval) followed by visual inspection. If foundry sand is used, ensure it meets the requirements of IAC 567 Section 108. Ensure suppliers of foundry sand submit a processing plan to the District Materials Engineer for review and approval.~~

#### **2506.02, E, Mix Design.**

##### **Replace the Article:**

1. For non critical fluidity, Use the basic proportioning for flowable mortar shown in Table 2506.02-4 3.

**Table 2506.02-4 3: Quantities of Dry Materials Per Cubic Yard (Cubic Meter) for Non-Critical Fluidity**

Cement	100 pounds (60 kg)
Fly Ash	300 pounds (180 kg)
Fine Aggregate	2600 pounds (1545 kg)

Previous or alternate mix designs may be approved by the District Materials Engineer.

2. ~~Submit samples of fine aggregate, cement, and fly ash intended for use to the Engineer. Submit the samples before the work begins for mix proportions to produce the required efflux time.~~ For critical fluidity, use the basic proportioning as shown in Table 2506.02-2 4.

**Table 2506.02-2 4: Quantities of Dry Materials Per Cubic Yard (Cubic Meter) for Critical Fluidity**

Cement	100 pounds (60 kg)
Fly Ash	400 pounds ( 240 kg)
Fine Aggregate	2600 pounds (1545 kg)

- a. Provide Engineer with mix proportions meeting requirements in Article 2506.02, F. Do not exceed 100 pounds of cement per cubic yard (60 kg/m<sup>3</sup>) and a total amount of cementitious material of 500 pounds per cubic yard (295 kg/m<sup>3</sup>).
  - b. When the design includes air entraining and water reducing admixtures, Engineer may approve the design without laboratory testing. Engineer may require representative materials for evaluation before approval. When required, one week before work begins, submit samples of fine aggregate, cement, and fly ash intended for use to the Engineer.
  - c. Previous mix designs for critical flow may be approved by the District Materials Engineer. These mixes may also be used for non critical flow.
- ~~3. The Engineer will determine the mix design. The cement content is not to exceed 100 pounds per cubic yard (60 kg/m<sup>3</sup>). The total amount of cementitious material is not to exceed 500 pounds per cubic yard (295 kg/m<sup>3</sup>).~~
- ~~4 3. These quantities of dry materials, with approximately 70 gallons (345 L) of water (mixes utilizing foundry sand may require more water), will yield approximately 1 cubic yard (1 m<sup>3</sup>) of flowable mortar of the proper consistency. The quantity of water used for the trial mix or at the project may require adjustment to achieve proper solids suspension and optimum flowability.~~
- ~~5 4. For information, volume loss during the cure period resulting from surface evaporation, moisture migration away from the flowable mortar unit, and hydration have been observed to be less than 4% of the original volume determined in the fluid condition. In mixes utilizing foundry sand, additional fly ash may be required and the limit of total cementitious material will not apply.~~

**2506.02, F, 3.****Replace** the Article:

In locations where fluidity is not critical, such as for placement below the beams under existing bridges or for use as backfill material in open trenches, ~~use an efflux time of 10 seconds to 26 seconds.~~ The Engineer will visually monitor. Provide sufficient fluidity to completely fill the space and produce a level surface without manipulation after discharge.

**Section 2507****2507.01, Description.****Add** the Article:

- C.** Place a layer of stone or concrete under overhead structures or along bridge wings for protection of earth slopes against erosion.

**2507.02, Materials.****Replace** Article A and title:**A. Revetment and Erosion Stone.**

Meet requirements of ~~Division~~ Section 4130 for the material specified.

**Replace** Article D:

Meet requirements of Section 4196 and listed on the appropriate Materials I.M. 496.01, Appendix ~~G~~.

**Add** the Articles:**E. Concrete for Slope Protection.**

Meet the requirements of Section 2403. Concrete shall have a Class 1, floated surface finish.

**F. Reinforcing Steel.**

Meet the requirements of Section 2404.

**G. Preformed Joint Filler.**

Meet the requirements of Article 4136.03, A.

**H. Macadam Stone.**

Meet the requirements of Section 4122. Choke Stone is not allowed.

**I. Treated Timbers.**

Meet the requirements of Section 4163. Preservative treatment shall follow requirements for guardrail posts.

**J. Granular Subbase.**

Meet the requirements of Section 4121.

**K. Porous Backfill.**

Meet the requirements of Section 4131.

**2507.03, Construction.****Add** the Articles:**F. Concrete Slope Protection.**

1. Compact and shape bridge berm foreslope to the dimensions and elevations shown in the contract documents. Berm foreslope shall be firm prior to placement of engineering fabric.
2. Place engineering fabric. If fabric is lapped, laps shall be a minimum of 1 foot (0.3 m) in width, with the up slope lap on top and stapled for continuity.

3. Prewet granular subbase and deposit by a method approved by the Engineer. Thoroughly tamp or vibrate granular subbase to ensure compaction.
4. Pour concrete to the dimensions shown in the contract documents. Pour concrete in equal widths of approximately 10 feet (3 m). Do not pour adjacent courses within 15 hours of each other. Stagger joints in the direction of the slope one half block width. Place preformed joint filler in joints as shown in the contract documents. Fill voids around pier columns with commercial bituminous patching material.

**G. Macadam Stone Slope Protection.**

1. Compact and shape bridge berm foreslope to the dimensions and elevations shown in the contract documents. Berm foreslope shall be firm prior to placement of engineering fabric.
2. Place engineering fabric. If fabric is lapped, laps shall be a minimum of 1 foot (0.3 m) in width, with the up slope lap on top and stapled for continuity.
3. When required, place treated timber edging and secure with steel pins or rebar as shown in the contract documents.
4. Place and compact porous backfill or granular subbase at front face of abutment footing as shown in the contract documents.
5. Deposit, spread, consolidate, and shape macadam stone by mechanical or hand methods that provide uniform depth and density and provide uniform surface appearance.

**H. Bridge Wing Armoring.**

1. Compact and shape area to receive armoring to the dimensions and elevations shown in the contract documents. Area shall be firm prior to placement of engineering fabric.
2. Place engineering fabric.
3. When required, place treated timber edging and secure with steel pins or rebar as shown in the contract documents.
4. Deposit, spread, consolidate, and shape macadam stone or erosion stone, as specified, by mechanical or hand methods that provide uniform depth and density and provide uniform surface appearance.

**2507.04, Method of Measurement.**

Add the Article:

- F. Slope Protection, of the type specified, and Bridge Wing Armoring, of the type specified: computed in square yards (square meters) from measurements of the surface as constructed to the nearest 0.1 foot (0.1 m).

**2507.05, Basis of Payment.**

Add the Article:

- D. Payment for Slope Protection, of the type specified, and Bridge Wing Armoring, of the type specified, will be at the contract unit price per square yard (square meter).
1. Payment for Concrete Slope Protection is full compensation for material and labor required to construct concrete slope protection as shown in the contract documents, including:
    - Excavation, shaping and compaction,
    - Engineering fabric,
    - Granular subbase,
    - Class C Structural Concrete,
    - Reinforcing steel,

- Preformed joint filler, and
  - Commercial bituminous patching material.
2. Payment for Macadam Stone Slope Protection is full compensation for material and labor required to construct the macadam stone slope protection as shown in the contract documents, including:
    - Excavation, shaping and compaction,
    - Engineering fabric,
    - Treated timber edging (including steel pins or rebar),
    - Porous backfill or granular subbase, and
    - Macadam stone.
  3. Payment for Bridge Wing Armoring, of the type specified, is full compensation for material and labor required to construct the bridge wing armoring as shown in the contract documents, including:
    - Excavation, shaping, and compaction.
    - Engineering fabric,
    - Treated timber edging (including steel pins or rebar) (when required), and
    - Macadam stone or erosion stone, as specified.
  4. Disposal of excess soil from shaping or trenching shall be incidental.
  5. When erosion control work has previously been completed, Contractor shall be responsible for plant materials destroyed adjacent to slope protection. Contractor shall replant, reseed, and remulch all areas in accordance with Section 2601 at no cost to the Contracting Authority.

### Section 2511

#### 2511.02, D, Detectable Warnings.

##### Replace the Article:

~~Furnish detectable warning that contrast visibly with adjoining surfaces, either light on dark or dark on light. Comply with Materials I.M. 411 Section 4171.~~

#### 2511.03, B, 1, General.

##### Replace the Article:

- a. Widths shown in contract documents are minimums, excluding curbs or flares.
- b. The contract documents will contain ~~staking diagram~~ sheets for construction of ~~pedestrian~~ curb ramps, ~~landings, sidewalk~~ turning spaces, and transitions. Measure or stake as required to construct features. If either of the following is met, Engineer will provide staking for that quadrant and verify slopes during finishing:
  - Running Slope. Tolerance between design slope and maximum allowable slope is less than 1.0%.
  - Cross Slope and Turning Space Slopes. Tolerance of  $\pm 0.5\%$  from design slope would exceed minimum or maximum allowable slope.
- c. If adequate construction tolerances are allowed, Engineer will not provide staking for construction of sidewalk or recreation trail. If field adjustments outside the acceptable range indicated in the contract documents are necessary, notify the Engineer prior to construction.
- d. ~~Verify slope compliance according to Materials I.M. 363.~~
- e. At locations other than curb ramps, turning spaces, and transitions, ensure cross slope is between 0.5% and 2.0%. Ensure grade is within approximately 2.0% steeper than profile grade of adjacent roadway, or does not exceed 5.0%, whichever is steeper.

~~Field adjustments shall comply with the following requirements.~~

- a. ~~Construct sidewalks and recreational trails to a longitudinal slope not to exceed 5.0% and a cross slope not less than 1.5% or greater than 2.0%. A cross slope less than 1.5% will be allowed in tie in areas.~~
- b. ~~Construct ramps as follows:~~
  - ~~5.0 feet (1.5 m) minimum width, exclusive of curbs or flares.~~
  - ~~Longitudinal slope not to exceed 8.0%.~~
  - ~~Cross slope not to exceed 2.0%.~~
- c. ~~Construct landings as follows:~~

- ~~• 5.0 foot (1.5 m) minimum width by 5.0 foot (1.5 m) minimum length.~~
- ~~• Longitudinal slope not to exceed 2.0%.~~
- ~~• Cross slope not to exceed 2.0%.~~

**f. d.** Install detectable warnings according to manufacturer's recommendations. Install detectable warnings for full width of curb ramp, excluding curbs and flares.

### **2511.03, B, 2, b, 1.**

**Add** to the end of the Article:

On projects where the Department is the Contracting Authority, perform process control sampling, testing, and inspection according to Article 2107.03, P.

### **2511.05, C, Special Compaction of Subgrade for Recreational Trail.**

**Add** the Article:

3. On projects where the Department is the Contracting Authority, payment includes process control sampling, testing, and inspection.

## **Section 2512**

### **2512.03, C, Forms.**

**Replace** the Article:

1. ~~Unless slip form equipment is permitted~~ When hand placement methods are used, form all straight sections of curb and gutter with steel forms for the full depth of the concrete. Wood forms may be used on curving sections.
2. Place a steel face, rigidly welded or bolted to the main form, on any extensions used to obtain the required depth of form.
3. Ensure the top face of forms does not vary from a true plane by more than 1/8 inch in 10 feet (3 mm in 3 m). Ensure the upstanding face, including any extension, does not vary from a true plane by more than 1/4 inch in 10 feet (6 mm in 3 m). Remove forms that are bent, twisted, warped, broken, or battered from the work. Allow Engineer to inspect and approve repaired forms before using.
4. Use flexible or rigid forms of proper curvature for curves having a radius of 100 feet (30 m) or less.
5. While concrete is being placed and consolidated, form the front face of the curb with fixed or movable forms. If movable ~~slip~~ forms are used, use forms that ~~are at least 6 feet (1.8 m) long with~~ provide a suitable opening for placing and consolidating concrete. ~~Obtain Engineer's approval for slip forms.~~
6. Curb may be placed and shaped by hand methods, without the use of a front face form, provided placement tolerances in Article 2512.03, C, 3, are met. Form back of curb and consolidate to produce an integral unit with underlying gutter section.
7. Set forms with the upper edge to the correct line and grade. Firmly hold forms in place with adequate stakes and bracing.
8. Forms with height greater than the thickness of the concrete may be used, with no additional cost to the Contracting Authority for extra concrete required, if:
  - The upper edge is set accurately to line and grade, and
  - The subgrade is excavated to meet the bottom edge of the form in a slope not steeper than one vertical to four horizontal.

**Section 2513****2513.02, Materials.**

**Add** to the end of the first paragraph of the Article:

Apply Section 2419 for precast concrete barrier rail.

**2513.02, D, Bolts Anchors, and Other Metal Fastenings.**

**Replace** the Article:

Apply Article ~~2407.02, G~~ 2419.02, F.

**2513.03, A, 1, a.**

**Replace** the first sentence of the Article:

Use concrete specified in Section ~~2407~~ 2419.

**2513.03, A, 2, b, 1.**

**Delete** the Article:

~~1) **Cement for Class BR.** Use a minimum cement content of 603 pounds per cubic yard (358 kg/m<sup>3</sup>).~~

**2513.03, C, 1.**

**Replace** the Article:

Apply Article ~~2407.03, D, except apply the finishing requirements in Article 2403.03, P, 2, b, only to temporary barrier rail~~ 2419.03, C.

**2513.03, D, 1, a.**

**Replace** the second sentence of the Article:

Apply Article ~~2407.03, D~~ 2419.03, D, when elevated temperature cure is used.

**2513.03, F, I.**

**Replace** the Article:

For permanent precast and cast-in-place concrete barrier, apply Article ~~2407.03, L~~ 2419.03, I, except do not commence the finishing operation until completion of the initial wet cure period.

**2513.03, F, 4.**

**Replace** the last sentence of the Article:

Complete patching operations only as directed by the Engineer ~~and according to Article 2407.03, L.~~

**Section 2518****2518.03, A, 1, Road Closures.**

**Renumber** Articles c and d and **Add** the Article:

- c. In lieu of Articles 2518.03, A, 1, a and b above, place a series of Type 3 barricades across the roadway from outside edge of shoulder to outside edge of shoulder. Ensure that gaps between Type 3 barricades are no greater than 6 inches (150 mm). Mount a ROAD CLOSED (R11-2) sign over the top two rails of on the Type 3 barricade located closest to the approximate roadway centerline.
- ~~e~~ d. Erect road closures as specified in the contract documents. Erect them on the mainline of the roadway where public traffic is diverted onto an on-site detour and where public traffic is prohibited from entering the work area.
- ~~d~~ e. Erect road closures beginning with the start of the contract period as specified in the contract documents, or when the work commences.

**2518.03, A, 2, Hazard Closures.**

**Renumber** Articles c and d and **Add** the Article:

- c.** In lieu of Articles 2518.03, A, 2, a and b above, place a series of Type 3 barricades across the roadway from outside edge of shoulder to outside edge of shoulder. Ensure that gaps between Type 3 barricades are no greater than 6 inches (150 mm).
- c d.** Erect hazard closures as specified in the contract documents. Erect them at locations within a work area when construction involves major hazards on existing or relocated roadways. Such hazards may be located at streams, gullies, railroads, bridge approaches, and driveway locations. Through public traffic should not normally encounter a hazard closure.
- d e.** Erect hazard closures beginning with the start of the contract period as specified in the contract documents, or when the work commences.

**Section 2521****2521.03. Application.**

**Replace** the Article:

- A.** This specification applies to all HMA, HMA patching material, PCC, structural concrete, and flowable mortar, except where excluded by a note in the contract documents.
- B.** ~~The Engineer may waive aggregate gradations, moisture, and specific gravity tests based on previous satisfactory experience with the plant for PCC which is furnished at a maximum rate of 25 cubic yards (25 m<sup>3</sup>) per day, whether from one or more sources. This may be based on quantities planned by the Contractor several days ahead of placement.~~

**Section 2522****2522.01, A.**

**Replace** the first sentence of the Article:

This specification is for design, fabrication, and construction of tower lighting systems, consisting of footings, towers, luminaires, and associated appurtenant items required by the contract documents.

**2522.03, D, 2.**

**Replace** the Article:

~~A list of approved brands of electrodes may be obtained from the Office of Materials.~~ Filler metal shall comply with the requirements of the AWS D1.1, Structural Welding Code.

**2522.03, E, Lighting Tower.**

**Replace** the first paragraph of the Article:

Ensure the structural design of the tower and its appurtenances meet the requirements of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, Fifth Edition 2009 " and interims, with the following clarifications:

**2522.03, E, 1, Wind Velocity.**

**Add** as the second sentence of the Article:

Fatigue requirements shall be Category I with 2<sup>nd</sup> mode vortex shedding included.

**2522.03, E, 4, Anchor Bolts, Washers, and Nuts.**

**Replace** the Article:

- a.** Ensure galvanizing for anchor bolts, washers, and nuts meets the requirements of ASTM F 2329 with zinc temperature bath limited to 850°F (455°C); or ASTM B 695, Class 50 55, Type I Coating.
- a b.** Furnish each anchor bolt with one leveling nut and two anchoring nuts. Use anchor bolts, nuts, and washers that meet the requirements of Materials I.M. 453.08. Anchor bolts shall be ASTM F 1554, Grade 105.

- ~~Meet the requirements of ASTM F 1554, Grade 105 (724 MPa),~~
- ~~Are full-length galvanized,~~
- ~~Are high strength low alloy steel, and~~
- ~~Unless specified otherwise, are Unified Coarse Thread Series with Class 2A tolerance.~~
- b. ~~Color code, in red, the end of each anchor bolt intended to project from the concrete to identify the grade.~~
- c. ~~Use galvanized washers that meet the requirements of ASTM F 436.~~
- d. ~~Use heavy hex, galvanized nuts that meet the requirements of ASTM A 563, DH. Nuts may be over-tapped according to the allowance requirements of ASTM A 563.~~

**2522.03, E, 5, a.****Replace the Article:**

Use a solid plate. Keep the holes cut out in the base plate for utility lines to a minimum, ~~subject to the Engineer's approval~~ maximum diameter of 12 inches (300 mm) as shown in the contract documents.

**2522.03, E, 7, b.****Replace the Article:**

~~When designated in the contract documents~~ Inspection:

- Visually inspect all welds,
- Radiographically inspect 100% of the full penetration sections of the longitudinal seam weld at the base plate connection location, and
- Use the magnetic particle method to inspect a random 10% of the partial penetration section of the longitudinal seam welds.

**2522.03, E, 9, Poles with Telescoped Lab Joints.****Replace the title:**

**Poles with Telescoped Lab Joints.**

**2522.03, E, 10, Hand Hole.****Replace the Article and title:**

~~Hand Hole~~ Handhole.

- a. Ensure the pole provides an opening for a minimum 10 inch by 30 inch (250 mm by 750 mm) handhole, to allow for servicing and maintenance of the lowering devices. ~~Ensure the handhole is reinforced to maintain the design strength of the pole.~~ Reinforce handhole as shown on the contract documents.
- b. Install a neoprene or rubber gasket to make the handhole weatherproof. Obtain Engineer's acceptance for the gasket prior to installation. Foam adhesive-back rubber gaskets are unacceptable.
- c. ~~Ensure the door is hinged and~~ handhole cover is fabricated from the same type of steel as the poles. Use 1/8 inch (3 mm) minimum thickness for the handhole cover. Ensure the securing hardware is stainless steel and provisions have been made to allow for the door to be bolted securely shut.

**2522.03, E, 12, Shaft, Base Plate, and Integral Shaft.****Replace the Article:**

- a. ~~Ensure the shaft, base plate, and integral shaft components are fabricated with steel meeting the requirements of ASTM A 709 Grade 50W (345W MPa) or ASTM A 871 Grade 65, with a minimum yield strength of 50,000 psi (345 MPa). All steel required to be ASTM A 709 Grade 50 (345 MPa) must meet impact requirements specified for main members in Article 4152.02. If the Engineer approves, certain components of the tower assembly may be fabricated from steel meeting requirements of ASTM A 709 Grade 36 (250 MPa). Ensure base plate is fabricated with steel meeting requirements of ASTM A 709 Grade 50W (345W). Steel used for shaft, base plate, and integral shaft components shall meet impact requirements specified in Article 4152.02.~~
- b. ~~Ensure that after fabrication, pole shafts, anchor bolts, base plate, washers, nuts, and all steel items are:~~
  - ~~Fully galvanized inside and outside according to ASTM A 123 or ASTM A 153 F 2329 as appropriate, and~~
  - ~~Are of uniform color and appearance.~~

**2522.03, F, 8, Slipfitter.****Replace the Article:**

Accommodate a standard ~~two~~ 2 inch (50 mm) pipe bracket and provide for leveling of the luminaire.

**2522.03, G, Luminaire Lowering Device.****Replace Articles 1, 2, and 3:****1. Luminaire Frame and Head Frame.**

- a. Ensure the luminaire frame and head frame assembly meet the requirements of ASTM A 709 Grade 50 (345-MPa). For the purpose of Charpy V-notch toughness requirements, all steel required to be ASTM A 709 Grade 50 (345-MPa) ~~will be considered main members~~ shall meet impact requirements specified in Article 4152.02. Miscellaneous appurtenant steel components may be constructed using ASTM A 709 Grade 36 (250-MPa) steel. Ensure all steel and the head frame dome are galvanized. Alternately, in a two cable lift system, the luminaire frame, head frame and miscellaneous appurtenant steel components will all be fabricated from ASTM A 240 Type 201LN stainless steel.
- b. Attach the luminaire frame to two or three lift cables. Attach a multiple conductor electrical cable to the luminaire frame with a double weave, stainless steel, grip type, strain relief connection. Pass all cables through a head frame assembly mounted at the top of the tower shaft, as shown in the contract documents. Ensure they pass freely through the shaft during raising and lowering operations.
- c. Ensure the luminaire frame is designed to accommodate the specified number of luminaires on mounts consisting of 2 inch (50 mm) slipfitters.
- d. Ensure the head frame assembly is enclosed and shielded from the elements by means the Engineer approves.
- e. In a three lift cable system, install three or more spring loaded centering arms with rubber or nylon rollers to control lateral movement of the luminaire frame during raising or lowering operations. Ensure the centering arms interlock with each other so the tower is centered within the luminaire frame.
- f. In two lift cable systems, luminaire frame shall be protected from contact with the pole shaft by means of two 2 7/16 inch (62 mm) diameter PVC bumpers on the inner surface of the luminaire frame.

**2. Support Cables.**

- a. Install support cables of anti-rotational aircraft type stainless steel with a minimum diameter of 3/16 inch (4.8 mm) and having a safety factor of 5.
- b. In a three lift cable system, space them 120 degrees apart where attached to the luminaire frame. Attach them to a terminating device which is located within the tower shaft and provides a means of equalizing tension of the lift cables.
- ~~b.~~ Ensure the terminator and attached components are shaped to prevent interference to the raising or lowering operation caused by irregularities on the interior surface of the tower shaft.
- c. In a two lift cable system, cables shall be spaced 180 degrees apart and no terminating device may be used since the cables go directly to the winch drums.

**3. Winch.**

- a. Install and securely anchor a winch assembly that:
  - Consists of a worm gear speed reducer with either one or two output shafts with cable drum attached.
  - Is capable of supporting five times the maximum lifted load.
  - Includes an integral drag brake to prevent unwinding, slipping, or free spooling of the winch cable.
  - In a three lift cable system, includes a drum provided with keepers to ensure that the cable will properly wrap onto the drum.
  - When powered by the internal power unit, raises the luminaire ring at a minimum rate of 12 feet (4 m) per minute.
- b. Install stainless steel, anti-rotational aircraft type winch cable(s) with 1/4 inch (6.4 mm) minimum diameter and a safety factor of 3 to be used to raise and lower the luminaire frame. In a three winch cable system attach the cable to the terminator. Include a safety device that is capable of stopping upward motion of the terminator at any time, in case of winch cable failure. Include a torque limiting device with the winch or power unit.
- c. In a three lift cable system, install a top-latching system that ensures the following:
  - Latch barrels are cast, high strength, copper-free aluminum or cast stainless steel.

- Latching is accomplished by the alternate raising and lowering of the luminaire ring assembly using the winch and hoisting assembly.
- There are no moving latch parts or springs attached to the head frame assembly.
- The latch mechanism is not impaired by the formation of ice and does not require adjustment after the original installation.
- Indicator flags are used to show when the luminaire supporting ring is in the latched or unlatched position.
- d. In a two lift cable system, ensure the following:
  - Latch mechanism can be engaged or disengaged manually in less than 60 seconds working through the handhole at the pole base and can be disengaged without power to the pole.
  - Entire Latch mechanism shall be accessible through handhole at the pole base with no pole top components to fail.
  - Latching Indicator system is visible through the handhole at the pole base.
  - Latching components are never exposed to ice formation so latch mechanism cannot be impaired by ice.
- e. Install pulleys that are:
  - Stainless steel type designed for the respective types and sizes of cables used, and
  - Equipped with permanently lubricated, sealed bearings or oil impregnated bronze bushings mounted on stainless steel shafts.

### Section 2523

#### 2523, Highway Lighting.

Replace the Section:

##### 2523.01 DESCRIPTION.

Furnish all work, apparatus, and materials to construct, install, and place in operation, to the Engineer's satisfaction, a complete highway lighting system as shown in the contract documents.

##### 2523.02 MATERIALS.

- A. Install lighting materials that meet the requirements of Division 41.
- B. Use cast-in-place concrete that meets the requirements of Section 2403.
- C. For granular base for handholes and preformed junction boxes, provide material meeting Gradation No. 3 or 5 of the Aggregate Gradation Table.

##### 2523.03 CONSTRUCTION.

###### A. General.

1. Furnish and install all components of the lighting system not furnished by the utility company serving the installation, including all incidental items appurtenant to the operation of the system.
2. Ensure all apparatus, materials, and work comply with the contract documents and with standards, practices, and codes of the electrical industry. Particular attention is directed to the following:
  - NEC, latest edition, including amendments.
  - IEEE Standards and Practices.
  - ANSI Standards and Practices.
  - NEMA Standards.
  - UL Standards.
3. Ensure the completed lighting installation complies with all local and special laws, codes, or ordinances of all Federal, State, and municipal authorities with due jurisdiction.
4. The Contracting Authority will be responsible for the cost of electric power used during installation and testing of lighting equipment and prior to final acceptance of the work. Do not put the installation into use prior to final acceptance without the Engineer's approval.

**B. Shop Drawings.**

1. Before any items are ordered or installation is started, the following list of shop drawings shall be submitted for approval according to Article 1105.03:
  - a. **Required Shop Drawings:**
    - 1) Lighting poles and mastarms.
    - 2) Transformer bases.
    - 3) Slip bases.
    - 4) Roadway luminaires with lamps.
    - 5) ~~Iowa DOT Standard Road Plan RM-41, Underdeck Lighting (High Pressure Sodium Luminaire)~~ Underdeck luminaires with lamps.
    - 6) Control cabinet components.
      - a) Enclosure.
      - b) Door latch mechanism.
      - c) Contactor.
      - d) Circuit breaker (main).
      - e) Circuit breaker (branch).
      - f) Photoelectric control.
      - g) Test switch(es).
      - h) Breather drain.
      - i) Wiring diagram, showing wire type and size
      - j) Component placement drawing.
      - k) Control fuse holder.
      - l) Surge suppressor protection device (SPD).
    - 7) ~~Iowa DOT Standard Road Plan RM-40, Cable Splices and Connectors.~~
    - 8) Insulated wire and cable.
    - 9) Anchor bolts, nuts, and washers.
    - 9 10) Additional drawings may be required on a project specific basis in accordance with the contract documents.
  - b. **Shop Drawings Not Required:**
    - 1) Wood pole.
    - 2) Concrete.
    - 3) Reinforcing steel.
    - 4) ~~Anchor bolts, nuts, and washers.~~
    - 5 4) Other bolts, nuts, and washers.
    - 6 5) Ground rods and clamps.
    - 7 6) ~~Iowa DOT Standard Road Plan RM-42, Type 1 Handholes and junction boxes.~~
    - 8 7) Rigid steel conduit and fittings.
    - 9 8) Rigid aluminum conduit and fittings.
    - 9) Rigid non-metallic conduit and fittings.
    - 10) Plastic conduit and fittings.
    - 11) Plastic warning tape.
    - 12) Bare copper ground wire.
2. Meet the following provisions for shop drawings:
  - a. Submit all drawings simultaneously for each project.
  - b. Include catalog cuts, diagrams, drawings, brochures, or other descriptive data required by the Engineer.
  - c. Include a schematic diagram and a component placement diagram of the control cabinet and panel.
  - d. Ensure all wire and cable sizes, placement of components, and dimensions are shown on the diagrams.
  - e. Ensure all drawings are completely legible and contain adequate information to identify that the described components comply with the contract documents.
  - f. Ensure identification markings on the described items correspond to like markings shown on the drawings to provide easy identification of the item.
  - g. Ensure apparatus or materials are not installed until the Engineer has reviewed and concurred with descriptive data.
  - h. Ensure each sheet or bound pamphlet is imprinted with the county and project number.
  - i. Ensure each set is assembled and contains one copy of the required data for each item listed on the schedule.

3. Incorrect or incomplete submittals will be returned to the Contractor for correction. The Engineer may require certified test results and samples of materials for consideration of all items including those described by reviewed drawings.

#### **C. Cooperation with Utility Companies.**

1. The utility company is to provide secondary service to the project in the vicinity indicated. Consult and cooperate with the utility company in locating the distribution lines and service poles so lines will be as short and direct as possible. If the utility company is unable to perform the required work, furnish and install the service poles (payment will be according to Article 1109.03). The Contracting Authority will be responsible for the cost for extension of power lines and for furnishing and installing meter sockets and meter loops as required in the contract documents.
2. The entire transformer pole installation, when required, including all accessories and appurtenances, is to be installed by the utility company that is to supply service according to their agreement for service. Cooperate with the utility company so that connections may be made in the proper manner and at the proper time.
3. Furnish all apparatus and material for the pole mounted control station cabinet, as shown in the contract documents. Upon acceptance of the project, they will become the Contracting Authority's property.
4. If concrete pad(s) and other incidental work for mounted transformers and control stations are specified, follow the utility company's guidelines. If utility company has no guidelines, ensure they are furnished and installed as specified in the contract documents. Ensure they are approved by the designated utility company.

#### **D. Excavation.**

1. **Foundations.**  
Drill the holes for pole footings and direct embedded poles.
2. **Trenches.**
  - a. Details of trenching for underground circuits will be shown in the contract documents.
  - 3 b. Pile the excavated material away from the trench to prevent cave-ins.
  - 4 c. Accurately grade the trench bottom to provide for placement of cable or duct work at a uniform depth.
  - 5 d. Ensure surface water does not enter the trench. Remove water that is present before duct work is installed, unless directed otherwise by the Engineer.
3. **Handholes and Preformed Junction Boxes.**  
Excavate as necessary to accommodate handhole (or preformed junction box) and granular base.

#### **E. Placing Backfill.**

1. After inspection of the completed trench, duct work, and cables, place backfill consisting of the material that was removed into the trench, unless stated otherwise in the contract documents or directed by the Engineer. Place backfill material in layers with the first layer not exceeding 2 feet (0.6 m) of loose thickness and each succeeding layer not exceeding 1 foot (0.3 m) of loose thickness. Compact each layer using hand or mechanical tampers. Do not use material containing glass, metal, concrete, brick, cinders, or any other abrasive material for backfill within 6 inches (150 mm) of the cable or conduit. Install approved plastic warning tape in all trenches.
2. Use the removed material to place backfill around direct embedded poles and handholes. Place the material in layers not exceeding 6 inches (150 mm) of loose thickness. Compact using hand or mechanical tampers.
3. Shape excess material to original contours as directed by the Engineer.
4. Shape all other disturbed areas to the original contours as directed by the Engineer.

**F. Seeding and Fertilizing.**

In locations where erosion control work has been completed or turf has been established, restore the areas disturbed by application of seed and fertilizer as indicated in the contract documents.

**G. Footings Foundations.**

1. Construct cast-in-place concrete footings foundations for all lighting units not located on structures or barriers. Form and pour the top portion of all footings foundations in form work to at least 6 inches (150 mm) below the finished ground level. Ensure the footings foundations conform in all respects to the details, including reinforcement and alignment to provide the correct overhang, as indicated in the contract documents. Ensure maximum exposed concrete above finished grade does not exceed 4 inches (100 mm) on all sides of finished foundation.
2. Ensure finished surfaces are smooth and free from stains and foreign material.
3. Construct an alternate footing foundation, as directed by the Engineer, when shale, sandstone, broken and or shattered rock, solid rock, or other similar materials are encountered.
4. Place anchor bolts to provide for placement of nuts and washers on the top and bottom of the transformer base or pole flange, leaving ample room for adjustment and plumbing the pole. When slip bases are used, position anchor bolts so that they do not interfere with the operation of the slip base. Place anchor bolts according to Article 2405.03, H, 3.

**H. Breakaway and Slip Bases.**

1. Furnish and install breakaway bases or slip bases of the size and type specified in the contract documents for each light pole not mounted on a roadway bridge. Use the same type and manufacturer for all bases for a project. Install a commercially available product. Comply with the details of bases shown in the contract documents.
2. Ensure each breakaway base has a nonmetallic spacer impervious to galvanic action placed between the breakaway base and pole base mounting flange.

**I. Aluminum Transformer Bases.**

~~Ensure the bottom flange of aluminum transformer bases are painted on the inside and outside surfaces with two coats of zinc-rich paint.~~ Install transformer base according to manufacturer's recommendations and the contracts documents.

**J. Poles and Mastarms.**

1. Furnish and install poles at all locations indicated in the contract documents. Install poles of the lengths shown in the contract documents.
2. Carefully erect all poles and mastarms. Check for vertical alignment, mounting height, and overhang, after installation, with mastarm and luminaire installed.
3. Rake single mastarm poles so the side of the shaft opposite the mastarm is plumb. Erect poles without mastarms, or with more than one mastarm, so the center line of the pole shaft is plumb within a tolerance of 1/32 inch per foot (3 mm/m).
4. Check the pole posture at no less than three radial locations on the shaft. For poles required to have plumb shaft center lines, space the checking positions approximately 120 degrees apart, as viewed from above. For raked poles required to have one side plumb, space the check points on the side to be plumbed at 90 degrees in either direction, as viewed from above.
5. Plumb the poles ~~using double nuts on each anchor bolt. Locate the nuts as follows:~~
  - ~~Above and below the bottom mounting flange of the breakaway base, or Transformer base: use base leveling shims.~~
  - ~~Above and below the pole base or slip base mounting flange where breakaway bases are not required.~~ Slip base: use base leveling shims or leveling bolts, whichever is appropriate for the slip base furnished.

6. Install anchor bolt washers according to the details in the contract documents.
- ~~7. Base leveling shims or alternate pole mounting methods will be permitted only when indicated.~~
- ~~8. After the erection has been inspected and approved, fill the space between the mounting flange and the concrete footing with an approved non-shrink grout and finish as detailed.~~
- 9 7. Install mastarms of the type and length specified. Unless shown otherwise in the contract documents, mastarms greater than 8 feet (2.4 m) in length are to be Type B, and all others Type A. Use the same type and material for all lighting poles and mastarms on a project.
- ~~10~~ 8. Install insect barriers in the ends of all mastarms at the point of luminaire attachment.
- ~~14~~ 9. Install wood poles of the length and class specified. Set them plumb in drilled holes as directed by the Engineer. Embed the poles no less than 8 feet (2.5 m). Additional embedment may be required by the Engineer if warranted by soil conditions.

#### K. Luminaires.

1. Furnish and install luminaires of the type and rating specified.
2. All roadway luminaires shall be leveled after installation unless a tilt is specified.
3. When light distribution is specified, ensure the luminaire has the necessary components and is adjusted properly.
4. Provide the Engineer with printed instructions regarding luminaire components and adjustment.

#### L. Circuits.

1. Unless specified otherwise, install an underground, multiple system roadway lighting circuit that is totally encased in conduit. Construct circuits and control ~~stations~~ cabinets according to the contract documents.
2. Ensure circuits are complete with all necessary accessories for proper operation. Thoroughly coordinate disconnecting devices, protective devices, and all other equipment to secure a safe operating lighting system. If any changes in arrangement of the circuit system are considered necessary by the Contractor, submit details of changes and reasons to the Engineer for approval. Obtain the Engineer's approval prior to making changes.
3. For line circuit conductor sizes, comply with NEC requirements based on the total load current ratings of the branch circuit breakers supplied by the respective circuit segments, with a minimum size of No. 8 AWG. Minimum size allowed for control circuit conductors will be No. 12 AWG.

#### M. Grounding.

##### 1. General Requirements.

- a. A component of the lighting system will be defined to be grounded when it is electrically bonded to a driven ground rod or a multiple system of ground rods producing a resistance to ground of 25 ohms or less when installed and tested according to the contract documents.
- b. Use ground rods and connections described in Article 4185.04 to ground major components of the lighting system, such as control stations, lighting units, and sign structures, and all metal duct work in exposed locations or installed on roadway bridges. Refer to the contract documents for details of these and other locations to be grounded.

##### 2. Grounding Installations.

- a. Whenever the ground rod installation does not have a resistance to ground of 25 ohms or less, couple additional rods to the first, and drive to the full depth until the required resistance is obtained. If a maximum depth of 50 feet (15 m) is reached, or if obstacles to further driving are encountered, install additional ground rods until the required resistance to ground is obtained.
- b. Permissible grounding installations are as follows:

- 1) Ensure that in no case is any portion of the ground rod closer than 18 inches (0.5 m) to the finished earth surface. Drive all rods as nearly vertical as possible. Whenever possible, drive a full length ground rod.
- 2) When rock or other obstructions prevent driving the rod to full depth, two half-length sections may be driven, with the Engineer's approval. The two half-length sections are considered as a minimum length rod when additional rods are required to obtain the specified resistance to ground.
- 3) Where two half-length rods can not be driven to the required depth, place full length rods horizontally at a depth of no less than the adjacent trench depth.
- 4) The minimum horizontal clearance between all rods in a multiple ground installation is to be 6 feet (2 m).

## N. Electrical Ducts.

### 1. General Requirements.

- a. Refer to the contract documents for details of duct installations. Ensure the completed duct systems are watertight. Use expansion fittings where duct runs cross structural expansion joints and elsewhere as direct by the Engineer.
- b. Thread metal conduit joints. Treat the mating threads with pipe joint compound. Treat all other threads with an approved rustproofing compound. For plastic conduits, use solvent welded, socket type joints.
- c. After the duct runs are installed, demonstrate that the runs are clear by pulling an approved brush or conduit swab through the entire length of each run. Ensure no deleterious material remains in the duct. Securely cap terminal ends until cable is installed. Before the wire and cable is installed, fit terminal ends of metal conduit with threaded insulating bushings. Fit terminal ends of plastic conduit with socket type, bell end fittings.
- d. Do not embed aluminum conduit in concrete.

### 2. Underground Ducts.

#### a. Lighting Circuit Ducts.

Fabricate lighting circuit ducts using Schedule 40 plastic conduit. As field conditions permit, install the runs to avoid adding bends or total bend angle to the design layout. Limit the total bend angle between pulling points to no more than 360 degrees.

#### b. Crossing Ducts.

- 1) Unless shown otherwise in the contract documents, use HDPE SDR 13.5 or Schedule 80 PVC conduit for crossing ducts.
- 2) If crossings are to be placed without disturbing the existing surface, install by jacking or boring methods approved by the Engineer. Do not use jetting. No access to duct or jacking of duct from median will be allowed without Engineer's approval.
- 3) After cable is installed, seal duct terminal ends in handholes, transformer bases, pole foundations, or similar locations (as directed by the Engineer) against moisture. Use either approved sealing bushings or a non-hardening sealing compound.

#### c. Primary Other Service Ducts.

Apply installation requirements for lighting circuit ducts and crossing circuit ducts to other service ducts including, but not limited to, ducts required for a complete installation that are not covered under the Utility Company service agreement.

### 3. Exposed Exterior Ducts.

- a. Unless shown otherwise in the contract documents, use rigid steel conduits for all ducts for exposed installations.
- b. When not shown in the contract documents, support exposed ducts at intervals of 6 feet (1.8 m) or less. Anchor the hangers or clamps to be attached to concrete structures by means of expanding anchors in drilled holes. The use of driven or explosive set anchors will not be permitted.

## O. Handholes.

Install handholes of the size and type and at locations shown in the contract documents.

1. ~~Construct handholes of the size and type and at locations shown in the contract documents, unless the Engineer specifies otherwise.~~ Do not ~~construct~~ install handholes in the following areas:

- Ditch bottoms,

- Low areas where ponding of water may occur, or
- Where they will be subject to normal vehicular traffic.

**2. Granular Base.**

~~Provide access ducts for each general direction of the circuit branch run. Position them for ease of cable installation.~~ Install 8 inch (200 mm) thick granular base extending a minimum of 6 inches (150 mm) beyond the outside walls of the handhole.

**3. Placement.**

- a. ~~Position handholes so that the top is at the same inclination as the adjacent grade.~~ In paved areas, install handhole at an elevation so lid or casting is level and flush with the pavement. In unpaved areas, install handhole approximately 1 inch (25 mm) above final grade.
- b. For precast handholes, verify ring placement. Invert rings when installed in paved areas.

**4. Conduit.**

- a. Remove knockouts as necessary to facilitate conduit entrance.
- b. Extend conduit into handhole, through a knockout, approximately 2 inches (50 mm) beyond inside of the wall. Slope conduit to down and away from the handhole.
- c. Place non-shrink grout (complying with Materials I.M. 491.13) in the opening of the knockout area after placement of conduit.

**5. Cable Hooks.**

Install cable hooks centered between the knockouts and the top of the handhole.

**6. Backfill.**

Place suitable backfill material according to Section 2552.

**7. Casting.**

Place casting on the manhole. Ensure final elevation meets handhole placement requirements.

**P. Junction Boxes.**

Furnish junction boxes of the type specified and install as indicated in the contract documents.

**Q. Wire or Cable.**

1. Furnish and install wire or cable of the size and type specified. When installing wire or cable in a conduit system, provide equipment to demonstrate to the Engineer that at no time will a pulling tension of 0.008 pound per circular mil (70 N/mm<sup>2</sup>) of conductor be exceeded.
2. Ensure unreeled wire or cable is not left on the ground surface or exposed to mechanical abrasion. Replace all wire or cable that is stressed or damaged in any way at no additional cost to the Contracting Authority. Do not install wire or cable with dirt or any other abrasive material adhering to it.
3. Use a lubricant when pulling wire or cable. Use a UL listed lubricant designed for use with the specified cable and conduit. The use of graphite or petroleum lubricants will not be permitted. Ensure the pulling device is attached to each conductor and all wire or cable within a single duct is pulled simultaneously.

**R. Connectors.**

Furnish and install connectors of the type specified at the locations shown in the contract documents. ~~Ensure connector assemblies are supplied with a disposable mounting pin, when required, and sufficient silicone compound to lubricate the metal parts and rubber housings. Ensure complete instructions are supplied with each connector.~~

**S. Splices.**

Use approved connector assemblies to make splices. Splices in the system will only be allowed in pole shafts, handholes, pull boxes, breakaway bases, and other specified locations.

**T. Control Station Cabinet.**

~~Furnish the components specified and construct~~ and install the control station cabinet as indicated in the contract documents. Furnish and install meter sockets and meter loops unless an agreement for unmetered

service has been secured at the time of construction. A meter loop is defined as the conduit, cable, enclosures, meter socket (if required), and other necessary components needed to form a complete system ready for connection as defined in either the Utility Company service agreement or the meter application.

### **1. General.**

Meet the following requirements:

- a. Load circuits within the control panel shall be connected phase-to-phase, with neutral connections to grounds only.
- b. Internal wiring for line and control circuits shall meet the requirements for single conductor cable. Thermoplastic cable may be used with the Engineer's approval.
- c. Minimum interrupting ratings for branch circuit breakers identical to line circuit breakers. Provide one branch breaker for each active circuit and specified spare.
- d. Unless shown otherwise, load current ratings of
  - 30 amperes for branch circuit breakers.
  - 100 amperes for main circuit breakers.
- e. Interrupting ratings for the contactor not less than the load current rating for the line circuit breaker.
- f. Minimum working voltage rating of 240 volts for the control fuse. Use cartridge type fuse with dimensions 13/32 inch (10 mm) by 1 1/2 inch (38 mm). Current ratings as recommended by the manufacturer.
- g. Double-break contact block test switch.
- h. The control cabinet electrically bonded to the ground rod(s) with a copper wire or jumper equivalent to No. 6 AWG or larger.

### **2. Pole Mounted.**

- a. The utility company is to furnish aerial service drop and required meters according to either their service agreement or the meter application.
- b. Provide control cabinets with components within arranged to provide access for maintenance and space for four branch circuit breakers without disturbing other components or wiring.
- c. Provide risers consisting of rigid conduit of the type shown on the plans. Use conduit with a nominal inside diameter of 2 inches (53 mm) or larger for top risers. Provide 2 inch (53 mm) nominal inside diameter bottom ducts for all bottom risers, unless shown otherwise on the plans. Use weatherproof threaded hubs or compression glands for riser connections into cabinet.

### **3. Pad Mounted.**

- a. The utility company is to furnish primary service cable, pad mounted transformer, and required meters according to either their service agreement or the meter application.
- b. Photoelectric control may be mounted on or in control cabinet if cabinet is equipped with photocell window. If plans call for remotely mounted photocell, connect photoelectric control socket to nearest accessible grounding connection, or where indicated on detail plans, by means of a No. 12 AWG copper wire.
- c. Use weatherproof threaded hubs or compression glands for all duct connections into the top or side of the cabinet.
- d. Construct concrete pad according to the contract documents. Slope the top surface of the concrete pad 1/4 inch per foot (20 mm per meter) in the direction of the natural ground. Place concrete pads as directed by the Engineer.
- e. Terminate all ducts extending up from the concrete pad with bell ends or bushings.

## **U. Final Acceptance.**

1. Perform electrical tests of all systems after the circuit installation work is complete, and at any other stage of construction when directed by the Engineer. Include the following tests:
  - Insulation resistance measurement for all underground circuit cable,
  - Voltage measurements, and
  - Ground resistance test for each individual grounding installation.
2. Perform insulation resistance measurements with all lamps or ballasts disconnected from the circuit and all neutral lines properly grounded. Measure with a properly calibrated 500 volt megohmmeter. Ensure insulation resistance is no less than 100 megohms.

3. Measure and record the voltages in the cabinet from phase to phase and phase to neutral at no load and at full load. Measure and record the voltage readings at the last termination of each circuit.
4. Measure ground resistance with the ground rod, or system of ground rods as described in Article 2523.03, K M, 2, disconnected from the circuit neutral wire. Measure with a Wheatstone bridge type ground resistance tester according to the manufacturer's instructions. Ensure the ground resistance of each individual grounding installation is no greater than 25 ohms.
5. Perform electrical tests and demonstrate to the Engineer that the lighting system complies with requirements of the contract documents.
6. Provide the Engineer with a written report of all test results for a permanent record.
7. In the insulation resistance report, include measurements from each insulated line to ground, and between all combinations of lines in a given circuit or contained in a single duct.
8. In the voltage measurement report, include measurements for each cabinet and each circuit.
9. In the ground resistance report, include measurements for each grounding installation identified by a lighting unit number and at other grounding locations by a means approved by the Engineer.
10. All components of the lighting system shall be in satisfactory operation according to the ratings and requirements specified.
11. After satisfactory completion of required testing, the complete lighting system is to be placed in operation for a 30 calendar day trial period, and final approval of the installation will not be made until the trial period ends. During the trial period, service and maintain the installation and make all necessary adjustments or replacements as are required, at no additional cost to the Contracting Authority. The Contractor will not be required to pay for energy consumed by the system, and working days will not be charged, during this trial period.
12. Where the existing ground has been disturbed by the Contractor, reshape to original contours or as directed otherwise by the Engineer.
13. Final acceptance of all lighting installations will be based on:
  - Satisfactory results of electrical tests the Contractor has performed, and
  - Satisfactory completion of the 30 calendar day trial period.

#### **2523.04 METHOD OF MEASUREMENT.**

Measurement for the quantities of the various items involved in the construction of highway lighting will be as follows:

- A. Lighting Poles.**  
By count.
- B. Electrical Circuits.**  
Linear feet (meters) shown in the contract documents.
- C. Handholes and Junction Boxes.**  
By count.
- D. Control Cabinet.**  
By count.
- E. ~~Under Deck~~ Underdeck Lighting.**  
By count.

#### **2523.05 BASIS OF PAYMENT.**

Payment for the quantities of the various items involved in constructing highway lighting will be the contract unit price as follows:

**A. Lighting Poles.**

1. Each.
2. Payment is full compensation for materials, equipment, excavation, and installation of the pole, luminaire, mastarm, ~~footing~~ foundation, base, ground rod, wiring within the pole, and connectors within the pole, according to the contract documents.

**B. Electrical Circuits.**

1. Per linear foot (meter).
2. Payment is full compensation for materials, equipment, excavation, and installation of the conduit and the wiring/cables between the connectors in the poles, including switches.

**C. Handholes and Junction Boxes.**

1. Each.
2. Payment is full compensation for materials, equipment, excavation, and installation of the handholes and junction boxes.

**D. Control Cabinet.**

1. Each.
2. Payment is full compensation for materials, equipment, excavation, meter socket, meter loop, control cabinet pole, and installation of control cabinet and all line and internal circuitry wiring.

**E. ~~Under Deck~~ Underdeck Lighting.**

1. Each.
2. Payment for ~~Under Deck~~ Underdeck Lighting is full compensation for luminaires ~~shall be complete including~~ with lamps, ballast, and mounting device.

**Section 2524****2524.03, B, Erection of Signs, Milepost Markers, and 6 Inch by 6 Inch (150 mm by 150 mm) Route Markers.**

Add the Article:

3. **Perforated Square Steel Tube (PSST) Posts and Anchors.**
  - a. Position posts within anchor at furthest corner from likely point of impact from an errant vehicle.
  - b. Embed post within anchor without any play.
  - c. Provide minimum insertion length as required by manufacturer.
  - d. Ensure inside of break-away and slip base anchors installed in concrete are free of concrete to allow drainage.
  - e. Install triangular slip base assembly as required by manufacturer.

**2524.03, B, 1, c.**

Replace the Article:

Set wood posts in 12 inch (300 mm) diameter holes of the proper depth with a minimum embedment of 5.0 feet (1.5 m).

**2524.04, Method of Measurement.**

Add the Articles:

- G. **Perforated Square Steel Tube Posts.**

Linear feet (meters), to nearest foot (0.3 m), measured from top of anchor to top of post. Embedded length will not be measured separately, but included in price bid for Perforated Square Steel Tube Posts.

#### **H. Perforated Square Steel Tube Post Anchors.**

By count of each type installed.

### **2524.05, Basis of Payment.**

**Renumber and Replace Article G:**

#### **G I. Excavation in Unexpected Rock.**

Excavation in unexpected rock for wood posts for Type A or B signs, steel posts for Type A or B signs, concrete footings for Type A or B signs, delineators, perforated square steel tube posts, and milepost marker posts will be paid for as extra work. Unexpected rock will be considered as rock encountered during post erection, but neither visible from the roadway nor indicated in the contract documents.

**Add the Articles:**

#### **G. Perforated Square Steel Tube Posts.**

1. Per linear foot (meter).
2. Payment is full compensation for furnishing, fabricating, and erecting posts.

#### **H. Perforated Square Steel Tube Post Anchors.**

1. Each, by type.
2. Payment is full compensation for providing and installing anchor, coring pavement, backfilling with concrete, slip base hardware, and other details necessary to provide anchor complete and erected in place.

### **Section 2526**

### **2526.03, A.**

**Replace** the second sentence of the Article:

Do not apply the provisions of Article ~~4405.06~~ 1105.16 to this work, except to preserve the original stakes set by the Engineer. Refer to Article 1105.17 for requirements when AMG is utilized.

### **2526.03, A, 2, Grading.**

**Replace** the Article:

#### **a. General.**

- 1) Survey right-of-way line between permanent right-of-way corners at 100 foot (20 m) intervals, or less if needed, including borrows, temporary easements, and right of entry. Mark these points by placement of a metal pin or wood hub, flat, and lath at the same location as the slope stakes. Clearly mark the flat with the station number, distance from centerline, and elevation (cut or fill) to subgrade.
- ~~b. Set slope stakes at 100 foot (20 m) intervals, or less if needed, for all embankment and excavation work including roadway, channel changes, and borrow areas. Interpolations may be necessary to match the cross sections. Set the stakes at the toe of the foreslope or the top of the backslope, or both. Mark slope stakes with a flat and lath. Clearly mark the flat with the station location, distance, slope, and cut/fill information.~~
- ~~c. Set grade check stakes at 100 foot (20 m) intervals for bottoms of subgrade treatments. Set the stakes on centerline for two-lane roads and in the median for four-lane roads. Mark grade check stakes with a lath. Clearly mark the lath with the station location and cut or fill information.~~
- ~~d. Set finish grade stakes (blue tops) at 100 foot (20 m) intervals, or less if needed. Set the blue tops at each shoulder line and at each point where there is a change in cross slope. Mark blue tops with a wood hub and a stake chaser or similar type tassel.~~
- e. 2) Take original and final elevations of all borrows. Provide original and final graphical cross sections at 100 foot (20 m) intervals, or less if needed, suitable for use by the Engineer to calculate excavation quantities.

- f. 3) Set bridge berm slope stakes to establish all transitions, including the face of the berm. Set finish grade stakes (blue tops) on all roadway shoulder lines and roadway centerlines to project down the face of the bridge berm at the top, face of berm bench, and toe.
- g. 4) When Class 12 excavation is a bid item, take cross section elevations at 100 foot (20 m) intervals, or less if needed, and plot cross sections for use by the Engineer to calculate the excavation quantities.
- h. 5) Use a lath to locate, on each side of roadway at the right-of-way line, agricultural drain tile shown in the contract documents. Clearly mark lath to show station location, distance from centerline, tile size and type, and flowline elevation.
- b. **Areas Constructed Without AMG.**
  - 1) Set slope stakes at 100 foot (20 m) intervals, or less if needed, for embankment and excavation work including roadway, channel changes, and borrow areas. Interpolations may be necessary to match cross-sections. Set stakes at toe of foreslope or top of backslope, or both. Mark slope stakes with a flat and lath. Clearly mark flat with station location, distance, slope, and cut or fill information.
  - 2) Set grade check stakes at 100 foot (20 m) intervals for bottoms of subgrade treatments. Set stakes on centerline for two-lane roads and in median for four-lane roads. Mark grade check stakes with a lath. Clearly mark lath with station location and cut or fill information.
  - 3) Set finish grade stakes (blue tops) at 100 foot (20 m) intervals, or less if needed. Set blue tops at each shoulder line and each point where there is a change in cross slope. Mark blue tops with a wood hub and stake chaser or similar type tassel.
- c. **Areas Constructed With AMG.**
  - 1) Establish elevation of secondary control points using differential leveling from project benchmarks, forming closed loops. Provide a copy of new control point information to Engineer prior to construction work. Contractor is responsible for errors resulting from their efforts. Correct deficiencies to the satisfaction of the Engineer at no additional cost to Contracting Authority.
  - 2) Set hubs at top of finished subgrade at hinge points on cross section at 1000 foot (300 m) intervals on mainline and at least two cross sections on side roads and ramps. Establish these hubs, using plan typicals and cross sections, for use by Engineer to check accuracy of construction.
  - 3) Provide grade stakes at critical transition points such as, but not limited to, PC's, PT's, super elevation points, and other critical points required for construction of drainage and roadway structures.

#### 2526.03, A, 3, d.

##### Replace the Article:

Perform an independent check of the above stakes. Independent check shall be performed by a second survey crew using their own calculations and equipment entries for staking bridge. Results and staking layout shall be sent to the Engineer prior to starting structure construction.

#### 2526.03, A, 9, Pavements (PCC & HMA).

##### Replace the Article:

- a. ~~Mark locations and elevations with metal pin or tack in a wood hub (only tack one side), flat, and lath. Mark elevations on both sides of the pavement at 50 foot (10 m) intervals on straight and level sections and at 25 foot (10 m) intervals on horizontal and vertical curves. Clearly mark the flat with the station location, cut/fill information, and offset distance to the edge of pavement. Include pavement cross slope information in superelevated curves.~~ **General.**
- b. 1) ~~Take elevations of pavement centerline and both edges at bridges and existing pavement at 10 foot (3 m) intervals for 100 feet (30 m). Adjust profile grade to provide smooth transition, and submit final elevations to the Engineer for approval. Obtain elevations of adjacent pavement and bridges at centerline, edge of pavement, and other locations necessary to characterize existing profile and cross slope. Obtain elevations at maximum 10 foot (3 m) intervals for a minimum of 100 feet (30 m). Adjust design profile grade and cross slope to provide a smooth transition, free of bumps and dips, from the new pavement to the existing pavement or bridge. Notify the Engineer when a smooth profile cannot be provided. Submit final elevations to the Engineer.~~
- ~~2) When a new profile grade is not included in the contract documents:~~
- 1) a) Obtain elevations of existing shoulders and/or pavement as stated in Article 2526.03, A, 9. and bridges at 100 foot (30 m) intervals on straight and level sections and 50 foot (10 m) intervals on horizontal and vertical curves.
- 2) b) Using these elevations, design a profile grade and cross slopes to provide a smooth transition, free of bumps and dips, from the new pavement to the existing pavement or bridge. Design a smooth profile grade line based on these elevations to provide the required pavement or shoulder thickness as detailed

in the contract documents. ~~This grade line shall tie into existing bridges, adjacent pavement and ramps, and provide the required pavement crown. Submit this proposed grade line to the Engineer for approval. Notify the Engineer when a smooth profile cannot be provided. Submit final elevations to the Engineer.~~

**b. Areas Constructed Without AMG.**

Mark locations and elevations with metal pin or tack in wood hub (only tack one side), flat, and lath. Mark elevations on both sides of pavement at 50 foot (10 m) intervals on straight and level sections and 25 foot (10 m) intervals on horizontal and vertical curves. Clearly mark flat with station location, cut or fill information, and offset distance to edge of pavement. Include pavement cross slope information in superelevated curves.

**c. Areas Constructed With AMG.**

- 1) When total stations are used for the AMG paving system, set additional control points at maximum 500 foot (150 m) intervals on each side of pavement. Furnish x,y,z coordinates and station offset information for each point.
- 2) Set paving hubs with cut or fill to finish pavement elevation at A, B, C, and D points along superelevated curve transitions and at station equation locations. Additional paving hubs will not be required for mainline pavement.

**2526.03, A, 11, PCC Overlays.**

Replace the Article:

- ~~a. Mark locations and elevations with metal pin or tack in a wood hub (only tack one side), flat, and lath. Mark elevations on both sides of pavement at 50 foot (10 m) intervals on straight and level sections and at 25 foot (10 m) intervals on horizontal and vertical curves. Clearly mark flat with the station location, cut/fill information, and offset distance to edge of pavement. Include pavement cross slope information in superelevated curves. General.~~
- ~~b. 1) Take elevations of pavement centerline and both edges at bridges and existing pavement at 10 foot (3 m) intervals for 100 feet (30 m). Adjust profile grade to provide a smooth transition, and submit final elevations to the Engineer for approval. Obtain elevations of adjacent pavement and bridges at centerline, edge of pavement, and other locations necessary to characterize existing profile and cross slope. Obtain elevations at maximum 10 foot (3 m) intervals for a minimum of 100 feet (30 m). Adjust design profile grade and cross slope to provide a smooth transition, free of bumps and dips, from the new pavement to the existing pavement or bridge. Notify the Engineer when a smooth profile cannot be provided. Submit final elevations to the Engineer.~~
- ~~c. 2) When a new profile grade is not included in the contract documents:~~
  - ~~a) Obtain elevations of adjacent pavement and bridges per Article 2526.03, A, 11, a, 1.~~
- ~~4 b) Obtain elevations of existing pavement at centerline and both pavement edges for bonded overlays and projects including mainline stress relief course and/or pavement scarification.~~
- ~~2 c) Obtain elevations of existing pavement at centerline, quarter points, and both pavement edges for unbonded overlays and whitetopping projects when a stress relief course and/or pavement scarification are not included.~~
- ~~3 d) Obtain elevations at maximum 400 50 foot (30 10 m) intervals on straight and level sections and at maximum 50 25 foot (10 m) intervals on horizontal and vertical curves.~~
- ~~4 e) Design a smooth profile grade line based on these elevations to provide the required pavement or shoulder thickness as detailed in the contract documents. This grade line shall tie into existing bridges, adjacent pavement and ramps, and provide the required pavement crown. This proposed grade line shall be submitted to the Engineer for approval. Using these elevations, design a profile grade and cross slopes to provide a smooth transition, free of bumps and dips, from the new pavement to the existing pavement or bridge. Design a smooth profile grade line to provide the required pavement or shoulder thickness as detailed in the contract documents. Notify the Engineer when a smooth profile cannot be provided. Submit final elevations to the Engineer.~~
- ~~d. 3) Reference and preserve existing control points located at each Point of Intersection (P.I.).~~
- ~~e. 4) Obtain Engineer's approval for method used to reference points.~~
- ~~f. 5) Reset Control Points after work is complete.~~
- b. Areas Constructed Without AMG:**

Mark locations and elevations with metal pin or tack in wood hub (only tack one side), flat, and lath. Mark elevations on both sides of pavement at 50 foot (10 m) intervals on straight and level sections and 25 foot (10 m) intervals on horizontal and vertical curves. Clearly mark flat with station location, cut or fill information, and offset distance to edge of pavement. Include pavement cross slope information in superelevated curves.
- c. Areas Constructed With AMG:**

- 1) When total stations are used for the AMG paving system, set additional control points at maximum 500 foot (150 m) intervals on each side of pavement. Furnish x,y,z coordinates and station offset information for each point.
- 2) Set paving hubs with cut or fill to finish pavement elevation at A, B, C, and D points along superelevated curve transitions and at station equation locations. Additional paving hubs will not be required for mainline pavement.

### Section 2527

#### 2527.02, D, 1, Removable Marking Tape.

**Rename** the Article:

Wet, Retroreflective Removable ~~Marking~~ Tape Markings.

#### 2527.02, D, 1, b.

**Replace** the Article:

Complying with the following:

- 1) Preformed markings consist of white or yellow films providing immediate and continuing retroreflection during dry, wet, and rainy conditions.
- 4 2) Nominal width of 4 inches (100 mm).
- ~~2) Yellow or white, weather and traffic resistant film, precoated on one side with a pressure sensitive adhesive.~~
- 3) Flexible and formable.
- 4) ~~Capable of remaining in place during its useful life.~~ Ensure tape is capable of performing for the duration of a normal construction season and being removed intact or in large pieces. Ensure tape is reflective throughout its useful life. Normal construction season is defined as the time between the last snowplowing in the spring and the first snowplowing in the fall/winter.
- 5) ~~Easily removed from the pavement at any time.~~ Ensure tape design and manufacture allows it to be readily removed when markings are no longer needed.

#### 2527.03, F, 2.

**Replace** the first sentence of the Article:

On Primary and Interstate highways, ~~R~~replace pavement markings before the lane or road is opened to traffic in the following situations:

#### 2527.03, F, 2, b, Two Lane Roads.

**Replace** the article:

- 1) ~~Paved Shoulder More Than 2 Feet (0.6 m).~~
  - ~~a) Center lines obliterated for 50 feet (15 m) or more.~~
  - ~~b) Edge lines obliterated for 50 feet (15 m) or more.~~
  - ~~c) No Passing Zone lines obliterated.~~
- 2) ~~Paved Shoulder 2 Feet (0.6 m) or Less.~~
  - ~~a) Center lines obliterated for 50 feet (15 m) or more.~~
  - ~~b) Edge lines obliterated on curves with a radius of 1,000 feet (300 m) or less.~~
  - ~~c) Edge lines obliterated at bridge approaches, or other obstructions within 3 feet (1 m) of the roadway, for 300 feet (90 m) or more.~~
  - ~~d 3) No Passing Zone lines obliterated.~~

#### 2527.03, F, Markings Obliterated During Construction.

**Renumber** Articles 3 and 4, and **Add** the Article:

3. On other roadways, centerline markings obliterated during construction shall be replaced within 3 calendar days after the operation that obliterated the markings has been completed within the entire project limits. Place traffic control as shown in the contract documents.

~~3~~ 4.

~~4~~ 5.

**2527.03, I, 2.**

**Replace** the Article:

Use wet, retroreflective removable tape markings for temporary pavement markings which extend diagonally across a final traffic lane.

**2527.04, A, 3, Removable Tape Markings.**

**Rename and Replace** the Article:

**Wet, Retroreflective Removable Tape Markings.**

Stations (meters) placed. Removing wet, retroreflective removable tape markings will not be measured separately for payment.

**2527.05, A, 3, Removable Tape Markings.**

**Rename and Replace** the Article:

**Wet, Retroreflective Removable Tape Markings.**

- a. Per station (meter) placed.
- b. Payment includes removing the wet, retroreflective removable marking tape markings, when required.

**Section 2528****2528.01, A, 10.**

**Replace** the first bullet:

Iowa Department of the Blind: ~~Program Administrator of Field Operations and Access Technology~~ Director's Office, telephone: ~~515.281.1364~~ 515.281.1336, website: [www.blind.state.ia.us](http://www.blind.state.ia.us).

**2528.01, C, 1.**

**Replace** the second sentence:

The Traffic Control Technician is required to have attended and passed the exam in an ATSSA Traffic Control Technician, IMSA Work Zone Traffic Control, ~~or Minnesota DOT Traffic Control Supervisor training class, or~~ Texas Engineering Extension Service Work Zone Traffic Control training class.

**2528.01, B, 3, b, Operation.**

**Replace** Articles 3 and 4:

- 3) ~~The Engineer may request to operate project related Portable Changeable Message Signs (PCMS) according to Article 2528.03, B, for advance traffic notification and warning. Authority to operate PCMS units will be under the direction of the Engineer according to the contract documents. Only the Engineer may add or modify any preprogrammed messages. The Contractor may only operate the CMS to display one of the preprogrammed messages.~~
- 4) During anticipated peak traffic times, the Engineer may direct Contractor to provide additional monitoring personnel for PCMS operation and other traffic monitoring functions.

**2528.03, B, Portable Changeable Message Signs.**

**Replace** the Article and title:

**Portable Changeable Dynamic Message Signs**

Furnish, place, operate (when specified), and maintain PCMS Portable Dynamic Message Sign (PDMS) meeting requirements of Article 4188.06 at the locations shown on the plans. Contractor maintains possession of the PCMS PDMS upon completion of the project.

**1. Sign Design.**

- a. ~~Trailer mounted signs. Message panel mounted at a height of at least 7 feet (2.2 m), measured from the bottom of the sign to the near edge of the pavement. Sign presents a level appearance. Sign is capable of displaying three lines of up to eight characters at one time. Character height is 18 inches (450 mm) and configured using a 7 pixel tall by 5 pixel wide font.~~

- ~~b. Message panel visible from 1/2 mile (800 m) under both day and night conditions. Letters legible from 750 ft (225 m). Message sign shall include automatic dimming for nighttime operation and a power supply capable of providing continuous 7 days (24 hours per day) service.~~
- ~~c. Message panel consisting of a line matrix or full matrix design controlled by an onboard computer capable of:
 
  - ~~Storing a minimum of 99 programmed messages for instant recall.~~
  - ~~Being programmed to accept messages created by the operator via an alpha-numeric keyboard.~~
  - ~~Being programmed by remote.~~~~
- ~~d. Physical access to the onboard computer protected by a padlock (using a key). Electronic access to the onboard computer protected by a username and password.~~

### 1. Testing and Configuration.

- a. Physical and electronic access to PDMS shall be granted to the Engineer.
- b. On Interstate and Primary projects:
  - 1) At least one week before PDMS is deployed to a project, a testing and configuration meeting with the Engineer shall be held.
  - 2) The Engineer, in conjunction with the Contractor, will perform necessary configuration adjustments to the PDMS and cellular modem to allow remote control by the Contracting Authority's NTCIP software.

### 2. Remote Operation.

- a. On Interstate and Primary projects, the Department will remotely operate signs through use of a modem and NTCIP software.
- b. Contracting Authority will use their own NTCIP compliant software to activate messages, check sign's status, and perform diagnostic tests.
- c. Anytime during the project, the Engineer may remotely activate a message on the PDMS. Any message placed on the PDMS shall not be removed or replaced by the Contractor unless requested by the Engineer.

### 2 3. Direct Operation of Signs.

- ~~a. Provide preventive maintenance efforts necessary to achieve uninterrupted service. If service is interrupted and not restored within 24 hours, the Engineer will cause such work to be performed as may be necessary to provide this service, at no additional cost to the Contracting Authority. On Secondary road projects, PDMS will be operated directly by either the Contractor or the Engineer.~~
- b. The Engineer may request Contractor to operate PCMS PDMS for advance traffic notification and warning. Authority to operate PCMS PDMS will be under the direction of the Engineer. Contractor may only operate PCMS PDMS to display messages authorized by the Engineer.
- c. Promptly program and/or reprogram the computer to provide the messages as directed by the Engineer.
- ~~d. Provide the Engineer with the username and password and two keys.~~

### 3. Internet Operation for Long Term Duration.

- ~~a. This section describes Internet operations for use of PCMS for long term duration. PCMS hardware and software that are required for Internet operation under this article will be considered extra work according to Article 1109.03, B.~~
- ~~b. Communication equipment at the sign, a web server at a central communications hub, and communications from the sign to the Internet are required.~~
- ~~c. Make an Internet web page available as the method for the Engineer to control the sign from the office. Choose software to control the signs that is not required to be installed on the Engineer's computer. Ensure the Internet web page performs the following functions:
 
  - ~~Displays the name of the sign.~~
  - ~~Shows the current display on the message board.~~
  - ~~Puts up a message using free text.~~
  - ~~Puts up a message by calling the onboard library of stored messages.~~
  - ~~Removes the current message.~~
  - ~~Displays the current voltage of the sign's batteries (if solar).~~~~

### 4. Maintenance.

- a. Provide preventive maintenance necessary to achieve uninterrupted service.

- b. On Interstate and Primary projects, Engineer will perform remote diagnostic tests of sign's operational status each morning and notify Contractor when a problem is detected.
- c. On Secondary road projects, verify operational status each morning and notify Engineer when a problem is detected.
- d. Provide unscheduled maintenance or total replacement of sign when sign is unable to display a message adequately within 24 hours of notification. Action shall be taken to resolve the following problems if they have been visually observed or confirmed by self diagnostics by the PDMS for three continuous days or seven intermittent days over a two week period.
  - 1) An entire pixel board is showing failure.
  - 2) Five or more pixel failures over entire message panel anytime while sign is deployed for use (blank or displaying a message).
  - 3) Two or more pixel failures in any character when displaying a message.
- e. If service is not restored within 24 hours, Engineer will cause such work to be performed as may be necessary to provide this service. The cost for this restoration shall be borne by the Contractor.

### 2528.03, C, 1, b, 3, a.

**Replace the Article:**

~~Between 28 inches (710 mm) and 34 inches (865 mm) in height.~~ A nominal 36 inch (915 mm) height.

### 2528.03, F, Modular Glare Screens.

**Replace the Article:**

1. When specified in the contract documents furnish, install, and maintain a modular glare screen system on the top of concrete barrier rail according to the contract documents and the modular glare screen system manufacturer's instructions. Furnish a system consisting of modular base ~~units~~ rails attached to the top of concrete barrier rail with blades evenly spaced and securely mounted to the base ~~units~~ rails. Ensure the following:
  - Modular base ~~units~~ rails and glare screen blades are compatible so the base unit and blades can be securely attached to each other.
  - Base ~~units~~ rails and blades supplied are manufactured by the same manufacturer.
  - The length of individual modular base ~~units~~ rails is no longer than the nominal length of individual temporary concrete barrier rail sections.
  - The width of the modular base ~~units~~ rails is no wider than the top width of the concrete barrier rail.
  - Glare screen blades are FHWA highway green in color and made of impact resistant non-metallic high density plastic material.
  - Blade height is from 24 inches to 30 inches (600 mm to 750 mm) and width is from 6 inches to 9 inches (150 mm to 225 mm).
  - The same uniform sized blades are used throughout the work.
  - The modular glare screen system is manufactured by a company on the approved manufacturer's list in Materials I.M. 486.06, Appendix A.
2. Install the modular glare screen system according to the manufacturer's instructions and the approval of the Engineer. Install the system so that:
  - It is centered along the longitudinal axis length of the top of the concrete barrier rail.
  - The overhang of the base ~~units~~ rails, blades, and associated assembly over the edges of the top of the concrete barrier rail is kept to a minimum.
  - The modular base ~~units~~ rails are flush with the top of the concrete barrier rail and they do not extend over the joints between concrete barrier rail sections. A maximum gap between base rails across barrier rail gaps shall be 12 inches (300 mm).
3. Install glare screen blades so the combination of blade width and spacing provide for a minimum 22 degree sight cut-off angle.
4. ~~At 10 foot (3 m) intervals along the glare screen installation, apply (appropriate to the direction of traffic) 3 inch by 6 inch (75 mm by 150 mm) yellow or white strips of Type III or IV retroreflective sheeting meeting the requirements of Section 4186 to the appropriate glare screen blades. Apply each strip at the vertical midpoint of the glare screen blade and to the side of the blade nearest to traffic. Apply the strip with the longer dimension vertical. Glare screen blades shall be free from reflective sheeting or other modifications and shall be consistent in appearance.~~

5. Maintain the modular glare screen throughout the work. Replace or repair damaged parts of the modular glare screen system, as soon as practical, at no additional cost to the Contracting Authority.
6. When moving temporary barrier rail with a modular glare screen system, the Contractor may temporarily remove base units rails and glare screen blades, if necessary, to assist in the moving. Reinstall the removed base units and glare screen blades as soon as the temporary concrete barrier rail has been moved to its new location.
7. Perform final removal of the modular glare screens from the concrete barrier rail when directed by the Engineer. Upon removal, ensure there are no protrusions on the top of the concrete barrier rail.
8. Upon completion of the work, the Contractor retains ownership of the modular glare screen system.

### 2528.03, I, Temporary Floodlighting.

**Replace** the Article:

- ~~1. Ensure floodlighting is installed and in service before work is started that requires nighttime traffic control by the traffic control plan.~~
  - ~~2. Ensure temporary floodlighting meets the following:
 
    - ~~a. Pole mounted luminaire or a luminaire mounted on portable equipment.~~
    - ~~b. Mounting height of luminaires is no less than 35 feet (11 m) above the roadway, and as shown in the contract documents. Pole length determined by field measurement to obtain specified mounting height.~~
    - ~~c. Clearance for overhead wiring a minimum of 18 feet (5.5 m). Auxiliary poles used to furnish power to floodlighting offset 30 feet (9 m) from the traveled way unless there are right of way restrictions.~~
    - ~~d. Poles placed outside the normal shoulder line at the approximate locations shown in the contract documents.~~
    - ~~e. Above ground lighting circuits are aluminum or A.C.S.R. triplex.~~
    - ~~f. Underground lighting circuits are type U.S.E. or U.F.~~~~
  - ~~3. Meet the following requirements for luminaires used for floodlighting:
 
    - ~~a. Standard roadway types with totally enclosed refractors.~~
    - ~~b. IES glare control rating of "cut off".~~
    - ~~c. The lamps with an initial output rating of 19,000 lumens or greater.~~
    - ~~d. Photoelectric controlled for dusk to dawn operation.~~
    - ~~e. Approval of the Engineer.~~~~
  - ~~4. Exercise reasonable care to avoid interruptions during the hours of darkness, promptly repair damage to the system, and replace all burned out lamps as soon as possible.~~
1. **General.**
    - a. Set up and operate either pole mounted or portable, mobile self contained LED temporary floodlights at locations shown in contract documents.
    - b. Ensure floodlighting is installed and in service before commencing work requiring nighttime traffic control according to the traffic control plan.
    - c. Exercise reasonable care to avoid interruptions during hours of darkness, promptly repair damage to system, and replace burned out lamps promptly.
  2. **Equipment.**
    - a. **Pole Mounted Floodlights.**
      - 1) Pole-mounted luminaire.
      - 2) Mounting height of luminaires is no less than 35 feet (11 m) above the roadway and as shown in the contract documents. Pole length determined by field measurement to obtain specified mounting height.
      - 3) Place poles outside normal shoulder line at approximate locations shown on the contract documents.
      - 4) Meet the following requirements for floodlighting luminaires:
        - Standard roadway types with totally enclosed refractors.
        - IES glare control rating of "cut off".

- Lamps with initial output rating at least 19,000 lumens.
  - Photoelectric controlled for dusk to dawn operation.
  - Approval of the Engineer.
- 5) Ensure clearance for overhead wiring at least 18 feet (5.5 m). Auxiliary poles used to furnish power to floodlighting offset 30 feet (9 m) from traveled way unless there are right-of-way restrictions.
  - 6) Above ground lighting circuits are aluminum or A.C.S.R. triplex.
  - 7) Underground lighting circuits are type U.S.E. or U.F.
- b. Portable, Mobile Self Contained LED Floodlights.**
- 1) Mounted on portable trailers containing solar cell array and storage battery system to power LED luminaire. Ensure system meets NCHRP 350 Category IV crash testing.
  - 2) Ensure mounting height of LED luminaires is no less than 17 feet (5.2 m) above roadway, or as shown in the contract documents.
  - 3) Locate portable trailers so LED luminaire is centered over outside edge of pavement and trailer is on shoulder offset as far as possible from traveled way
  - 4) Meet materials requirements of Article 4188.05 for LED Floodlighting Luminaires.

### 2528.03, L, Limitations.

#### Replace the Article:

5. ~~All Personnel in the highway right-of-way are required to~~ shall wear orange or strong yellow green ANSI 107 Class 2 apparel ~~at all times~~ when exposed to traffic or construction equipment. Orange or strong yellow green ANSI 107 Class E pants or shin reflectors/gaiters are also required to be worn at night. Shin reflectors/gaiters shall have a minimum of two 2 inch (50 mm) bands of retroreflective material spaced at least 6 inches (150 mm) apart. Background material shall extend at least 2 inches (50 mm) above and below retroreflective bands and continue through the length of shin reflector/gaiter. Shin reflector/gaiter shall completely encircle the leg and be worn on lower leg between knee and ankle.

#### Add the Article:

13. When milled or scarified surfaces exist, sign approaches to scarified areas using ROUGH ROAD (W8-8) signs. Place signs at least 250 feet (75 m) in advance of milled or scarified areas. Repeat signs for traffic that may enter within the scarified area from intersecting public roads. At locations where milled or scarified areas end at project limits, bridges, or end of day's work; place BUMP (W8-1) signs within 50 feet (15 m) in advance of each location. Erect, move, and maintain these signs until milled or scarified areas have been covered with new HMA or PCC pavement.

### 2528.04, B, Portable Changeable Message Signs.

#### Replace the Article and title:

#### **Portable Changeable Dynamic Message Signs.**

The Engineer will count the number of days each ~~PCMS~~ Portable Dynamic Message Sign is required to be in a location to display potential place along a road and capable of displaying messages to the traveling public. Days when PDMS is blank and is in good working condition, will be measured. Days when PDMS is unable to display a message due to cellular (when specified) or mechanical problems will not be measured. Days when PDMS is on the roadway and not approved by the Engineer will not be measured.

### 2528.05, B, Portable Changeable Message Signs.

#### Replace the Article and title:

#### **Portable Changeable Dynamic Message Signs.**

1. Payment will be at the contract unit price per calendar day for each ~~PCMS~~ Portable Dynamic Message Sign ~~that is required to be in a location to display potential messages to the traveling public~~ measured as provided in Article 2528.04, B.
2. Payment is full compensation for furnishing, placing, operation (when specified), and maintenance of ~~PCMS~~ PDMS. Payment includes the cost of preventative and unscheduled maintenance, cellular communication (when specified), on-board software, hardware, and power supply.

**2528.05, C, Temporary Barrier Rail.**

Add the Article:

3. Payment for repair or replacement of temporary barrier rail damaged by public traffic will be paid according to Article 1109.03, B.

**Section 2529****2529.01, B.**

Add the Articles:

8. Full depth PCC finish patches (50 feet (15 m) or greater in length).
9. Full depth HMA finish patches (50 feet (15 m) or greater in length).

**2529.03, A, 1.**

Replace the fourth sentence of the Article:

The patch thickness and type of patch material ~~may~~ will be included.

**2529.03, B, Full Depth Patch Thickness.**

Delete the Article:

**~~B. Full Depth Patch Thickness.~~**

~~If full depth patch thickness is not shown in the contract documents, establish thickness as follows:~~

**~~1. HMA Patches.~~**

~~Interstate and Primary pavement: the thickness of the HMA pavement, but no less than 9 inches (230 mm) or more than 15 inches (380 mm).~~

**~~2. PCC Patches.~~**

- ~~a. PCC pavements on Interstate and Primary Roads: the thickness of the pavement but no less than 9 inches (230 mm) or more than 12 inches (300 mm).~~
- ~~b. County roads: thickness no less than 6 inches (150 mm) or more than 12 inches (300 mm).~~

**~~3. Composite Patches.~~**

~~PCC pavements which have been resurfaced with HMA: patch materials and thickness the same as the existing pavement except the PCC portion of the patch is not to be less than 9 inches (230 mm) or more than 12 inches (300 mm) unless specified otherwise in the contract documents. If the HMA resurfacing exceeds 4 1/2 inches (120 mm) (nominal) place an HMA patch, unless specified otherwise in the contract documents.~~

**2529.03, H, 2.**

Replace the first sentence of the Article:

Place, consolidate, finish, and cure ~~of the~~ concrete as provided in Section 2301, except as follows:

Add the Article:

- i. Temperature restrictions in Article 2301.03, S, will not apply.

**2529.03, H, 2, c.**

Replace the Article:

Dump or convey the concrete into the patch areas to avoid segregation ~~of the aggregates and cement~~. Spread it into place and vibrate with a mechanical vibrator. Smooth the concrete and finish it to the elevation of the adjacent PCC pavement surface. Avoid excessive vibrating.

**2529.03, I, Smoothness.**

Replace the first sentence of the Article:

Apply Section 2316 to smoothness of full depth finish patches (except when the contract includes an overlay or pavement surface repair by diamond grinding or milling within the patch area) with the following modifications for Full Depth Finish Patches (50 feet (15 m) or greater in length):

**2529.03, I, 1.**

**Delete** the third sentence of the Article:

~~For each patch added by the Engineer that is greater than 50 foot (15 m) long, the Contractor will be paid \$500 in addition to the appropriate unit prices involved. This is to compensate for additional smoothness requirements.~~

**2529.03, K, 5.**

**Delete** the third sentence of the Article:

~~A flagger will be required at these locations.~~

**2529.03, K, 6.**

**Delete** the Article:

~~6. When HMA patches on two-lane roadways and PCC patches with calcium chloride are constructed, adjust the work schedule so all equipment and obstructions are removed from the travel lanes and shoulders from 30 minutes before sunset to 30 minutes after sunrise.~~

**2529.04, Method of Measurement.**

**Add** the Article:

**H. Subbase Patch with EF Joint.**

1. The Engineer will compute in square yards (square meters) areas of subbase placed as provided in Paragraph A, above. The Engineer will not measure subbase aggregate used for special shaping at longitudinal drains.
2. The Engineer will separately compute areas in square yards (square meters), where subbase was directed to be placed to a depth greater than originally specified.
3. When required by the contract documents, subgrade stabilization material will not be measured separately for payment.

**2529.05, A, 1, a.**

**Replace** the Article:

Each. The type or types of patches to be counted will be identified by the following types and tabulated in the contract documents.

- ~~1) Full Depth HMA Finish Patches.~~
- ~~2) Full Depth PCC Finish Patches, Without Dowels.~~
- ~~3) Full Depth PCC Finish Patches, Without Dowels, Composite Section.~~
- ~~4) Full Depth PCC Finish Patches, With Dowels.~~
- ~~5) Full Depth PCC Finish Patches, Composite Section.~~
- ~~6) Full Depth PCC Finish Patches, Continuously Reinforced.~~
- ~~7) Full Depth PCC Finish Patches, Continuously Reinforced, Composite Section.~~

**2529.05, A, 2, Full Depth Finish Patches, By Area.**

**Rename** the Article:

**Full Depth Finish Patches, by Area and Full Depth Finish Patches, by Area (50 Feet (15 m) or Greater in Length).**

**2529.05, A, 2, b.****Replace** the Article:

Payment is full compensation for:

- Removal of the old pavement,
- Restoring the subgrade or subbase,
- Furnishing and installation of tie bars,
- Restoring longitudinal reinforcement for continuously reinforced patches, ~~and~~
- Furnishing and placing the patching material, including the asphalt binder, tack coat, curing, joint sealing, and placing backfill material in the disturbed area- and,
- Profilograph testing and any required profile correction for patches 50 feet (15 m) or greater in length.

**2529.05, A, 2, c.****Replace** Table 2529.05-1:**Table 2529.05-1: Patching Quantity Adjustment**

<b>% Change of Thickness</b>	<b>% Change of Quantity</b>
0 to 10	0
> 10 to 20	10
> 20 to 30	15
> 30	20 Paid per Article 1109.03, B

**2529.05, E, 2.****Replace** the second bullet:

Furnishing and placing 4 inch (100 mm) perforated corrugated polyethylene pipe, porous backfill, impervious fill, ~~and~~ shoulder material, ~~and rodent guard.~~

**2529.05, F, 2.****Replace** the second sentence of the Article:

If removal of anchor lugs is not a bid item in the contract documents, payment will be paid ~~\$600~~ 1200 per lane in which an anchor lug, or portion of anchor lug, is removed.

**2529.05, Basis of Payment.****Add** the Article:**H. Subbase Patch with EF Joint.**

1. For the number of square yards (square meters) of subbase furnished and placed, Contractor will be paid the contract unit price per square yard (square meter).
2. Payment is full compensation for:
  - Furnishing and installing subbase,
  - Additional excavation necessary for this placement and removal of excavated material,
  - Placing backfill material in the disturbed shoulder area.
  - Furnishing and installing subgrade stabilization material when required.
3. When subbase has been placed to a greater depth than specified in the contract documents, at the Engineer's direction, payment per square yard (square meter) for those areas will be increased by 20% for each inch (30 mm) of increased depth. This increased payment is full compensation for additional excavation and subbase material, associated compaction, and if so ordered, additional depth for the transverse subdrain.

**Section 2530****2530.03, B, 3, c, 1, Class A Patching Material.**

**Replace** the second sentence:

~~Use a minimum curing time according to Materials I.M. 401.20, Appendix A. If manufacturer's strength data at anticipated curing temperatures is not available, use only when mix and substrate temperature are 50°F (10°C) or greater and cure for a minimum of 4 hours.~~

**Section 2532****2532.03, B, 3, a.**

**Replace** the Article:

When specified in the contract documents, ~~G~~grind and longitudinally groove the entire surface of the bridge deck according to Article 2412.03, D, 4, a. For other projects, re-establish transverse grooving through corrected areas using diamond blades to provide a surface similar to a new deck except the area within approximately 2 feet (0.6 m) from the curb.

**Section 2535****2535.02, A, Concrete Crib Units.**

**Replace** the Article:

Precast concrete complying with the applicable requirements of Section ~~2407~~ 2419.

**Section 2538****2538.03, D, 4, Dust Control.**

**Replace** the Article:

~~Minimize the spread of fugitive dust during demolition of masonry by thoroughly wetting the material. Comply with the provisions of the Iowa DNR fugitive dust rules contained in 567 IAC 23.~~

**2538.03, D, 6, d.**

**Replace** the Article:

~~Remove and dispose of appliances and other items that may contain refrigerants according to 40 CFR, Part 82, mercury, or PCB-containing capacitors in accordance with the Iowa DNR discarded appliance demanufacturing rules contained in 567 IAC 118. Appliances and other items that may contain refrigerants include, but are not limited to, refrigerators, freezers, dehumidifiers, and portable or central air conditioners. Venting refrigerants into the atmosphere when removing or disposing of these appliances is prohibited. Ensure a technician certified through a U.S. EPA approved course evacuates refrigerants from these appliances. Ensure equipment used to evacuate refrigerants is certified by the ARI or UL.~~

**2538.03, D, 7, a, 1.**

**Replace** the third sentence of the Article:

Ensure sewage is disposed of according to ~~IA~~ 567 IAC, 68.

**2538.03, D, 8, Wells.**

**Replace** the Article:

- ~~a. Seal well with methods and materials according to 567 IAC 567, 39, Requirements for Properly Plugging Abandoned Wells. Ensure wells are sealed by a certified well subcontractor certified in accordance with 567 IAC 82.~~
- ~~b. Remove all obstructions before beginning to fill and seal the abandoned well. Use one or more of the following materials to fill the well:
 
  - Sand,
  - Pea gravel,~~

- ~~• Class A, B, or C granular surfacing material,~~
- ~~• Agriculture lime.~~
- ~~c. Ensure all fill materials are free of foreign matter and any toxic residue. Introduce the material at the bottom of the well, or at the starting location. Fill and place progressively upward to the bottom of the seal material location.~~
- ~~d. Use one or more of the following materials to seal the well:~~
  - ~~• Neat cement (14 lbs. (1.7 kg) cement per gallon (liter) of water);~~
  - ~~• Graded bentonite, bentonite pellets, or bentonite grout,~~
  - ~~• Sand cement grout (1 sack of cement/equal volume masonry sand/not more than 6 gallons (23 L) water);~~
  - ~~• PCC.~~
- ~~e. Place sealing materials using a grout pipe, tremie pipe, cement bucket, or dump bailer, in such a way as to avoid segregation or dilution of the sealing materials. Bentonite pellets or graded bentonite may be added as sealing materials by pouring in place and agitating to avoid bridging.~~
- ~~f. For a deep well, place neat cement from 10 feet (3 m) below the bottom of the casing to 10 feet (3 m) above the bottom of the casing or to the static water level, whichever is higher.~~
- ~~g. For wells complete in multiple aquifers, re-use this same procedure throughout subsequent aquifers.~~
- ~~h. Cut off the upper portion of the well casing at least 4 feet (1.2 m) below ground or construction level. Plug the upper 6 feet (2 m) of the remaining casing with neat cement.~~

### 2538.03, D, 10, Erosion Control.

#### Replace the Article:

Seed, ~~and~~ fertilize, and mulch, as specified in the contract documents, areas disturbed by Contractor's operations. Cost of erosion control work shall be included in the price bid for other items of work. Erosion control work shall be performed according to Sections 2601 and 2602 except as noted below.

- a. Seeding: 3 pounds of Tall Fescue, Kentucky 31, or Fawn per 1000 square feet (1.5 kg per 100 m<sup>2</sup>).
- b. Fertilizer: 17 pounds of 13-13-13 (or equivalent) commercial fertilizer per 1000 square feet (8.5 kg per 100 m<sup>2</sup>).
- c. Mulch: 70 pounds of dry cereal straw per 1000 square feet (35 kg per 100 m<sup>2</sup>). For areas disturbed, but not seeded by September 30<sup>th</sup>, scarify to a 3 inch (75 mm) depth and mulch. Consolidate mulch into the soil with a mulch stabilizer.

The Engineer may require additional erosion control measures and placement of silt fence and/or perimeter and slope sediment control devices. Additional erosion control measures and sediment control devices will be paid for according to Article 1109.03, B.

### 2538.05, A, 2.

#### Replace the Article:

- Payment is full compensation for:
- Removal and disposal of buildings, building materials, contents of buildings, appliances, trash, rubbish, basement walls, foundations, sidewalks, steps and driveways,
- Water and sewer disconnection,
- Obtaining permits,
- Dust control,
- Removal and handling of refrigerants, mercury and PCB-containing materials,
- Furnishing and compacting backfill material,
- Finish grading of disturbed areas,
- Furnishing and placing seed, ~~and~~ fertilizer, and mulch,
- Placing and removing safety fencing, and
- Removal of septic tanks and cisterns.

### Section 2541

### 2541.03, C, 3.

#### Delete the second sentence of the Article:

~~When work encroaches on an adjacent lane, a flagger will be required at that location.~~

## Section 2542

### 2542, Crack and Joint Cleaning and Sealing (Portland Cement Concrete Pavement).

Replace the Section and title:

#### Section 2542. Crack and Joint Cleaning and Sealing Filling (Portland Cement Concrete Pavement)

#### 2542.01 DESCRIPTION.

- A. Rout or saw and clean random cracks and existing transverse and longitudinal joints in PCC pavement. ~~Seal~~ Fill prepared cracks and joints with an approved sealing material.
- B. Crack and joint cleaning and ~~sealing~~ filling is intended to address longitudinal cracking, transverse cracking, and corner breaks. Crack and joint cleaning and ~~sealing~~ filling is not intended to ~~clean or seal~~ for durability ("D") cracking or map cracking. Definitions for these pavement distress types can be found in the 'Distress Identification Manual for the Long-Term Pavement Performance Program' (Publication No. FHWA-RD-03-031, dated June 2003, web address: <http://www.fhwa.dot.gov/publications/research/infrastructure/pavements/ltpdp/reports/03031/03031.pdf>).

#### 2542.02 MATERIALS.

- A. Use hot poured joint sealer and backer rod that meet the requirements of Article 4136.02.
- B. Installation of preformed elastomeric joint seals meeting the requirements of Article 4136.02 may be required in the contract documents. Substitution of elastomeric joint seal material for poured joint sealer material will not be allowed unless specified otherwise in the contract documents.

#### 2542.03 CONSTRUCTION.

##### A. Equipment.

##### 1. Routing or Sawing Equipment.

- a. Use power driven routing or sawing equipment, where required, capable of cutting the cracks to the required dimensions without excessive spalling of the adjacent surface.
- b. Use power driven sawing equipment (wet or dry), where required, capable of sawing the sealant reservoir to the dimensions shown in the contract documents.

##### 2. ~~Water and Abrasive Blasting~~ Cleaning Equipment.

- ~~a. To remove existing joint sealer, debris, and loose material from the crack or joint, use water cleaning equipment capable of delivering water with a pressure of 2,000 psi (13.8 MPa) from a nozzle.~~
- ~~b. Use abrasive blast equipment capable of removing the existing sealant, saw slurry, silt, or other foreign material from the vertical face of the crack or joint to the specified depth. Ensure the equipment leaves a clean, dry, newly exposed concrete surface.~~

##### 3. Air Compressors.

Use air compressors that provide moisture free and oil free air and are of sufficient size to blow sand and other foreign material from the crack or joint prior to placing the sealant material.

##### 4. Equipment for Heating and Placing Sealant Material.

Use an oil jacketed, double boiler type, heating kettle or other thermostatically controlled equipment of a type approved by the Engineer, capable of heating the material to 400°F (205°C) and pumping the material into the prepared crack or joint.

##### 5. Auxiliary Equipment.

Provide auxiliary equipment, such as brooms, scrapers, etc., as necessary to perform the work.

##### B. Construction.

- 1. A partial depth finish patch may be required when joints or cracks have edge spalls or other distress greater than 3 inches (75 mm) in width. If not otherwise included as part of the contract work, these areas

will be designated by the Engineer as extra work. Construct partial depth finish patches according to Section 2530. ~~Seal~~ Fill joints or cracks less than or equal to 3 inches (75 mm) in width without patching.

2. Clean cracks and joints of existing joint sealer, vegetation, dirt, and all other foreign material to the required depth ~~of the bottom of the backer rod. Sand blast the edges throughout the proposed depth of the joint sealer, leaving a clean, dry, newly exposed concrete surface on the vertical edges. This will require two passes of the sand blasting operation for each joint and crack: one pass for each joint or crack edge. Set the angle of approach of the sand blast nozzle to each vertical face of the reservoir to be approximately 30 degrees. The sand blast nozzle shall have a guide which inserts in the joint and assures positive location and directional control of the nozzle.~~
3. ~~Perform sand blasting just prior to the application of the joint sealer. When cleaned joints or cracks are contaminated before being sealed, reclean them by sand blast before sealing. Rain will be considered contamination.~~
4. When required, ~~P~~place a backer rod at the bottom of the joint or crack as a bond breaker. Install it dry. If the width of opening exceeds the maximum size available, approved alternates of bond breakers at the bottom of the crack or joint may be used.
5. Widen cracks and joints in partial depth HMA finish patches ~~to 1/2 inch (13 mm), if widening is necessary~~ as needed to allow room for filling of the joint or crack. Extend the cleaning and ~~sealing~~-filling operation across the joint or crack.
6. Prior to placing backer rod (when used) and joint sealer:
  - Ensure cracks and joints are dry.
  - Use compressed air to blow cracks and joints clean.
  -
7. Fill joints and cracks to the level shown in the contract documents.
8. Heat, handle, and apply the sealer material according to the manufacturer's recommendations.
9. ~~Rout or s~~Saw cracks and joints with an average opening of ~~3/8~~ 1/2 inch (40 13 mm) or less to ~~provide a minimum sealant reservoir of 3/8 inch (10 mm) in width by a nominal 1/2 inch (13 mm) in depth the full width and depth of the existing joint. Sawed joint should not exceed 1/2 inch (13 mm) in width.~~
10. Rout or saw cracks with an average opening of 1/2 inch (13 mm) or less, and place backer rod to provide a minimum sealant reservoir of 1/2 inch (13 mm) in width by a nominal 1/2 inch (13 mm) in depth.
11. For cracks and joints with an existing width greater than ~~3/8~~ 1/2 inch (40 13 mm), place backer rod to a depth that will provide at least ~~5/8~~ 1/2 inch (46 13 mm) clearance above the backer rod for the sealer.
12. Clean cracks and joints of all foreign material to a depth necessary to accommodate the sealer material and the backer rod, ~~to be~~ when used. Ensure backer rod is dry when placed.

#### C. Traffic Control.

1. When there is a separate item for traffic control, furnish all signs and traffic control devices, such as flaggers, barricades, traffic cones, warning lights, and pilot car signs (when required) according to Section 2528. Erect, maintain, and remove all traffic control devices.
2. Conduct the work on only one lane of the pavement width at a time. ~~When work encroaches on an adjacent lane, a flagger will be required at that location.~~
3. Apply Articles 1107.08, 1107.09, and 1108.03.

#### D. Limitations.

1. When other work is included in the contract, sequence operations in the following order:
  - a. Undersealing,

- b. Longitudinal subdrains,
  - c. Patching,
  - d. Installation of retrofit load transfer,
  - e. Grinding or milling, and then
  - f. Crack and joint ~~sealing~~ filling.
2. Perform joint and crack ~~sealing~~ filling only when the ambient air and pavement surface temperatures are above 40°F (4°C). When near this minimum temperature, additional air blasting or drying time, or both, may be necessary to assure a satisfactory bond to the joint surfaces.
  3. Lanes may be opened to traffic only after the sealer has set sufficiently so it will not pick up under traffic. Blotting material may be applied to the sealer, but only after the sealer surface has set so as to avoid penetration of the blotting material into the sealer.
  4. Remove old sealant, other debris, and saw slurry from the pavement surface before the pavement is opened to traffic.
  5. Before the pavement is opened to traffic, clean the dry sawed or routed joints or cracks with a stream of air sufficient to remove all dirt, dust, and deleterious material that can adhere to the joint face. Complete this work within 3 hours after the joint or crack has been dry sawed or routed.
  6. Clean wet sawed joints using high pressure water immediately after sawing to remove residue produced by the sawing operation.
  7. ~~Seal~~ Fill joints and cracks within 5 working days after completion of any sawing or routing or removing old joint sealant material or debris from the crack or joint.
  8. Do not perform crack and joint ~~sealing~~ filling after September 30. When joint sealer cannot be placed in an otherwise completed joint or crack prior to this date due to temperature or other conditions, temporarily ~~seal~~ fill these joints or cracks with a joint sealer over the winter shutdown period. Remove this seal and ~~reclean and reseal~~ fill the joint or crack according to this specification during the next construction season (at no additional cost to the Contracting Authority).
  9. Do not overfill with sealant. Immediately remove sealant placed on the pavement surface.

#### **2542.04 METHOD OF MEASUREMENT.**

Measurement will be as follows:

##### **A. Crack and Joint Cleaning and ~~Sealing~~ Filling (PCC Pavement).**

1. Miles (kilometers), calculated to the nearest 0.1 mile (0.1 km), of main line pavement and shoulders on which cracks and joints were cleaned and ~~sealed~~ filled. Calculations will be based on the center line distance of main line, two-lane pavement, corrected for main line pavement of more than two lanes, including climbing lanes.
2. Shoulders 4 feet (1.2 meters) or less in width will not be measured separately for payment.
3. At intersections, rest areas, and interchanges designated for cleaning and ~~sealing~~ filling, the additional areas of widened pavement, ramps, storage lanes, turning lanes, paved medians, and parking in rest areas will not be separately measured for payment.
4. Between limits for which cleaning and ~~sealing~~ filling is intended for either pavement or shoulders, no deductions will be made for bridges, intersections, or other interruptions where cracks or joints are not to be cleaned and ~~sealed~~ filled.

##### **B. Sealer Material (PCC Pavement).**

Pounds (kilograms) of sealer material used in cracks and joints.

**2542.05 BASIS OF PAYMENT.**

Payment will be the contract unit price as follows:

**A. Crack and Joint Cleaning and Sealing Filling (PCC Pavement).**

1. Per mile (kilometer) for pavement or shoulders on which the cracks and joints were cleaned and ~~sealed~~ filled.
2. Shoulders 4 feet (1.2 meters) or less in width are incidental to the price bid for Crack and Joint Cleaning and ~~Sealing~~ Filling (PCC Pavement).
3. Payment is full compensation for all labor, equipment, and materials (except for sealer, but including backer rod) for cleaning and ~~sealing~~ filling cracks and joints.

**B. Sealer Material (PCC Pavement).**

1. Per pound (kilogram). Price is predetermined.
2. Payment is full compensation for furnishing the sealer material only.

**C. Partial Depth Finish Patches.**

If not included otherwise as part of the contract work, payment for partial depth finish patches designated by the Engineer will be as extra work according to Article 1109.03, B.

**Section 2544****2544.04, A, 1, a.**

**Replace** the Article:

Miles (kilometers), calculated to the nearest 0.1 mile (0.1 km), of main line pavement, including shoulders 4 feet (1.2 m) wide or less, on which cracks were cleaned and filled. Calculations will be based on the center line distance of main line, two-lane pavement, corrected for main line pavement of more than two lanes, including climbing lanes.

**2544.04. A. 2, a.**

**Replace** the Article:

Miles (kilometers), calculated to the nearest 0.1 mile (0.1 km), of paved shoulders greater than 4 feet (1.2 m) in width, on which cracks were cleaned and filled. Calculations will be based on the center line distance of the adjacent main line pavement, a single measurement for shoulders on both sides of the pavement.

**Section 2547****2547.03, Construction.**

**Replace** the Article:

- A. The type of structure used, if any, is at the Contractor's discretion provided it complies with Article 1105.14. Unless indicated otherwise in the contract documents, the Contracting Authority will obtain approval for temporary stream crossings, constructed according to Standard Road Plan ~~RL-16~~ EW-401 or as shown in the contract documents, in the Section 404 permit. Should the Contractor elect to access the waterway using different methods than provided for in the contract documents, the Contractor shall be responsible to ~~Obtain~~ a Section 404 permit for temporary stream crossings ~~not to be constructed according to RL-16 or the contract documents~~ from the U.S. Army Corps of Engineers.
- B. ~~Ensure temporary structures do not restrict expected high flows or disrupt the movement of aquatic life native to the stream or water body. Expected high flows are those flows which the Contractor expects to experience during the period of time that the crossing is in place. Temporary structures are not to extend over 100 feet (30 m) into any swamp, bog, marsh, or similar area that is adjacent to the stream or water body.~~ Unless indicated otherwise in the contract documents, the Contracting Authority will obtain Section 408 approval from the U.S. Army Corps of Engineers and the local sponsor for work on a federal levee,

federal control structure, or access to a waterway within a federal levee and the use of a temporary stream crossing (Standard Road Plan EW-401). Should the Contractor elect to construct the project using different methods than provided for in the contract documents, the Contractor will be responsible to obtain Section 408 approval from the U.S. Army Corps of Engineers and the local sponsor and Section 404 approval from the U.S. Army Corps of Engineers.

- C. ~~Ensure pre-construction downstream flow conditions are maintained.~~ temporary structures: Maintain normal downstream flows, do not restrict expected high flows, do not disrupt movement of aquatic life native to the stream or water body, and minimize the potential for flooding. Expected high flows are flows which the Contractor expects to experience during the period of time the crossing is in place.
- D. Maintain temporary structures to prevent unnecessary erosion and other non-point sources of pollution.
- E. Completely remove temporary structures and return affected areas to preconstruction conditions within 30 calendar days of no longer being needed. Revetment that has been removed may be incorporated elsewhere in the project, provided it meets the specification for the intended final use. Remove all other fill material to an upland area. Reshape, and stabilize, and revegetate as appropriate all disturbed areas.

### Section 2548

#### 2548.02, B, 1.

**Replace** the Article:

Use asphalt emulsion Grade CSS-1 or CSS-1h, meeting requirements of Section 4140.

### Section 2549

#### 2549.01, C.

**Replace** the second sentence of the Article:

Includes construction of structural liners, protective liners, and ~~chimney-seal~~ infiltration barriers.

#### 2549.03, B, 2, Rubber Chimney Seal.

**Rename** the Article:

~~Rubber Chimney Seal~~ Infiltration Barrier.

#### 2549.04, D, Rubber Chimney Seal.

**Rename** and **Replace** the Article:

~~Rubber Chimney Seal~~ Infiltration Barrier.

Each ~~rubber chimney seal~~ infiltration barrier installed on an existing manhole will be counted.

#### 2549.05, D, Rubber Chimney Seal.

**Rename** and **Replace** the Article:

~~Rubber Chimney Seal~~ Infiltration Barrier.

1. Payment will be made at the contract unit price for each ~~chimney-seal~~ infiltration barrier.
2. Payment is full compensation for all necessary compression or expansion bands and extension sleeves as necessary to complete ~~chimney-seal~~ infiltration barrier.

### Section 2551

#### 2551.01, A.

**Replace** the first sentence:

Furnish and install crash cushions accepted as crashworthy devices by the FHWA and meeting the requirements of NCHRP Report 350, Test Level 3 criteria or AASHTO MASH criteria for any crash cushion evaluated after January 1, 2011.

**Section 2552****2552.02, A, 1, a, Suitable Backfill Material.**

**Replace** the Article:

Class II, Class III, Class IVA, or Class IVB as defined in Article 2552.02, B C.

**2552.02, A, 1, b, 1.**

**Replace** the Article:

Soils not classified as suitable backfill material, as defined in Article 2552.02, B C.

**2552.02, A, 1, c, Topsoil.**

**Replace** the Article:

Class V material. Apply Article 2552.02, G D.

**2552.02, B, Bedding Material.**

**Rename** and **Replace** the Article:

**Bedding (Class I) Material.**

**1. ~~Class I Material.~~**

**a. ~~Crushed stone complying with the following gradation:~~**

<b>Sieve</b>	<b>Percent Passing</b>
1 1/2 inch (37.5 mm)	100
1 inch (25 mm)	95 to 100
1/2 inch (12.5 mm)	25 to 60
No. 4 (4.75 mm)	0 to 10
No. 8 (2.36 mm)	0 to 5

**b. ~~The Engineer may allow the use of gravel or authorize a change in gradation subject to materials available locally at the time of construction~~**

**c. ~~The Engineer may authorize the use of crushed PCC for pipe sizes up to 12 inches (300 mm).~~**

**d. ~~Use aggregates having a percentage of wear, Grading A or B, not exceeding 50%, determined according to AASHTO T 96.~~**

Meet the requirements of Section 4118.

**2552.02, Materials.**

**Renumber** Articles C, D, E, and F and **Retitle** Articles C, D, and E:

**G D. Backfill Material (Other Areas).**

**D E. Topsoil (Class V) Material).**

**E F. Stabilization (Foundation) Materials.**

**F G. Special Pipe Embedment and Encasement Material.**

**Add** the Article:

**C. Backfill Material (Under Interstate and Primary Roadways).**

Meet the requirements of Section 4119.

**2552.03, E, Pipe Bedding and Backfill Material.**

**Renumber** and **Rename** Articles 3, 4, and 5:

**3 4. Haunch Support (Other Areas).**

**4 5. Primary and Secondary Backfill (Other Areas).**

**5 6. Final Trench Backfill (Other Areas).**

Add the Article:

**3. Backfill Under Interstate and Primary Roads.**

- a. Place in lifts no greater than 6 inches (150 mm) thick.
- b. Thoroughly tamp or vibrate each layer to insure compaction.
- c. Place backfill material after recording locations of connections and appurtenances or at the Engineer's direction.
- d. Terminate backfill material at subgrade elevation.

**Section 2553**

**2553.02, B, 3, Pipe Diameter.**

Replace the second sentence of the Article:

If diameter is not specified, use a minimum inside casing diameter of at least 4 inches (100 mm) greater than the largest outside diameter of the carrier pipe, including pipe bells.

**2553.02, D, 3.**

Replace the Article:

**Option 3:** CLSM according to Article 2552.02, E G, 3.

**2553.02, E, 2, c.**

Replace the Article:

**Controlled Low Strength Material (CLSM):** Apply Article 2552.02, E G, 3.

**Section 2554**

**2554.03, A, 7, Conflicts.**

Replace the Article:

**a. Horizontal Separation of Gravity Sewers from Water Mains.**

- 1) Separate gravity sewer mains from water mains by a horizontal distance of at least 10 feet (3 m) unless:
  - The top of a sewer main is at least 18 inches (450 mm) below the bottom of the water main, and
  - The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet (1 m) from the water main.
- 2) When it is impossible to obtain horizontal clearance of 3 feet (1 m) and a vertical clearance of 18 inches (450 mm) between sewers and water mains, the sewers shall be constructed of water main materials meeting the requirements of Article 4150.02, A. However, provide a linear separation of at least 2 feet (600 mm).

**b. Separation of Sewer Force Mains from Water Mains.**

Separate sewer force mains and water mains by a horizontal distance of at least ~~4 linear~~ 10 feet (1.2 3 m)- unless:

- Sewer force main is constructed of water main materials meeting a minimum pressure rating of 150 psi (1000 kPa) and the requirements of Article 4150.02, A, and
- Sewer force main is laid at least 4 linear feet (1.2 m) from water main.

**c. Separation of Sewer and Water Main Crossovers.**

- 1) Vertical separation of sanitary sewers crossing under any water main should be at least 18 inches (450 mm) when measured from the top of the sewer to the bottom of the water main. If physical conditions prohibit the separation, the sewer may be placed not closer than 6 inches (150 mm) below a water main or 18 inches (450 mm) above a water main. Maintain the maximum feasible separation distance in all cases.
- 2) Where the sewer crosses over or less than 18 inches (450 mm) below a water main, locate one full length of sewer pipe of water main material (or reinforced concrete pipe with rubber O-ring or profile gasket per Article 4149.03, A, for storm sewer) so both joints are as far as possible from the water main. The sewer and water pipes shall be adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet (3 m) of the point of crossing.

**d. Surface Water Crossings.**

Comply with Recommended Standards for Water Works, 2007 Edition (Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers).

**1) Above-water Crossings.**

Ensure pipe is adequately supported and anchored; protected from vandalism, damage, and freezing; and accessible for repair or replacement.

**2) Underwater Crossings.**

Provide minimum cover of 5 feet (1.6 m) over pipe unless otherwise specified in the contract documents. When crossing water courses greater than 15 feet (4.6 m) in width, provide the following.

- a) Pipe with flexible, restrained, or welded watertight joints,
- b) Valves at both ends of water crossings so the section can be isolated for testing or repair; ensure valves are easily accessible and not subject to flooding, and
- c) Permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples on each side of the valve closest to the supply source.

## **Division 26. Roadside Development.**

### **Section 2601**

#### **2601, Erosion Control.**

**Replace the Section:**

#### **Section 2601. Erosion Control**

##### **2601.01 DESCRIPTION.**

Perform the following erosion control measures on areas within and adjacent to the right-of-way according to the contract documents:

- Seeding and fertilizing,
- Stabilizing crop seeding and fertilizing,
- Overseeding and fertilizing,
- Mulching,
- Composting,
- Sodding,
- Special ditch control,
- Turf reinforcement mat,
- Slope protection,
- Outlet or channel scour protection (transition mat), and
- Mowing.

##### **2601.02 MATERIALS.**

- A. Furnish materials meeting the requirements of Section 4169.
- B. Apply materials at no less than the minimum rate specified in the contract documents. Apply seed for native grass, wildflower, and wetland grass seeding on a PLS basis, as computed by the Engineer.
- C. Additional compensation will not be allowed for materials in excess of that specified, unless directed by the Engineer.
- D. If, after application of fertilizer, it is determined by test that the fertilizer fails to comply with minimum requirements, furnish and apply additional fertilizer to comply with minimum requirements as defined in Article 4169.03.
- E. Perform work in a manner that provides the Engineer the opportunity to verify the quantity of material furnished and the rate of application. Divide project area into small natural areas that are to be constructed as identifiable units. Furnish a tally of the quantities of each material as it is used on each area. This may include the quantities below:
  - Weights (mass) from approved scales of truck loads of bulk materials,
  - Other scaled weights (mass),

- Counts of containers, bags, or bales, or estimates of partially used packages of materials, as approved by the Engineer.
- F.** Provide Engineer with the opportunity to verify quality and quantities in a manner that will allow continuous operation with minimum delays.
- G.** When handling inoculants and sticking agents, follow safety precautions as specified on the product label.

### **2601.03 PLACEMENT OF EROSION CONTROL.**

#### **A. Equipment.**

Use equipment meeting the requirements of Section 2001 and the following, except that other equipment which produces similar results will be considered for approval. Use methods and procedures consistent with equipment manufacturers' recommendations; however, do not operate ground driven equipment at speeds greater than 10 mph (15 km/h).

##### **1. Disk.**

When preparing a seedbed on ground having heavy vegetation, use a disk having cutaway blades. Provide for the addition of weight (mass) to obtain proper cutting depth.

##### **2. Slope Harrow.**

Use a rolling weight (mass) attached by heavy chain to a tractor. Use a chain of suitable length, with picks attached and a means of rotating the picks as the rolling weight (mass) is pulled in a direction parallel to the movement of the tractor.

##### **3. Field Tiller.**

Use equipment designed for preparation of seedbed to the degree specified.

##### **4. Rotary Tiller.**

Use equipment with rotary type blades designed for preparation of seedbed to the degree specified.

##### **5. Spike Tooth Harrow.**

Use equipment designed to:

- Provide adjustment of spike teeth to level the ground, or
- Be used as specified by the Engineer.

##### **6. Compaction Equipment.**

###### **a. Cultipacker.**

- 1) Use a pull type cultipacker with individual rollers or wheels. Cultipackers having sprocket type spacers between the wheels may be used. Ensure cultipacker produces a corrugated surface on area being compacted.
- 2) Use a cultipacker that operates separate from other operations. Attachment of cultipacker to the seeder or disk will not be permitted, except when the combined cultipacker seeder is manufactured to operate as a unit. Provide for the addition of weight (mass).

###### **b. Compaction Rollers.**

Apply Article 2001.05, A.

###### **c. Hand Tamping Equipment.**

Use base plate type hand tamping equipment adapted to the performance of the work. Obtain Engineer's approval.

###### **d. Expanded Mesh Roller.**

Use open grid type equipment or cultipacker type equipment modified by covering with expanded metal mesh.

##### **7. Hydraulic Seeder and Mulcher.**

- a. Use hydraulic seeding equipment with a pump rated at no less than 100 gallons (350 L) per minute. Inoculant, seed, and fertilizer may be applied in a single operation, unless stated otherwise in the contract documents. Apply hydraulic mulch as a separate operation. Ensure equipment has suitable working pressure and a nozzle adapted to the type of work.
- b. Ensure supply tanks have a means of mechanical agitation. Calibrate tanks and provide a calibration stick or other approved device to indicate the volume used or remaining in the tank.

**8. Gravity Seeders.****a. Ensure gravity seeders:**

- Provide agitation of the seed,
- Have an adjustable gate opening, and
- Uniformly distribute seed on the prepared seedbed.

- b.** Use a seed hopper equipped with baffle plates spaced no more than 2 feet (0.6 m) apart. Ensure baffle plates extend from the agitator shaft to within approximately 2 inches (50 mm) of the top of the seed hopper.
- c.** Wind guards will be required to facilitate seeding when moderate wind conditions exist and when required by Engineer. Place wind guards in front or in back (or both) of seed outlet and extend to near ground line.
- d.** This seeder may be used for application of fertilizer.

**9. Endgate Cyclone Seeders.**

Ensure endgate cyclone seeders are:

- Suitably mounted,
- Provide movement by mechanical means, and
- Drop through an adjustable flow regulator onto a rotating, power driven, horizontal disk or fan.

**10. Hand Cyclone Seeders.**

Use a seeder that drops seed through an adjustable flow regulator onto a rotating, hand driven, horizontal disk or fan.

**11. Native Grass Seed Drill.**

~~Use a drill designed to provide uniform distribution of native grass and wildflower seeds. Provide separate seed boxes to apply both small seeds as well as fluffy bearded seeds. If a no till attachment is specified, use an attachment manufactured by the same manufacturer as the drill. that:~~

- Is free of soil and seed when it arrives on the project,
- Accurately meters and uniformly mixes various seed types throughout drilling operation,
- Provides separate seed boxes to apply both small seeds and a large box with an aggressive picker wheel for continual mixing and applying fluffy bearded seed,
- Has disc furrow openers and packer assembly wheels that compact soil directly over drill rows,
- Contains a no till attachment manufactured by same manufacturer as the drill, and
- Has dimensions to ensure it maintains uniform soil contact over seeded area without bridging.

**12. Pneumatic Seeder.**

Use a pneumatic (air blower) system with enough power and hose to reach 300 feet (100 m).

**13. Aerial Equipment.**

When aerial application of seed and fertilizer is specified, use aerial equipment capable of providing a uniform distribution of seed and fertilizer on the specified area.

**14. Straw Mulching Machine.**

Use a type that will uniformly apply mulch material over desired area without excessive pulverization. Engineer may consider excessive pulverization as the general absence of straw longer than 6 inches (150 mm) after distribution.

**15. Mulch Anchoring Equipment.**

- a.** Use mulch anchoring equipment designed to anchor straw or hay mulch into soil by means of dull blades or disks. Use blades or disks that:
- Are flat,
  - Have a nominal minimum diameter of 20 inches (500 mm), and
  - Are spaced at approximately 8 inch (200 mm) intervals.
- b.** The blades may have cutaway edges. Pull mulch anchoring equipment using mechanical means. Use equipment that weighs approximately 1,000 pounds (has a mass of approximately 450 kg). When directed by the Engineer, increase the weight (mass) of the equipment by the addition of ballast.

**16. Mechanical Trencher.**

Use a machine designed for the specific purpose of constructing a trench for placement of check slots to depth specified.

**17. Mowers.**

Use rotary, flail, disk, or sickle type mowers that do not bunch or windrow mowed material.

**B. Seeding and Fertilizing.**

1. On various portions of the right-of-way, except the traveled portion of the roadbed:
  - Prepare the seedbed,
  - Furnish, sow, and cover the seed, and
  - Compact the seedbed.
2. Seed other areas as may be indicated in the contract documents or directed by the Engineer. The limits of areas to be seeded will be clearly marked before seedbed is prepared.
3. Do not disturb areas having a satisfactory growth of desirable grasses or legumes.
4. Sow seed only at times of the year when temperature, moisture, and climatic conditions will promote germination and plant growth. Normal seed application dates are according to Article 2601.03, C for each seed type. Perform seeding according to the following procedures:
  - a. **Seedbed Preparation.**
    - 1) Ensure area to be seeded is relatively smooth. Fill washes and gullies to conform to desired cross section. When such fills exceed 6 inches (150 mm), compact the material with a tractor wheel or other suitable field equipment. Coordinate preparation of ditches designated for special ditch control with the seedbed preparation.
    - 2) Thoroughly work areas accessible to field machinery to a depth of no less than 3 inches (75 mm). Use mechanical rotary tillage equipment to prepare seedbed on earth shoulders, urban or raised medians, rest areas, and islands. Hand prepare areas inaccessible to field machinery to a depth of not less than 2 inches (50 mm). Ensure entire width of shoulder and areas around headwalls, wingwalls, flumes, and other structures are prepared in the manner specified.
    - 3) ~~Where weed growth has developed extensively, weeds may be disked into the ground. If weed growth develops sufficiently to interfere with proper seedbed preparation, mow weeds and remove them from project (at no additional cost to Contracting Authority).~~ Where enough vegetative growth exists to sufficiently interfere with proper seedbed preparation, mow vegetative growth before seeding, at no additional cost to the Contracting Authority.
    - 4) Use crawler type or dual wheeled tractors to prepare seedbeds. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross section.
    - 5) Prior to rolling with cultipacker, harrow ridging in excess of 4 inches (100 mm) caused by operation of tillage equipment. Prior to permanent seeding, roll the area with no less than one pass of cultipacker.
    - 6) Remove ruts that develop during the sequence of operations before subsequent operations are performed.
    - 7) After completing seedbed preparation, pick up and remove debris according to Article 1104.08, including 3 inch (75 mm) diameter or larger stones, logs, stumps, cable, or other objectionable material that may interfere with seeding operation.
  - b. **Application of Fertilizer.**
    - 1) Spread over the areas at rate designated in Article 2601.03, C for each seed type, unless specified otherwise in the contract documents.
    - 2) Spread with a mechanical spreader which will secure a uniform application rate. Do not use truck mounted spreading equipment for bulk fertilizer. On areas accessible to field machinery, spread after preliminary preparation of seedbed, but prior to sowing of seed. Disk in fertilizer and roll the area prior to application of permanent seed. If roller cannot be operated satisfactorily, Engineer may permit substituting a harrow for the roller. Areas inaccessible to field machinery, spread fertilizer after preparation of seedbed and thoroughly rake into the soil.
    - 3) If using a hydraulic seeder, apply fertilizer in combination with seeding as specified in Article 2601.03, B, 4, d, 2. When the contract documents require two applications of fertilizer, perform second application during next permanent seeding period following initial seeding and fertilizer application.
  - c. **Preparation of Seed.**
    - 1) Except when a hydraulic seeder is used, thoroughly mix all seed specified for the contract prior to placing seed in seed hopper. ~~Ensure Engineer witnesses seed mixing for Native Grass, Wildflower, and Wetland Grass seeding mixtures. Provide 48 hour notice to Engineer prior to~~

~~mixing seed.~~ Seed mixing shall meet requirements of Materials I.M. 469.02 of this specification. Permanent rural, permanent urban, urban stabilizing, Native Grass, Wetland Grass, and Wildflower seeding mixtures shall be mixed off-site by a seed conditioner approved by the Iowa Crop Improvement Association or other state's Crop Improvement Association.

- 2) Inoculate legumes with a standard culture at the rate as specified by manufacturer of inoculant, according to Article 4169.04. Use a type of inoculant specified for each legume seed and approved by the Engineer.
  - 3) Do not allow inoculated seed to be exposed to direct sunlight for more than 30 minutes. Prior to use, reinoculate seed that is not sown within 8 hours after inoculation. Preinoculated seed with manufacturer's recommended protective coating may be used in lieu of seed with Contractor applied inoculant.
  - 4) When gravity or cyclone seeder is used for application of seed, inoculate legume seed according to manufacturer's recommended procedures before mixing with other grass seeds for sowing. If hydraulic seeder is used, inoculant, in quantities specified above, may be applied directly into supply tank with seed, water, and other material. Furnish and apply inoculant.
  - 5) Treat seed with a commercial sticking agent. Apply prior to application of inoculant, or as a mixture when the sticking agent is compatible with other materials, except with hydraulic equipment. A sticking agent optional if a liquid formulation of inoculant is used.
  - 6) Use mechanical mixing equipment to apply sticking agent and inoculant on seed quantities over 50 pounds (25 kg) per batch.
- d. Application of Seed.**
- 1) **Sowing, Covering, and Compaction.**
    - a) On areas accessible to field machinery, seed may be sown with:
      - A gravity, cyclone, or hydraulic seeder,
      - A native grass seed drill, or
      - As specified in the contract documents.
    - b) On areas inaccessible to field machinery, use of hand cyclone seeders may be used.
    - c) Sowing of seed shall be performed as a split rate application (no less than two passes).
    - d) Covering, compaction, rolling, dragging, or raking of seedbed will not be required provided the friable condition exists. For spring seeding (following fall seedbed preparation) after April 1, Contractor shall roll or harrow when, in the opinion of the Engineer, a friable condition does not exist. Cover stabilizing crop seeding and fertilizing with a light disking or other tillage equipment such as a rigid harrow, spring tooth harrow, or field cultivator.
    - e) Follow sowing of grasses and legumes with at least one complete rolling with cultipacker. Roll shoulders immediately to prevent loss of seed due to air currents caused by passing traffic. For stabilizing crop seeding and fertilizing, follow tillage by rolling area with a cultipacker. If cultipacker cannot be operated satisfactorily, Engineer may permit harrow to be substituted for cultipacker.
    - f) Where compaction equipment will not operate satisfactorily, lightly drag or rake in seeded area by hand. Roll seedbed with a cultipacker before and after seeding.
  - 2) **Seeding and Fertilizing with Hydraulic Seeder.**
    - a) A hydraulic seeder may be used when seedbed has been prepared according to Article 2601.03, B, 4, a. When a hydraulic seeder is used, apply seed or fertilizer, or both, at the rates specified in approximately 400 gallons (4000 L) of water slurry per acre (hectare).
    - b) Apply mixture within 1 hour after fertilizer and seed are placed in hydraulic seeder. Use continuous agitation. Seed remaining in the fertilizer solution for more than 1 hour will be unacceptable. Additional seed at the specified rate will be required.
  - 3) **Pneumatic Seeding.**

Includes furnishing and applying compost to a depth of 1 inch (25 mm) on designated disturbed areas. Apply compost using a pneumatic (air blower) system with sufficient hose to reach 300 feet (100 m). Driving on soil to apply compost will not be allowed. Incorporate fertilizer into full depth of compost material. Prepare seedbed according to Article 2601.03, C, 4, a, 1. Apply seed within top 1/4 inch (6 mm) of compost material.

## C. Types of Seeding.

### 1. Stabilizing Crop Seeding and Fertilizing (Rural).

#### a. Preparation and Application.

- 1) Prepare seedbed according to Article 2601.03, B, 4, a.
- 2) Prepare seed according to Article 2601.03, B, 4, c.

- 3) Apply seed according to Article 2601.03, B, 4, d.
  - 4) For stockpile stabilization seeding, seedbed preparation will not be required for areas not accessible to field equipment.
- b. Seed Mixture.**  
Unless otherwise specified in the contract documents, use rates and schedule shown in Table 2601.03-1.

**Table 2601.03-1: Rural Stabilizing Crop Seeding Rates and Schedule**

<b>March 1 through October 31</b>	
Oat	50 lbs. per acre (56 69 kg/ha)
Grain rye	50 lbs. per acre (56 69 kg/ha)
Canada wildrye ( <i>Elymus canadensis</i> )	5 lbs PLS. per acre (6 8 kg/ha)
<b>November 1 through February 28 (or 29)</b>	
Oat	62 lbs. per acre (56 kg/ha)
Grain rye	62 lbs. per acre (56 kg/ha)
Canada wildrye ( <i>Elymus canadensis</i> )	7 lbs. PLS. per acre (6 kg/ha)
For stabilizing crop only, Canada wildrye ( <i>Elymus canadensis</i> ) seed will not be required to be certified as Source Identified Class (Yellow Tag) Source G0-Iowa.	
Canada wildrye ( <i>Elymus canadensis</i> ) seed shall be debarbed or equal to facilitate application of seed.	

- c. Fertilizing.**
- 1) Apply to seeded areas at the rate of 250 pounds per acre (280 kg/ha) of 13-13-13 (or equivalent) unless specified otherwise in the contract documents.
  - 2) Apply provisions of Article 2601.03, B, 4, b.
- d. Application Dates.**  
Refer to Table 2601.03-1 for normal seed application dates.

## **2. Stabilizing Crop Seeding and Fertilizing (Urban).**

### **a. Preparation and Application.**

- 1) Use a rotary tiller for preparation of seedbed according to Article 2601.03, B, 4, a. Prior to application of seed, ensure seedbed is firm, smooth, and free of material 1.5 inches (40 mm) in diameter or greater including clods, rocks, and other debris. Roll seedbed before and after application of seed. For rolling, use either open grid type equipment or cultipacker type equipment modified by covering with expanded metal mesh.
- 2) Prepare seed according to Article 2601.03, B, 4, c.
- 3) Apply seed according to Article 2601.03, B, 4, d.
- 4) Prepare, roll, seed, and fertilize areas inaccessible to field equipment by hand or using hand operated equipment, including lawn type, hand cyclone, or gravity equipment.

### **b. Seed Mixture.**

Unless specified otherwise in the contract documents, use seeding rates shown in Table 2601.03-2 for urban areas.

**Table 2601.03-2: Urban Stabilizing Crop Seeding Rates**

Bluegrass, Kentucky	122 lbs. per acre (62 137 kg/ha)
Ryegrass, Perennial (fineleaf variety)	35 lbs. per acre (51 39 kg/ha)
Fescue, Creeping Red	18 lbs. per acre (6 20 kg/ha)

- c. Fertilizing.**
- 1) **Apply prior to preparing seedbed.**
  - 2) Apply to seeded areas at the rate of 300 pounds per acre (336 kg/ha) of 6-24-24 (or equivalent) unless specified otherwise in the contract documents.
  - 3) Apply provisions of Article 2601.03, B, 4, b.
- d. Application Dates.**  
Normal seed application dates are March 1 through May 31, and August 10 through September 30.

## **3. Rural Seeding.**

### **a. Preparation and Application.**

- 1) Prepare seedbed according to Article 2601.03, B, 4, a.
- 2) Prepare seed according to Article 2601.03, B, 4, c.
- 3) Apply seed according to Article 2601.03, B, 4, d.

**b. Seed Mixture.**

Use seeding rates in Table 2601.03-3 for permanent seeding of rural areas, unless otherwise specified in the contract documents:

**Table 2601.03-3: Permanent Seed Rates, Rural Areas**

Fescue, Tall (Fawn)	100 lbs. per acre (112 kg/ha)
Ryegrass, Perennial (Linn)	75 lbs. per acre (84 kg/ha)
Bluegrass, Kentucky	20 lbs. per acre (22 kg/ha)

**c. Fertilizing.**

- 1) Spread over the areas at the rate designated. Unless otherwise specified in the contract documents, use a rate of 300 pounds per acre (336 kg/ha) of 6-24-24 (or equivalent).
- 2) Apply provisions of Article 2601.03, B, 4, b.

**d. Application Dates.**

Normal permanent seed application dates are March 1 through May 31, and August 10 through September 30.

**4. Urban Seeding.**

**a. Preparation and Application.**

- 1) Use rotary tiller for preparation of seedbed according to Article 2601.03, B, 4, a. Prior to application of seed, ensure seedbed is firm, smooth, and free of material 1.5 inches (40 mm) in diameter or greater including clods, rocks, and other debris. Roll seedbed before and after application of seed. For rolling, use either open grid type equipment or cultipacker type equipment modified by covering with expanded metal mesh.
- 2) Prepare seed according to Article 2601.03, B, 4, c.
- 3) Apply seed according to Article 2601.03, B, 4, d.
- 4) Prepare, roll, seed, and fertilize areas inaccessible to field equipment by hand or using hand operated equipment, including lawn type, hand cyclone, or gravity equipment. Obtain Engineer's approval for such equipment.

**b. Seed Mixture.**

Use seeding rates in Table 2601.03-4 for permanent seeding of urban areas, including areas previously maintained as a lawn.

**Table 2601.03-4: Permanent Seed Rates, Urban Areas**

Bluegrass, Kentucky	122 lbs. per acre (62 137 kg/ha)
Ryegrass, Perennial (fineleaf variety)	35 lbs. per acre (51 39 kg/ha)
Fescue, Creeping Red	18 lbs. per acre (6 20 kg/ha)

**c. Fertilizing.**

- 1) Apply prior to preparing the seedbed.
- 2) Spread over the areas at a rate of 300 pounds per acre (336 kg/ha) of 6-24-24 (or equivalent).
- 3) Apply the provisions of Article 2601.03, B, 4, b.

**d. Application Dates.**

Normal permanent seed application dates are March 1 through May 31, and August 10 through September 30.

**5. Native Grass Seeding.**

**a. Preparation and Application.**

- 1) In areas without existing stabilized crop seeding residue, prepare seedbed according to Article 2601.03, B, 4, a. Seed areas accessible to field equipment with native grass seed drill, gravity, or broadcast equipment. Cultipack as specified in Article 2601.03, B, 4, d. Broadcast seed other areas and follow with a light dragging or hand raking.
- 2) In areas with existing stabilized crop residue, apply seed with a native grass seed drill with a no till attachment. Seedbed preparation and cultipacking will not be required. Seedbed preparation is required for areas with rills and gullies.

- 3) Prepare seed according to Article 2601.03, B, 4, c.
  - 4) Calibrate native grass seed drill to specified seeding rate for the project prior to operation at the project.
  - 5) Plant seed at a maximum 1/8 inch (3 mm) depth. Do not perform seeding when wet soil conditions would cause seed to be placed deeper than specified.
  - 6) Fill seed boxes loosely without packing seed to allow agitator wheels to run freely and seed flows freely through drill.
  - 7) Set no-till coulters to penetrate between 1/4 and 1/2 inch (6 and 13 mm) below soil surface.
  - 8) Operate drill so the drive wheel maintains ground contact. Perform two passes with drill, with second pass being offset from first pass.
  - 9) Operate tractor between 3 and 5 mph (5 and 8 kmph) to prevent drill from bouncing.
  - 10) Remove seed remaining in drill at the end of each day. At the completion of seeding, remove remaining seed from drill by vacuum or other means. Hand broadcast remaining seed on project.
- b. Seed Mixture.**  
Use seeding rates in Table 2601.03-5 for areas designated for native grass seeding, unless specified otherwise in the contract documents.

**Table 2601.03-5: Native Grass Seed Rates**

Species (Scientific Name)	Application Rate (PLS)
Furnish seed certified as Source Identified Class (Yellow Tag) Source G0-Iowa. Oats are excluded from this requirement.	
*Big bluestem ( <i>Andropogon gerardii</i> )	6 lbs. per acre (7 kg/ha)
*Canada wildrye ( <i>Elymus canadensis</i> )	2 lbs. per acre (2.2 kg/ha)
*Indiangrass ( <i>Sorghastrum nutans</i> )	6 lbs. per acre (7 kg/ha)
*Little bluestem ( <i>Schizachyrium scoparium</i> )	6 lbs. per acre (7 kg/ha)
Blackeyed susan ( <i>Rudbeckia hirta</i> )	4 oz. per acre (280 g/ha)
Blue vervain ( <i>Verbena hastata</i> )	1/2 oz. per acre (35 g/ha)
Gray-headed coneflower ( <i>Ratibida pinnata</i> )	3 oz. per acre (210 g/ha)
Ironweed ( <i>Vernonia fasciculata</i> )	3 oz. per acre (210 g/ha)
New England aster ( <i>Symphyotrichum novae-angliae</i> )	2 oz. per acre (140 g/ha)
Pale purple coneflower ( <i>Echinacea pallida</i> )	6 oz. per acre (420 g/ha)
Partridge pea ( <i>Chamaecrista fasciculata</i> )	4 lbs. per acre (4.5 kg/ha)
Side-oats grama ( <i>Bouteloua curtipendula</i> )	4 lbs. per acre (4.5 kg/ha)
Switchgrass ( <i>Panicum virgatum</i> )	1 lbs. per acre (1.1 kg/ha)
Oats ( <i>Avena sativa</i> )	32 lbs. per acre (36 kg/ha)
*Note: Canada wildrye, Big bluestem, Indiangrass, and Little bluestem shall be debarbed or equal to facilitate the application.	

- c. Fertilizing.**  
Not required unless specified otherwise in the contract documents.
- d. Application Dates.**  
Normal seed application dates are April 1 through June 30 May 31 and November 1 until ground conditions are unsuitable for seeding due to moisture or frost.

## 6. Wetland Seeding.

### a. Preparation and Application.

- 1) In areas without existing stabilized crop seeding residue, prepare seedbed according to Article 2601.03, B, 4, a. Seed areas accessible to field equipment with a native grass seed drill, gravity, or broadcast equipment. Cultipack as specified in Article 2601.03, B, 4, d. Broadcast seed other areas and follow with a light dragging or hand raking.
- 2) In areas with existing stabilized crop residue, apply seed with a native grass seed drill with a no till attachment. Seedbed preparation and cultipacking will not be required. Seedbed preparation is required for areas with rills and gullies.

3) Prepare seed according to Article 2601.03, B, 4, c.

**b. Seed Mixture.**

Use the seeding rates in Table 2601.03-6 for areas designated for wetland grass seeding, unless specified otherwise in the contract documents.

**Table 2601.03-6: Wetland Grass Seed Rates**

Common Name	Scientific Name	PLS (per ac)	PLS (per ha)
Blue vervain	Verbena hastata	1 oz.	70 g
Boneset	Eupatorium perfoliatum	1 oz.	70 g
Nodding bur marigold	Bidens cernua	8 oz.	560 g
Swamp milkweed	Asclepias incarnata	1 lb.	1.1 kg
Sneezeweed	Helenium autumnale	2 oz.	140 g
Water plantain	Alisma plantago-aquatica	4 oz.	280 g
Arrowhead	Sagittaria latifolia	4 oz.	280 g
New England aster	Symphyotrichum novae-angliae	2 oz.	140 g
Big Bluestem	Andropogon gerardii	1 lb.	1.1 kg
Switchgrass	Panicum virgatum	8 oz.	560 g
Prairie cordgrass	Spartina pectinata	1 lb.	1.1 kg
Virginia wild-rye	Elymus virginicus	5 lbs.	5.6 kg
Bluejoint grass	Calamagrostis	1 oz.	70 g
Rice cutgrass	Leersia oryzoides	4 oz.	280 g
Dark Green bulrush	Scirpus atrovirens	1 oz.	70 g
Fox sedge	Carex vulpinoidea	4 oz.	280 g
Softstem bulrush	Schoenoplectus tabernaemontani	8 oz.	560 g
Spike rush	Eleocharis palustris	4 oz.	280 g
Porcupine sedge	Carex hystericina	8 oz.	560 g
Broom sedge	Carex scoparia	2 oz.	140 g
Tussock sedge	Carex stricta	2 oz.	140 g

**c. Fertilizing.**

Not required unless specified otherwise in the contract documents.

**d. Application Dates.**

Normal seed application dates are April 1 through June 30.

**7. Wildflower Seeding.**

**a. Preparation and Application.**

- 1) Uniformly apply seed to areas with the seedbed prepared as in Article 2601.03, B, 4, a.
- 2) Seed areas accessible to field equipment using a native grass seed drill at an approximate depth of 1/8 inch (3 mm), or using gravity or broadcast equipment. Cultipack as specified in Article 2601.03, B, 4, d. Broadcast seed other areas and follow with a light dragging or hand raking.
- 3) In areas with existing stabilized crop seeding residue, apply seed with a native grass seed drill with a no till attachment. Seedbed preparation and cultipacking will not be required.

**b. Seed Mixture.**

As specified in the contract documents.

**c Fertilizing.**

Not required unless specified otherwise in the contract documents.

**d. Application Dates.**

Normal seed application dates are April 15 through June 30.

**8. Special Seed.****a. Preparation and Application.**

- 1) Apply at the rate specified in the contract documents or as directed by the Engineer as a separate operation either immediately before or immediately after sowing the regular grass mixture.
- 2) No additional work other than sowing of the seed will be required unless specified otherwise in the contract documents.
- 3) On limited areas, this seed may be applied by hand cyclone seeders.

**b. Seed Mixture.**

- 1) As specified in the contract documents.
- 2) When not shown in the contract documents but directed by the Engineer, a special seed or seed mixture may be required in addition to the regular seed mixture.

**c. Fertilizing.**

As specified in the contract documents.

**d. Application Dates.**

As specified in the contract documents.

**D. Overseeding and Fertilizing.**

1. Seedbed preparation will not be required, provided overseeding is applied when ground is friable from frost action after February 1 and before April 1 or as directed by the Engineer.
2. When, in the opinion of the Engineer, a friable soil condition does not exist, roll with a cultipacker or harrow.
3. Areas with rills or gullies require seedbed preparation according to Article 2601.03, B, 4, a.
4. Apply fertilizer according to Article 2601.03, B, 4, b.
5. Prepare seed according to Article 2601.03, B, 4, c.
6. Apply seed according to Article 2601.03, B, 4, d unless specified otherwise in the contract documents.
7. Overseeding will not be allowed on more than 1 inch (25 mm) of snow cover.

**E. Mulching.**

Mulch seeding areas unless designated otherwise in the contract documents. For disturbed areas that are mulched only, scarify area to a 3 inch (75 mm) depth prior to mulching.

**1. Time of Mulching.**

Apply to areas requiring mulch as soon as seed is sown and final rolling completed.

**2. Application of Mulch.****a. Straw Mulch.**

- 1) Distribute evenly and uniformly and anchor it into the soil. Use an application rate for reasonably dry material of approximately 1.5 tons per acre (3.5 Mg/ha) of dry cereal straw, native grass straw, or other approved material, depending on the type of material furnished.
- 2) In accessible mulched areas, anchor mulch into the soil using mulch anchoring equipment with a minimum of two passes. Operate equipment along the contour. Use crawler type or dual wheel tractors for mulching operation. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross section.

**b. Hydraulic Mulches.**

- 1) Apply at no less than 3000 pounds per acre (3.5 Mg/ha) using standard hydraulic mulching equipment, unless specified otherwise in the contract documents.

- 2) If using with hydraulic seeding, apply as a separate operation.

#### **F. Composting.**

Compost may be used as a top dress application or as an incorporated soil amendment.

1. Top dress applications may be used for urban seeding or on soils that are highly erosive or sloped soils to prevent surface or rill erosion and to provide organic material and nutrients needed for vegetative establishment. Ensure areas top dressed with compost have little or no drainage onto them.
2. In highly erosive soils or sloped embankments with drainage onto the area, incorporate compost by mixing it into the top soil a minimum of 2 inches (50 mm) to prevent the compost from washing off the slope.

#### **G. Sodding.**

1. Refer to the contract documents for areas to be sodded. Engineer may designate other areas for sodding.
2. Prior to shaping the sodbed, Engineer will define upon the ground the limits of areas to be sodded, and indicate the center lines of waterways. Cover designated areas with sod meeting requirements of Article 4169.06.

3. Closely place and properly fit sod against structures and adjacent sod according to the following provisions:

##### **a. Preparation of Sodbed.**

- 1) Shape and prepare surfaces to be sodded. Ensure areas are firm and even surfaces. Ensure they are free of material 1.5 inches (40 mm) in diameter or greater including clods, rocks, and other debris. Ensure ditch channels, slopes, and flumes to be sodded have a typical cross section as shown in the contract documents.
- 2) Construct ditch channel to secure a relatively level, flat bottom ditch cross section with a minimum depth of 6 inches (150 mm), measured from the finished sodbed ground line at the edge of the ditch. Scarifying prior to shaping may be necessary to assure the minimum depth. A minimum sod ditch overall width of 7.5 feet (2.2 m) (sloping sides) will be required.
- 3) Use a soil compaction roller complying with Article 2601.03, A, for compaction and reshaping of ditches. Limit layers of fill materials to no more than 8 inches (200 mm) in depth.
- 4) After the surface of the layer has been smoothed and before material for the next layer is deposited upon it, compact the layer:
  - With no less than one pass of a soil compaction roller per inch (25 mm) of loose thickness of the layer, and
  - Until the roller is supported entirely on its tamping feet.
- 5) The roller will be considered entirely supported on its tamping feet when the tamping feet penetrate no more than 3 inches (75 mm) into an 8 inch (200 mm) layer being compacted. A single section roller may be necessary for this operation in some locations.
- 6) Extend compacted area approximately 6 inches to 12 inches (150 mm to 300 mm) beyond the width of the ditch.
- 7) After compaction, shape the ditch.

##### **b. Fertilizer for Sod.**

- 1) Two applications are required (initial and prior to final acceptance). After sodbed preparation and prior to placing sod, fertilize the area to be sodded and the adjacent disturbed area at a rate of 10 pounds per 1000 square feet (5 kg per 100 m<sup>2</sup>). Use a commercial fertilizer specified for the project.
- 2) Place the final application of fertilizer at a rate of 10 pounds per 1000 square feet (5 kg per 100 m<sup>2</sup>) within 5 calendar days of the end of the 30 calendar day watering period and prior to final acceptance of the project. Place the final application when the grass is dry and with a dry form of fertilizer.
- 3) For both applications, if the type of fertilizer is not specified, apply 13-13-13 (or equivalent). Spread with a mechanical spreader which will secure a uniform rate of application. Manipulation or mixing with the soil, other than that incidental to Article 2601.03, G, 3, d, will not be required.

##### **c. Placing Sod.**

- 1) Do not place between May 31 and September 1, or on frozen ground unless otherwise directed by the Engineer.

- 2) Place in rows or strips. On slopes, place strips transverse to the flow of water over the area. On sides and bottoms of ditches and channels, place strips at right angles to center line of channel. Place tightly against each other so that no open joints are apparent.
  - 3) Stagger joints at the ends of sod strips at least 1 foot (0.3 m) on adjacent rows or strips of sod. Cut sod to be placed in road ditch channels, intercepting ditches, or sod flumes where the total sodded width is less than 7.5 feet (2.2 m) into strips having lengths equal to the width of the sodded area. At the top of slope or at the edge of a channel, lay sod so water from adjacent areas will have free flow onto the sodded area. In road ditch channels and flumes, begin sodding at the outlet or lower end and progress upward. On slopes, begin sodding at the bottom and progress upward. If necessary to protect sod already laid, furnish (without extra compensation) ladders or planks for workers to use.
  - 4) The Engineer may order sod flumes, slopes, and ditch channels to be staked to minimize erosion loss before establishment. Stake sod as shown in the contract documents and as required by the Engineer.
- d. Finishing Sod.**
- 1) Firm the soil along the edge of the sodded area. Properly shape and smooth the adjacent disturbed area to allow surface water to flow into the sod ditch. Excessive soil placed over the edge of the sod will not be permitted.
  - 2) Prepare and seed the seedbed for all rural disturbed areas adjacent to the sod. Rake the seed in. Seed the disturbed area with the following seed mixture at the rate of 2 pounds per 1000 square feet (1 kg per 100 m<sup>2</sup>):
    - Fescue, Fawn 80%
    - Ryegrass, Perennial 20%
  - 3) For urban projects adjacent to sod, use seed mixture specified for the project. Mulch disturbed area with grass, hay, or straw at the rate of 70 pounds per 1000 square feet (35 kg per 100 m<sup>2</sup>).
  - 4) After sodding and seeding, water sod, sodbed, and disturbed areas according to Article 2601.03, G, 3, e.
  - 5) When sod ditches are constructed after October 1, overseed grasses the following spring, between March 1 and April 1, when weather and soil conditions are favorable.
  - 6) When initial watering of the sod does not secure adequate bond between the sod and soil, the Engineer may require rolling. If sod is allowed to be placed between May 31 and August 10, and it is not to be staked, roll the sod using equipment approved by the Engineer. Remove from the project sod rejected from sod ditches. Remove from the site any other material not otherwise incorporated into the work.
  - 7) In urban areas, islands, and rest areas, roll the sod prior to or following the initial watering using a hand operated, lawn type roller approved by the Engineer.
- e. Watering Sod.**
- 1) Provide watering equipment and an approved water supply before beginning any sodding operation. Six waterings will be required. Allow no more than 1 hour to elapse between laying and initial watering. Perform second, third, and fourth waterings at 4 calendar day intervals, and fifth and sixth waterings at weekly intervals. Perform waterings unless notified by the Engineer in writing at least 1 calendar day prior to the day the watering is to occur. A price adjustment will be assessed at a rate of \$200.00 per day for each calendar day that the Contractor fails to complete the watering from the day watering is to commence.
  - 2) Ensure waterings are sufficient to thoroughly saturate sod, sodbed, and adjacent disturbed areas to a depth of approximately 4 inches (100 mm).
  - 3) Each watering may require a maximum of 100 gallons of water per square (40 L of water per square meter). Apply water as a spray or dispersion to prevent damage to sod. Complete each watering within a 4 hour period. More than one application for each watering may be necessary to provide adequate saturation without runoff.
- f. Urban, Island, and Safety Rest Area Sodding.**
- 1) Prepare areas to be sodded, except ditch channels, according to Article 2601.03, C, 4, a.
  - 2) During the total watering period, mow sod once to a 3 inch (75 mm) height approximately 3 weeks after placement.

**H. Special Ditch Control, Turf Reinforcement Mat, Slope Protection, and Outlet or Channel Scour Protection (Transition Mat).**

Use material meeting the requirements of Article 4169.10. Engineer will designate areas for each type of work.

**1. Preparation of Area to be Treated with Special Ditch Control, Turf Reinforcement Mat, Slope Protection, and Outlet or Channel Scour Protection (Transition Mat).**

- a. Shape ditch channel in the same manner as preparing a ditch for sod as provided in Article 2601.03, G, 3, a.
- b. Apply provisions of Article 2601.03, B, 4, a.
- c. Remove material 1.5 inches (40 mm) in diameter or greater, including clods, rocks, and other debris, which may prevent contact of the specified material with the seedbed.
- d. Coordinate preparation and placement of the specified material with the seedbed preparation, seeding (including sticking agent and inoculant), fertilizing, and mulching of the adjacent area of right-of-way.

**2. Special Ditch Control.**

**a. Seeding.**

- 1) Prepare seed according to the provisions of Article 2601.03 B, 4, c. Sow seed prior to placement of special ditch control material according to Article 2601.03 B, 4, d.
- 2) Seed ditches and depressed medians using the following seeding rates in Tables 2601.03-7 and 2601.03-8:

**Table 2601.03-7: Ditches - Outside Shoulder Adjacent to Native Grass Seedings**

Oats	25 lbs/Acre (28 kg/ha)
Grain Rye	25 lbs/Acre (28 kg/ha)
Switchgrass ( <i>Panicum virgatum</i> )	3 lbs PLS/Acre (3.4 kg/ha)
Side-oats grama ( <i>Bouteloua curtipendula</i> )	4 lbs PLS/Acre (4.5 kg/ha)
Canada wildrye ( <i>Elymus canadensis</i> )	9 lbs PLS/Acre (10 kg/ha)
Virginia wildrye ( <i>Elymus virginicus</i> )	5 lbs PLS/Acre (5.6 kg /ha)
Partridge pea ( <i>Chamaecrista fasciculata</i> )	4 lbs PLS/Acre (4.5 kg/ha)
Note: Canada wildrye shall be debarbed or equal to facilitate the application.	

**Table 2601.03-8: Medians and Ditches - Outside Shoulder Adjacent to Rural Seedings**

Fescue, Tall (Fawn)	100 lbs. per acre (112 kg/ha)
Ryegrass, Perennial (Linn)	75 lbs. per acre (84 kg/ha)
Bluegrass, Kentucky	20 lbs. per acre (6 kg/ha)

**b. Fertilizing.**

- 1) After the area is prepared and prior to laying the special ditch control material, fertilize at the rate specified. Apply provisions of Article 2601.03, B, 4, b. Spread with a mechanical spreader to secure a uniform rate of application. Manipulation or mixing with the soil other than that incidental to Article 2601.03, H, 7, will not be required.
- 2) If the type of fertilizer is not specified for the project, apply 300 pounds per acre (336 kg/ha) of 6-24-24 (or equivalent) to Medians and Ditches - Outside Shoulder Adjacent to Rural Seedings (Table 2601.03-8).
- 3) No fertilizer will be required for Ditches - Outside Shoulder Adjacent to Native Grass Seedings.

**c. Application.**

- 1) Space check slots on ditch channels so one check slot occurs within each 50 foot (15 m) increment on slopes of more than 4%.
- 2) Apply special ditch control (wood excelsior mat) without tension and in the direction of the flow of water. Where more than one strip is required, lap the lap joint no less than 3 inches (75 mm). Bury anchor slot on top edge of special ditch control (wood excelsior mat) from 6 inches to 12 inches (150 mm to 300 mm), as designated by Engineer.
- 3) On junction slots, bury the upslope end of each strip of wood excelsior mat 6 inches (150 mm). Firmly tamp the soil. Overlap the ends of the special ditch control (wood excelsior mat) at least 12 inches (300 mm) and staple, with the upgrade section on top.
- 4) Staple terminal end at bottom of special ditch control (wood excelsior mat).
- 5) Use staples meeting requirements of Article 4169.10, A. Space staples as shown in the contract documents.

**3. Turf Reinforcement Mat (TRM).**

**a. Seeding.**

- 1) Prepare seed according to provisions of 2601.03 B, 4, c. Sow after TRM and soil fill have been placed and prior to laying the special ditch control (wood excelsior mat) according to Article 2601.03 B, 4, d.
- 2) Apply in ditches and depressed medians using rates in Tables 2601.03-7 and 2601.03-8.

**b. Fertilizing.**

- 1) After TRM and soil fill have been placed and prior to laying special ditch control (wood excelsior mat), apply at the rate specified. Apply provisions of Article 2601.03, B, 4, b. Spread with a mechanical spreader to secure a uniform rate of application. Manipulation or mixing with the soil other than that incidental to Article 2601.03, H, 7, will not be required.
- 2) If the type of fertilizer is not specified for the project, apply 300 pounds per acre (336 kg/ha) of 6-24-24 (or equivalent) to Medians and Ditches - Outside Shoulder Adjacent to Rural Seedings (Table 2601.03-8).
- 3) No fertilizer will be required for Ditches - Outside Shoulder Adjacent to Native Grass Seedings (Table 2601.03-7).

**c. Application.**

Place type specified on channel or slope after shaping. Apply according to ~~manufacturer's instructions~~ and the contract documents. Furnish and apply a minimum of 1 inch (25 mm) of soil suitable for the establishment of vegetation on the TRM. Furnish and apply seed and fertilizer. Furnish and apply special ditch control (wood excelsior mat) one soil fill.

**4. Special Ditch Control over Sod.**

When shown in the contract documents, place plastic netting or other approved material over sod and staple it in place. Space staples 3 feet (1 m) apart in the row. Space rows no more than 2 feet (0.6 m) apart. Place staples alternately to adjacent rows. No junction slots or check slots are required. Anchor slots and terminal ends will be required.

**5. Slope Protection.****a. Seeding.**

- 1) Prepare seed according to Article 2601.03, B, 4, c. Sow prior to placement of slope protection according to Article 2601.03, B, 4, d.
- 2) Use mixture specified.

**b. Fertilizing.**

For slope protection, use fertilizer specified. Apply provisions of Article 2601.03, B, 4, b.

**c. Application on Backslopes.**

- 1) Where erosive gullies or rills have developed in backslope, fill with soil and compact prior to placement of mat.
- 2) Apply slope protection without tension in a perpendicular direction on backslopes. Where more than one strip is required, lap the lap joint no less than 3 inches (75 mm).
- 3) Bury the slope protection in an anchor slot on the top edge of the backslope from 6 inches to 12 inches (150 mm to 300 mm), as designated by the Engineer.
- 4) On junction slots, bury the upslope end of each strip of slope protection 6 inches (150 mm). Firmly tamp soil. Overlap ends of slope protection at least 12 inches (300 mm) and staple, with upgrade section on top.
- 5) Staple terminal end at bottom of slope protection.
- 6) Use staples meeting requirements of Article 4169.10, A. Space staples as shown in the contract documents.

**d. Application on Foreslopes.**

- 1) If erosive gullies or rills have developed adjacent to shoulder material, fill with suitable soil and compact prior to placement of slope protection.
- 2) Apply slope protection without tension parallel to the roadway on foreslopes. Where more than one strip is required, butt strips together and staple 3 inches (75 mm) from each edge.
- 3) Install staples 3 inches (75 mm) from upside terminal and downside terminal.
- 4) Use staples meeting the requirements of Article 4169.10, A. Space remaining staples as shown in the contract documents.

**6. Outlet or Channel Scour Protection (Transition Mat) (TM).****a. Seeding**

- 1) Prepare seed according to the provisions of 2601.03 B, 4, c. Sow prior to placement of TRM and TM according to Article 2601.03 B, 4, d.
- 2) Seed outlets or channels using rates in Tables 2601.03-7 and 2601.03-8.

**b. Fertilizing**

- 1) Prior to laying the TRM and TM, apply fertilize to the area at the rate specified. Apply provisions of Article 2601.03, B, 4, b. Spread with a mechanical spreader to secure a uniform rate of

application. Manipulation or mixing with the soil other than that incidental to Article 2601.03, H, 7, will not be required.

- 2) If type of fertilizer is not specified, apply 300 pounds per acre (336 kg/ha) of 6-24-24 (or equivalent) to Medians and Outlets/Channels - Outside Shoulder Adjacent to Rural Seedings (Table 2601.03-8).
- 3) No fertilizer will be required for Outlets/Channels – Outside Shoulder Adjacent to Native Grass Seedings (Table 2601.03-7).

**c. Application**

- 1) Place TM in channels or outlets at locations specified in the contract document.
- 2) Prior to the placement of the TM, place TRM - Type 2 according to Article 2601.03, H, 3 to extend the entire length and width of the TM. No special ditch control (wood excelsior mat) or soil fill is required under the TM. Seed is placed under the TRM.
- 3) Place TM panels in such a manner as to produce a planar surface.
- 4) Place each TM panel longitudinally with the flow. Overlap panels upstream over downstream, and/or upslope over downslope.
- 5) Secure each TM panel to the soil with bullet anchors driven 30 inches (760 mm) into the ground. Anchors should be driven through both panels at the edges with overlapping panels. A minimum of eight anchors per panel is required.

**7. Finishing Adjacent to Special Ditch Control, Turf Reinforcement Mat, Slope Protection Areas, and Outlet or Channel Scour Protection (Transition Mat).**

For adjacent areas disturbed, uniformly shape, fertilize, seed, and rake in the seed in the same manner required for disturbed areas adjacent to sod ditches, except use the seed specified in Article 2601.03, H. Complete this work during the normal permanent seeding period or by the date specified to complete seeding.

**8. Watering of Special Ditch Control, Turf Reinforcement Mat, Slope Protection, and Outlet or Channel Scour Protection (Transition Mat).**

- a. Provide watering equipment and an approved water supply before starting special ditch control, TRM, slope protection, or TM work. Water the area no later than the day following placement of the materials. If Contractor fails to water by second day following placement a price adjustment will be assessed at a rate of \$200.00 per calendar day until the watering has been completed.
- b. Apply three additional waterings at intervals of 5 to 8 calendar days. Perform waterings unless notified by Engineer in writing at least 1 calendar day prior to the day watering is to occur. If Contractor fails to complete watering before the 8th calendar day has elapsed, a price, adjustment will be assessed at a rate of \$200.00 per calendar day, beginning on the 9th day, until the watering is completed.
- c. Ensure waterings are sufficient to thoroughly saturate seedbed to a depth of approximately 2 inches (50 mm).
- d. Each watering may require a maximum of 50 gallons of water per square (20 L of water per square meter). Apply water as a spray or dispersion to prevent damage to the seedbed. Complete each watering within a 4 hour period.
- e. More than one application for each watering may be necessary to provide adequate saturation without runoff.

**I. Mowing.**

1. Mowing may be required prior to permanent seeding and any time during the growing season following permanent seeding. Engineer will notify Contractor in writing prior to each mowing. Notification may be issued as early as 15 calendar days following execution of the contract. Contractor will be given 5 mowing days, plus 1 additional day for each 50 acre (20 ha) increment, that has been requested to be mowed. A mowing day is a calendar day, exclusive of Saturdays, Sundays, or recognized legal holiday, on which weather or other conditions (not under the control of the Contractor) will permit mowing operations to proceed for no less than 3/4 of a normal work day in the performance of a controlling item of work. When multiple projects are combined into a single contract, mowing days will be administered independently for each project. Mowing days will be charged starting on the day following the Contractor's notification. A price adjustment will be assessed at a rate of \$200.00 per mowing day after the work was to be completed.

2. Use suitable equipment for mowing. Bunching or windrowing mowed vegetation will not be permitted. When wet soil conditions result in rutting, suspend mowing. Repair rutting damage at the direction of the Engineer at no additional expense to the Contracting Authority. Hand equipment will be required for areas inaccessible to other equipment. Set the cutting height at approximately 6 inches (150 mm). More than one pass may be required for each mowing.

#### **J. Completion of the Work.**

1. Complete all phases of this work, excluding the 30 calendar day maintenance of sodded areas, within the specified construction schedule.
2. If a fertilized or seeded area is damaged by rain prior to the required mulching, refertilize or reseed, or both, that area at a rate not to exceed the specified rate as designated by the Engineer. Perform this work at no additional cost to the Contracting Authority.
3. When any work included in the contract is washed out or damaged prior to final acceptance of the project, the Engineer may order replacement of the damaged portion at contract unit prices. The Engineer will advise the Contractor of the approximate quantity of replacement required. Perform these repairs during the normal seeding period for the seed type. Maintain the work in a manner satisfactory to the Engineer. Should the repair work not be done with reasonable promptness, payment for repair will be limited to the work described at the time of notification.
4. The Contractor is responsible for replacement in addition to the quantity directed by the Engineer to complete the work in an acceptable condition should the Contractor fail to:
  - Make this replacement when directed by the Engineer, or
  - Perform necessary maintenance to the area.

#### **2601.04 METHOD OF MEASUREMENT.**

Measurement for the various items of work involving erosion control, satisfactory completed, will be as follows:

- A. Engineer will compute in acres to the nearest 0.1 acre (hectares to the nearest 0.1 hectare) the surface areas of:
  - Seeding and Fertilizing,
  - Stabilizing Crop Seeding and Fertilizing,
  - Native Grass Seeding,
  - Wetland Grass Seeding,
  - Wildflower Seeding,
  - Seeding Special Areas,
  - Overseeding and Fertilizing,
  - Mulching, and
  - Composting.
- B. Surface areas of Sodding: squares of 100 square feet (square meters) calculated from measurements to the nearest foot (0.1 m).
- C. Debris picked up and removed according to Article 2601.03, B, 4, a: cubic yards (cubic meters) by cross sectional measurement or in the hauling units, at the option of the Engineer.
- D. Special Ditch Control, Turf Reinforcement Mat, and Slope Protection: squares of 100 square feet (square meters) calculated from measurements to the nearest foot (0.1 m). Measurement of actual ditch area covered will be used, but will not exceed an area based on the actual measured length and design width. Materials used for anchor slots, junction slots, check slots, terminal folds, and lap joints, ~~mulch, and~~ are incidental. ~~Seed and fertilizer for Special Ditch Control and TRM are incidental.~~
- E. Outlet or Channel Scour Protection (Transition Mat): square feet (square meters) calculated from measurements to the nearest foot (0.1 m).
- F. Watering: by counting loads from a transporting tank of known volume or by metering.

- G. Mobilization for watering: by count. Mobilization for the initial watering required at installation of the plant material will not be measured for count.
- H. Mowing described in Article 2601.03, I: acres to the nearest 0.1 acre (hectares to the nearest 0.1 hectare) of surface area.

#### **2601.05 BASIS OF PAYMENT.**

- A. Payment for the various items of work involved in erosion control will be made as described below.
  - 1. When suitable soil for filling holes, gullies, or washes is not available adjacent to the area to be filled or when soil must be removed, payment for necessary loading and hauling directed by the Engineer will be as extra work according to Article 1109.03, B.
  - 2. Contract unit price per acre to the nearest 0.1 acres (hectare to the nearest 0.1 hectares) for the following. Payment is full compensation for preparing the area and furnishing and applying each material:
    - Seeding and Fertilizing,
    - Stabilizing Crop Seeding and Fertilizing,
    - Native Grass Seeding,
    - Wetland Grass Seeding,
    - Wildflower Seeding,
    - Seeding Special Areas,
    - Overseeding and Fertilizing, and
    - Composting.
  - 3. For sowing special seed as directed by the Engineer, but not provided for in the contract documents: delivered cost of the seed plus 10% of the contract unit price for Seeding and Fertilizing.
  - 4. Sodding:
    - a. Contract unit price per square (square meter).
    - b. Payment is full compensation for:
      - Preparing the sodbed,
      - Furnishing, placing, and finishing the sod,
      - Fertilizing, and
      - Repair of adjacent areas disturbed by the sodding operation.
    - c. Payment will not be allowed for the Sod until the watering, as specified, has been completed. Replace or repair, at the discretion of the Engineer, Sod areas which are damaged by weather or other causes before the specified initial watering has been completed, at no additional cost to the Contracting Authority.
  - 5. Squares (square meters) of staking of sod flumes, slopes, and ditch channels: 25% of the contract unit price for Sodding in addition to payment for Sodding.
  - 6. Mulch furnished and placed: predetermined contract unit price per acre (hectare).
  - 7. Debris picked up according to Article 2102.03, C, for grading work:
    - a. Payment for debris pickup of additional boulders resulting from Stabilized Crop Seeding and Fertilizing will be as described in Article 2102.05 for Class 12 boulders. If there is no Class 12 item, payment will be at 10 times the contract unit price for Class 10 excavation.
    - b. Payment for the number of cubic yards (cubic meters) of debris picked up and removed in conjunction with other work will be paid at 25% of the contract unit price for Stabilizing Crop Seeding or Seeding and Fertilizing, as applicable.
  - 8. Squares (square meters) of Special Ditch Control or Special Ditch Control over Sod with material as specified:
    - a. Contract unit price per square (square meter).
    - b. Payment is full compensation for the special ditch control preparation and materials. This includes seedbed preparation, seed and fertilizer, special ditch control (wood excelsior mat), stapling and installation of materials.

9. Squares (square meters) of Turf Reinforcement Mat of the type specified:
    - a. Contract unit price per square (square meter).
    - b. Payment is full compensation for the Turf Reinforcement Mat, preparation and materials including shaping channels, ditches and slopes, soil fill, seed and fertilizing, and special ditch control (wood excelsior mat).
  10. Squares (square meters) of Slope Protection with material as specified:
    - a. Contract unit price per square (square meter).
    - b. Payment is full compensation for the slope protection materials in addition to the amount paid for seed and fertilizer.
  11. Square feet (square meters) of Outlet or Channel Scour Protection (Transition Mat) with material as specified:
    - a. Contract unit price per square feet (square meter).
    - b. Payment is full compensation for Outlet or Channel Scour Protection (Transition Mat), TRM, preparation and materials including shaping outlets/channels, ditches, soil fill (if required), seed, fertilizer and anchors.
  12. When a large area is to be watered, the contract documents will include an item for watering. For the quantity of water applied to sod, Article 2601.03, G, 3, e, and to special ditch control, TRM, slope protection, and TM, Article 2601.03, H, 8, payment will be the predetermined contract unit price per 1000 gallons (kiloliter). When an item for watering is not included, the cost of watering is included in the amount paid for the item to be watered.
  13. Mobilization for watering: pre-determined unit price for each mobilization for required watering. Payment will not be made for mobilization for watering for projects identified as erosion control or landscaping. Payment will not be made for mobilization for watering if labor and equipment is already onsite.
  14. Mowing as described in Article 2601.03, I: contract unit price per acre to the nearest 0.1 acres (hectare to the nearest 0.1 hectares).
  15. Payment for furnishing extra length stakes or staples when directed by the Engineer will be as extra work according to Article 1109.03, B.
- B. Payment for these items is full compensation for furnishing all materials, equipment, tools, and labor necessary to complete the work according to the contract documents.
- C. Payment will not be allowed for any area seeded until fertilizer and mulch are placed.

## Section 2602

### 2602.01, Description.

Add the Article:

#### **D. Water Pollution Control Quality Control.**

1. For projects regulated by a NPDES storm water permit, maintain an individual that will be onsite daily during construction activities. This individual shall have completed Iowa DOT Erosion & Sediment Control Basics (ESC Basics) web-based training, which will be valid for 2 years. This individual shall be responsible for coordinating all erosion and sediment control operations. For this daily requirement, the Contractor may subcontract this responsibility.
2. Additional responsibilities of an ESC Basics trained individual that shall not be subcontracted include:
  - Attend required storm water inspections with the Contracting Authority.
  - Prepare required initial Erosion Control Implementation Plan (ECIP) submittal and ECIP updates.
  - Attend construction progress meetings to discuss erosion and sediment control issues.
3. For projects regulated by a NPDES storm water permit, maintain an Erosion Control Technician (ECT) on staff, even though the erosion and sediment control portion of the contract may be subcontracted. This individual shall be responsible for overall management of Contractor's quality

control program for erosion and sediment control. The ECT is required to obtain certification through the Technical Training and Certification Program (TTCP) of the Department.

### **2602.03, A.**

#### **Replace the Article:**

Prior to the preconstruction conference, furnish the Engineer an initial ECIP for accomplishment of temporary and permanent erosion control. ~~In addition, furnish the proposed method of erosion control on haul roads and borrow pits as well as the plan for the removal of excess materials from the project.~~

In the ECIP, include stages for erosion control work to address Contractor's timetable and sequence for major activities or stages on the contract, including:

- Initial controls required prior to land disturbing activities,
- Number of earthwork balances for the contract,
- Sensitive areas requiring special consideration,
- Anticipated suspension of work,
- Compliance with Pollution Prevention Plan (PPP),
- Method of erosion control on haul roads and borrow pits, and
- Removal of excess materials from project.

### **2602.03, Construction.**

#### **Add the Articles:**

#### **L. Mobilizations, Erosion Control.**

1. Mobilizations, Erosion Control, applies to projects not identified as erosion control or landscaping and containing at least one of the following items:
  - Stabilizing crop seeding and fertilizing: 1 acre (0.4 ha) or more,
  - Stabilizing crop seeding and fertilizing (urban): 1 acre (0.4 ha) or more,
  - Silt fence: 250 feet (75 m) or more, or
  - Silt fence for ditch checks: 250 feet (75 m) or more.
2. Only one mobilization will be paid for each stage of work described in the ECIP. Within the scope of work defined for each single mobilization described in the ECIP, additional movement due to weather delays or at the option of the Contractor will not be counted as a mobilization.
3. Separate mobilizations needed for different crews performing work such as silt fence, seeding, or ditch checks will be counted, however, multiple mobilizations will not be paid for a single crew performing different items of erosion control work.
4. Payment for mobilization applies to contract items from Sections 2601 and 2602, excluding watering, mowing, debris pickup, monitoring well, or removal items.
5. Additional mobilizations not outlined in the ECIP must be approved by the Engineer.
6. Payment for mobilization to correct items not properly installed will not be approved. Payment for mobilization will also not be approved if labor, equipment, and materials to perform erosion control are used for other non-erosion control work onsite.
7. Mobilize with sufficient labor, equipment, and materials to perform erosion control included in ECIP or as ordered or approved by Engineer. Failure to mobilize when erosion control work is needed to comply with the ECIP or PPP, will result in the Engineer, by written order, direct mobilization within 72 hours of a written order.
8. Failure to mobilize within such time period, will result in a deduction of \$750.00 per calendar day from payment due under the contract, except when Engineer extends such time period.
9. Mobilizations, Erosion Control, will not include work provided under the item of Mobilizations, Emergency Erosion Control.

**M. Mobilizations, Emergency Erosion Control.**

An emergency will be considered to be a sudden occurrence of a serious and urgent nature which is beyond normal maintenance of erosion control items. Emergency work requires immediate mobilization and movement of necessary labor, equipment, and materials to the emergency site, followed by immediate installation of temporary erosion control measures.

1. Mobilize with sufficient labor, equipment, and materials on job site within eight hours of Engineer's written order to install temporary erosion control items on an emergency basis. Engineer's written order will include a description of required work. Only one mobilization will be paid for work described in the written order.
2. Failure to mobilize within eight hours of written order, will result in a deduction of \$1500.00 per calendar day from payment due under the contract, except when Engineer extends such time period.

**N. Removal of Silt Basins.**

Fill silt basin with Class 10 material and a minimum of 4 inches (100 mm) of topsoil. Furnish Class 10 material according to Section 2107 and compact by driving over a minimum of two times. Furnish and place topsoil according to Section 2105. Smooth surface of topsoil and leave in a finished condition that drains properly.

**2602.04, Method of Measurement.**

**Replace** Article G:

- G. Cubic yards (cubic meters) as Class 10 Excavation according to Article 2102.04 for material used to fill silt basins.** By count for each silt basin removed.

**Renumber** Articles J and K and **Add** the Article:

**J. Removal of Perimeter and Slope Sediment Control Device.**

Linear feet (meters) to the nearest foot (meter).

**J K. Mobilizations, Erosion Control.**

By count for each mobilization in the accepted ECIP and acceptably performed, as well as additional mobilizations ordered or approved by Engineer and acceptably performed.

**K L. Mobilizations, Emergency Erosion Control.**

By count for each mobilization directed in writing by Engineer and acceptably performed.

**2602.05, A.**

**Replace** Article 7:

- 7. Per cubic yard (cubic meter) for Class 10 Excavation, according to Article 2102.05, for each silt basin properly.** Each. Payment is full compensation for providing, preparing, transporting, and placing Class 10 material and topsoil. Contractor has the option, at no additional cost to the Contracting Authority, of stripping and stockpiling Class 10 material and topsoil from constructing silt basins for later use in silt basin removal. Overhaul will not be paid for this item.

**Add** the Article:

**10. Removal of Perimeter and Slope Sediment Control Device.**

Per linear foot (meter) for the length of device removed.

**2602.05, Basis of Payment.**

**Renumber** Articles, B, C, and D and **Add** the Article:

- B.** Payment for Mobilizations, Erosion Control, and Mobilizations, Emergency Erosion Control, will be at unit prices stipulated in the proposal. If bid items are not included in the proposal then mobilizations for erosion control will paid at unit prices stipulated below. Mobilization for Erosion Control costs are not included as part of the contract item for "Mobilization" described in Section 2533.

**1. Mobilizations, Erosion Control.**

The quantity will be paid for at the unit price of \$500.00 each for Mobilizations, Erosion Control, which is full compensation for staged movement of labor, equipment, and materials; and labor, tools, equipment, and incidentals necessary to complete the movement.

**2. Mobilizations, Emergency Erosion Control.**

The quantity will be paid for at the unit price of \$1000.00 each for Mobilizations, Emergency Erosion Control, which is full compensation for movement of labor, equipment and materials; and for labor, tools, equipment, and incidentals necessary to complete the movement.

**B C.**When it is necessary for the Contractor to clean out, repair, or reconstruct a silt ditch, dike, or basin, the additional payment will be 100% of the contract unit price for construction of that item. When applicable bid items are not in the contract documents, payment for clean out, repair, or reconstruction will be according to Article 1109.03, B.

**C D.**If water control measures are required due to the Contractor's negligence, carelessness, or failure to install the controls as a part of the work as scheduled, and are ordered by the Engineer, perform this work at no additional cost to the Contracting Authority.

**D E.**All water pollution control features are to be in functional condition before final acceptance of the contract.

**Section 2610****2610.03, C, Pruning.**

**Replace** the Article:

**1. General.**

- ~~a. Complete Prune pruning prior to wrapping throughout establishment period.~~
- ~~b. Perform all pruning to retain the natural shape of the plant. Unless removing dead or damaged material, do not top plants. Prune back dead, broken, and damaged branches to the closest outward growing bud on healthy sound wood. Remove rubbing branches and suckers. Remove all suckers and stubs. Remove all debris resulting from pruning from the right-of-way according to Article 1104.08.~~

**2. Deciduous Trees.**

- ~~a. Remove all broken, damaged, or otherwise defective branches, as well as all branches which may not develop properly. In addition, eliminate narrow crotches or competing leaders.~~
- ~~b. Prune trees to develop an upright leader which will best promote the symmetry of the tree. Prune flowering or specimen trees to develop their natural form.~~

**3. Evergreen Trees and Shrubs.**

~~Remove dead and broken branches.~~

**4. Deciduous Shrubs.**

~~Remove dead or irregular branches.~~

**5. Vines and Ground Cover.**

~~Remove broken, damaged, or dead portions from vines and ground cover plants.~~

**Section 2611****2611.03, Construction.**

**Add** the Article:

**H. Pruning.**

Prune according to Article 2610.03, C.

## Division 41. Construction Materials.

### Section 4100

#### 4100.08, Concrete Compression Test Specimens.

**Replace** the Article:

- ~~A. Cast concrete compression test specimens may be cast:~~
- ~~• A according to Materials I.M. 315, or unless otherwise specified in the contract documents.~~
  - ~~• Horizontally in molds with a diameter of 4 1/2 inches (114.3 mm) and length of 9 inches (228.6 mm) or a diameter of 6 inches (152.4 mm) and length of 12 inches (304.8 mm).~~
- ~~B. When compressive strength is a specification requirement, use of horizontal molds is subject to agreement of the Contractor.~~

### Section 4101

#### 4101.01, B, ASTM C 595 Cements.

**Add** the Article:

5. Meet the requirements of Materials I.M. 401 for initial approval of Type IL cement.

#### 4101.01, C, Cement Type Usage.

**Replace** Articles 2 and 3:

2. Type IP, ~~or~~ Type IS, or Type IL cement may be furnished at the Contractor's option when Type I or Type II cement is specified. Apply the limitations of the following articles:
  - 2301.02, B.
  - 2403.02, B.
  - 2407.02.
  - 2412.02.
  - 2413.02.
  - 2424.02.
  - 2426.02.
  - 2507.02.
  - 2513.02.
  - 2529.02.
  - 2530.02.
  - 2539.02.
3. Use the same unit volume of Type IP, ~~or~~ Type IS, or Type IL cement in the concrete that is specified for Type I or Type II cement.

### Section 4105

#### 4105.01, General Requirements.

**Replace** the Article:

Comply with ~~AASHTO M148~~ ASTM C 309 and the following requirements.

#### 4105.07, A.

**Replace** the first sentence:

Use clear liquid membrane curing compounds complying with the requirements of ~~AASHTO M148~~ ASTM C 309, Type 1-D, Class A.

**Section 4110****4110.03, Quality.**

Replace the Article:

- ~~A.~~ Meet the requirements of Table 4110.03-1:

**Table 4110.03-1: Test Limits and Methods**

Fine Aggregate Quality	Test Limits	Test Method
Shale and Coal	2.0% (maximum)	Materials I.M. 344
Mortar Strength	6000 psi (41.4 MPa) (minimum)	Office of Materials Test Method No. Iowa 212

- ~~B.~~ The Engineer may require additional mortar strength testing for sources where quality changes.

**Section 4112****4112, Intermediate Aggregate for Portland Cement Concrete.**

Replace the Section:

**4112.01 DESCRIPTION.**

- A. Crushed carbonate stone chips or pea gravel from approved sources as described in Materials I.M. 409. ~~Coarse natural sand resulting from disintegration of rock through erosional processes, without addition of crushed over-sized material may be used in place of the intermediate and fine aggregate.~~
- B. For crushed limestone or dolomite chips, meet the durability class required for the coarse aggregate. Acquire uncrushed pea gravel or coarse sand from any PCC approved durability class gravel. When the gravel durability is lower than the coarse aggregate durability requirements, the pea gravel is not to exceed 15% of total aggregate in the mix. ~~Aggregate meeting the requirements of Section 4117 will be considered coarse sand.~~

**4112.02 GRADATION.**

~~A. Intermediate Aggregate.~~

~~For gradations, intermediate aggregate is considered coarse aggregate. Meet the following gradation limits:~~

Sieve Size	% Passing
1/2 inch (12.5 mm)	95-100
No. 8 (2.38 mm)	0-10

~~B. Coarse Sand.~~

~~Meet the following gradation limits:~~

Sieve Size	% Passing
1/2 inch (12.5 mm)	100
3/8 inch (9.5 mm)	90-100
No. 4 (4.75 mm)	75-95
No. 8 (2.36 mm)	60-90
No. 30 (600 $\mu$ m)	10-60
No. 200 (75 $\mu$ m)	0-1.5

Intermediate aggregate shall meet the requirements for gradation No. 2 of the Aggregate Gradation Table, Article 4109.02.

**4112.03 QUALITY.****A. Intermediate Crushed Stone.**

Meet the requirements of Table 4112.03-1:

**Table 4112.03-1: Aggregate Quality**

Aggregate Quality	Maximum Percent Allowed	Test Method
Alumina <sup>(a)</sup>	0.5	Office of Materials Test Method No. Iowa 222
A Freeze	6	Office of Materials Test Method No. Iowa 211, Method A
Clay Lumps and Friable Particles	0.5	Materials I.M. 368
<sup>(a)</sup> If the Alumina value fails, determine the A Freeze value for specification compliance.		

**B. Pea Gravel and Coarse Sand.**

- ~~For the portion of coarse sand passing the No. 4 (4.75 mm) sieve, meet the quality requirements of Section 4110.~~
- For pea gravel and the portion of coarse sand retained on the No. 4 (4.75 mm) sieve, mMeet the quality requirements of Table 4112.03-2:

**Table 4112.03-2: Maximum Permissible Amounts of Objectionable Materials**

Objectionable Materials.	Maximum Percent Allowed	Test Method
Coal and carbonaceous shale	0.5	AASHTO T 113
Total of all shale, similar objectionable materials, coal and iron combined	1.0	AASHTO T 113
Organic Materials, except coal	0.01	Office of Materials Test Method No. Iowa 215
Unsound chert particles retained on 3/8 inch (9.5 mm) sieve (Nonstructural concrete)	3.0	Materials I.M. 372
Unsound chert particles retained on 3/8 inch (9.5 mm) sieve (Structural concrete)	2.0	Materials I.M. 372
<p>Note: Chert particle which break into three or more pieces when subjected to the freezing and thawing test will be considered unsound.</p> <p>Chert in aggregate produced from limestone sources is defined as unsound when any of the fractions of the crushed or uncrushed chert do not meet the soundness requirements.</p>		

**Section 4115****4115.04, A.**

**Replace** Table 4115.04-1, Aggregate Use Durability Requirements:

**Table 4115.04-1: Aggregate Use Durability Requirements**

Specification Section Number	Minimum Durability Class Required			Use
	3i	3	2	
2122, 2201, 2212, 2213, 2301, 2302, 2310, 2529, 2530 Interstate System Primary System Other	X*	X*	X	PCC Paved Shoulders, Base, Base Repair, Base Widening PCC Pavement, Widening, PCC Overlay, Finish Patches, and Bridge Approaches
2403			X	Structural Concrete
2406 (See 2403)			X	Concrete Structures
2407			X	Precast Units

2407, 2501		X		Prestressed Units, Concrete Piles
2412 (See 2403) Interstate and Primary System Other		X	X	Concrete Bridge Decks
2413 (See 2413.02, D, 1)		X		Bridge Deck Surfacing, Repair, & Overlay
2414 (See 2403)			X	Concrete Railings
2415 (See 2403)			X	Concrete Box, Arch, & Circular Culverts
2416 (See 4145)			X	Rigid Pipe Culverts
2424			X	Shotcrete
2503 (See 2403)			X	Storm Sewers (Catch Basins, Intakes, & Utility Access)
2505 (See 2403)			X	Guardrails (Concrete End Anchorage)
2511, 2515 (See 2403)			X	PCC Sidewalks, Paved Driveways
2512 (See 2403)			X	PCC Curb & Gutter
2513 (See 2403)			X	Concrete Barrier
2516 (See 2403)			X	Concrete Walls and Steps

### Section 4118

#### 4118, Pipe Bedding Material.

Add the Section:

#### Section 4118. Pipe Bedding Material.

##### 4118.01 DESCRIPTION.

~~Gravel or crushed stone. Crushed PCC may be used if approved by the Engineer.~~

Aggregate of the following types:

- Crushed Stone,
- Gravels for which 75% or more of the particles retained on the 3/8 inch (9.5 mm) sieve have at least one fractured face as defined in Materials I.M. 305 (the fractured face requirement shall only apply to bedding material placed under Primary or Interstate roadways), or
- Crushed PCC, if approved by the Engineer.

##### 4118.02 GRADATION.

Meet the requirements for Gradation No. 3 of the Aggregate Gradation Table, Article 4109.02 (Appendix). Restrictions on the No. 200 sieve do not apply.

##### 4118.03 QUALITY.

The requirements of Table 4118.03-1 apply to individual virgin aggregates:

**Table 4118.03-1: Coarse Aggregate Quality (Virgin Material)**

Coarse Aggregate Quality	Maximum Percent Allowed	Test Method
Abrasion	50	AASHTO T 96
C - Freeze	45 20	Iowa 211, Method C

For crushed PCC, meet requirements of Materials I.M. 210.

### Section 4119

#### 4119, Pipe Backfill Material Under Interstate and Primary Roadways.

Add the Section:

#### Section 4119. Pipe Backfill Material Under Interstate and Primary Roadways.

##### 4119.01 DESCRIPTION.

Aggregate of the following types:

- Crushed Stone,
- Gravels for which 75% or more of the particles retained on the 3/8 inch (9.5 mm) sieve have at least one fractured face as defined in Materials I.M. 305, or
- Crushed PCC, if approved by the Engineer.

**4119.02 CRUSHED STONE.**

Meet the requirements of Article 4120.04.

**4119.03 CRUSHED GRAVEL.**

Meet the requirements of Article 4120.03.

**4119.04 CRUSHED PCC.**

Meet the requirements of Materials I.M. 210 and for Gradation No. 11 of the Aggregate Gradation Table, Article 4109.02 (Appendix).

**Section 4127****4127.01, B.**

**Replace** the Article:

If a gravel aggregate has ~~less than 5% retained on the No. 4 sieve (6 mm)~~ 100% passing the 3/8 inch (9.5 mm) sieve, the Engineer may replace the requirements of Table 4127.02-1 with the requirements of Article 4127.03.

**Section 4137****4137, 01, D.**

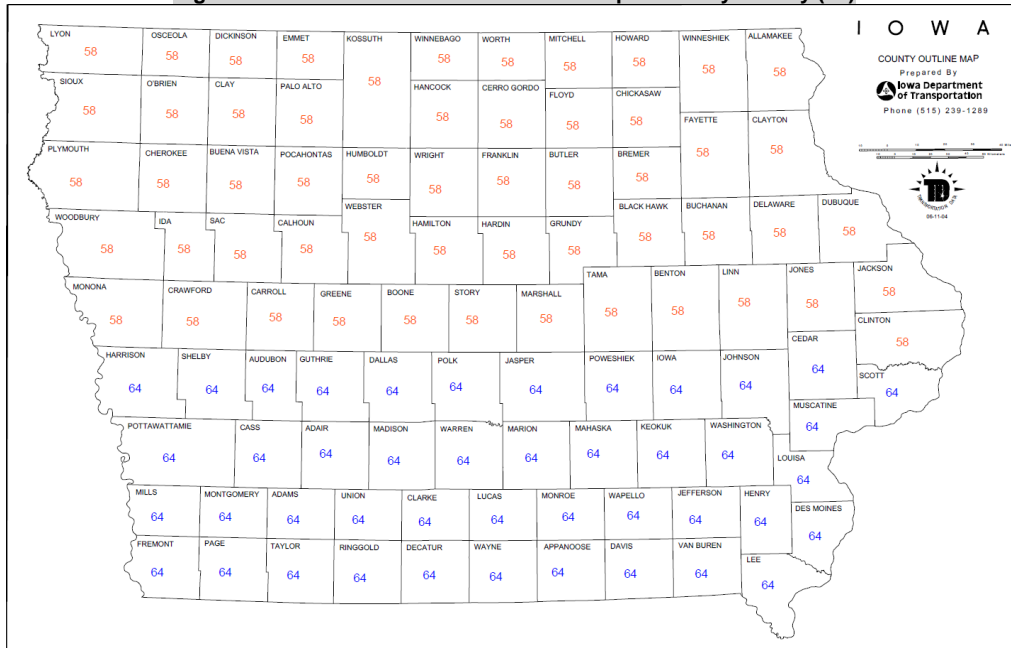
**Replace** the Article:

For asphalt binder grades with a temperature spread of 92° or greater<sup>1</sup>, ~~use binders that~~ meet the **PG+** requirements ~~established by~~ of the Combined State Binder Group as follows:

**Table 4137.01-1: PG+ Requirements**

<b>Temperature Spread<sup>1,2</sup></b>	<b>92</b>	<b>98</b>	<b>104</b>
Elastic Recovery: AASHTO T 301 at 77° F. (RTFO Aged AASHTO T 240)	65% min.	65% min.	65% min.
DSR Phase Angle; degrees (original binder)	77.0 max.	75.0 max.	73.0 max.
<sup>1</sup> Temperature spread is determined by subtracting low temperature from high temperature; for example PG 64-28: 64 - (-28) = 92 <sup>2</sup> When a grade change is required to compensate for binder in recycled materials, the virgin binder provided shall meet the above requirements for the original grade specified in the contract documents.			

AASHTO R 29 Grade	AASHTO T 350 Minimum Percent Recovery (R <sub>3.2</sub> )		DSR Phase Angle; degrees (original binder)
	Test Temperature <sup>2</sup>		
	58°C	64°C	
58-34P	30	25	77
64-28P	30	25	77
64-34P	55	45	75
70-22P	55	45	77
70-28P	55	45	75
70-34P	75	75	73
76-28P	75	75	73
76-34P	75	75	73
82-22P	75	75	73
<div><div>1</div>Temperature spread is determined by subtracting low temperature from high temperature; for example PG 64-28: 64 - (-28) = 92.</div> <div><div>2</div>See Figure 4137.01-01 for test temperatures.</div>			

**Figure 4137.01-01: AASHTO T 350 Test Temperature by County (°C)****Section 4141****4141, Corrugated Steel Culvert Pipe.**

Replace the Article:

**Section 4141. Corrugated Steel Metal Culvert Pipe****4141.01 GENERAL REQUIREMENTS.****A. Corrugated Steel Pipe.**

1. Unless specified otherwise, meet the requirements of AASHTO M 36/M 36M for the following:
  - Circular corrugated steel culvert pipe, Type I.
  - Pipe arch shapes, Type II.
  - Coupling bands, special fittings, and associated hardware.
2. Meet requirements of AASHTO M 218 Steel Sheet Zinc Coated (Galvanized) for corrugated Steel Pipe or AASHTO M 274 Steel Sheet Aluminum Coated (Type 2) for corrugated Steel Pipe.
3. Metallic coated sheets or coils used for corrugated pipe shall meet requirements of, and be marked in accordance with ASTM A 929.

**B. Corrugated Aluminum Pipe.**

Unless specified otherwise, meet requirements of AASHTO M 196/M 196M for the following:

- Circular corrugated steel culvert pipe, Type I.
- Pipe arch shapes, Type II.
- Coupling bands, special fittings, and associated hardware.

**B C.** The minimum sheet thickness will be shown in the contract documents and zinc coating shall be 610 g/m<sup>2</sup> (min) total amount on both sides of the sheet.

**C D.** When the diameter of round pipe is elongated, increase one diameter by approximately 5%. Permanently mark each piece at least once inside and once outside to indicate the top.

**D E.** Types of approved coupling devices are described in Materials I.M. 441.01. Joint types are standard and positive, and the type may be designated in the contract documents. When not designated, either type may be used.

**4141.02 COATED CORRUGATED PIPE.**

- A. Use pipe coated by either of the following methods:
  - 1. Meet the requirements of Article 4141.01 and AASHTO M 245/M 245M, Type I. The polymeric coating is to have a minimum thickness of 0.010 inch (254 µm) on inside surfaces and 0.003 inch (76 µm) on outside surfaces.
  - 2. Aluminized pipe meeting requirements of Article 4141.01 may be furnished.
- B. Repair, to the Engineer's satisfaction, breaks or damage to the coating that occur during handling or installation.

**4141.03 METAL PIPE APRONS AND BEVELED END SECTIONS.**

- A. Materials for pipe aprons and beveled end sections shall meet requirements of AASHTO M 218/M 218M.
- B. Galvanized sheet metal of aprons and end sections shall be comparable to pipe sections in type, grade, sheet thickness, corrugations, dimensions, and coatings.
- C. Furnish Aprons and end sections ~~shall~~ meeting requirements of Standard Road Plans ~~RF-5~~ DR-203 and ~~RF-44~~ DR-211.

**Section 4145****4145.03, Materials.**

**Replace** the Article:

~~Comply with the applicable requirements of Division 41. Apply Section 2419.~~

**4145.04, B.**

**Replace** the Article:

Apply ~~AASHTO M 198~~ ASTM C 990/C 990M or ~~AASHTO M 315~~ ASTM C 443/C 443M when circular pipe with gaskets is specified.

**4145.05, C.**

**Replace** the Article:

Conduct ~~A~~all strength tests ~~will be conducted~~ according to AASHTO T 280 at the frequency in Materials I.M. 445.01.

**Section 4149****4149.02, A, 1, c.**

**Delete** the second sentence:

~~Do not exceed 10 parts by weight (mass) per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.~~

**4149.02, A, 2, c.**

**Delete** the second sentence:

~~Do not exceed 10 parts by weight (mass) per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.~~

**4149.02, A, 3, c.**

**Delete** the second sentence:

~~Do not exceed 10 parts by weight (mass) per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.~~

**4149.02, A, 4, c.**

**Delete** the second sentence:

~~Do not exceed 10 parts by weight (mass) per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.~~

**4149.02, A, 5, c.**

**Delete** the second sentence:

~~Do not exceed 10 parts by weight (mass) per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.~~

**4149.02, A, 6, a, 1.**

**Replace** the Article:

Comply with Section 2419 and ASTM C 76/C 76M (AASHTO M 170/M 170M).

**4149.02, A, 6, a, 4.**

**Replace** the Article:

Rubber O-ring flexible joint complying with ASTM C 443/C 443M ~~(AASHTO M 315/M 315M).~~

**4149.03, A, 1.**

**Replace** the Article:

Comply with Section 2419 and ASTM C 76/C 76M.

**4149.03, B, 1.**

**Replace** the Article:

Comply with Section 2419 and ASTM C 506/C 506M.

**4149.03, C, 2.**

**Delete** the second sentence:

~~Do not exceed 10 parts by weight (mass) per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.~~

**4149.03, E, 1.**

**Replace** the Article:

Comply with ~~AASHTO M 198~~ ASTM C 990/C 990M.

**4149.04, A, 1.**

**Replace** the Article:

**Precast:** Comply with Section 2419 and ASTM C 478/C 478M.

**4149.04, D, 2, a, 2.**

**Replace** the last sentence:

Comply with ~~AASHTO M 198~~ ASTM C 990/C 990M.

**4149.04, I, 1, Gray Cast Iron.**

Replace the title and Article:

~~Gray Cast Iron Casting Materials.~~

- a. **Gray Cast Iron.**  
Comply with AASHTO M 306.
- b. **Carbon Steel.**  
Comply with ASTM A 36.

**4149.04, J, 1, Chimney Seal.**

Replace the Article:

~~Chimney Seal Infiltration Barrier.~~

- a. ~~External Rubber Chimney Seal.~~
  - 1) **Rubber Sleeve and Extension.**
    - a) Corrugated; minimum thickness of 3/16 inches (5mm), according to ASTM C 923/C 923M.
    - b) Minimum allowable vertical expansion of at least 2 inches (50 mm).
  - 2) **Compression Bands.**
    - a) One-piece band assembly to compress sleeve or extension against manhole and casting surfaces.
    - b) 16 gage ASTM A 240/A 240M, Type 304 stainless steel, minimum 1 inch (25 mm) width, minimum adjustment range of 4 inches (100 mm) more than the manhole outside diameter.
    - c) For standard two-piece castings, shape top band to lock sleeve to manhole frame's base flange. For three-piece adjustable castings, shape top band to lock sleeve to upper piece of adjustable frame.
    - d) Stainless steel fasteners complying with ASTM F 593 and ASTM F 594, Type 304.
- b. ~~Internal Rubber Chimney Seal.~~
  - 1) **Rubber Sleeve and Extension.**
    - a) Double pleated, minimum thickness 3/16 inch (5 mm) thick, according to ASTM C 923/C 923M.
    - b) Minimum allowable vertical expansion of at least 2 inches (50 mm).
    - c) Integrally formed expansion band recess top and bottom with multiple sealing fins.
  - 2) **Expansion Bands.**
    - a) One-piece band assembly to compress sleeve or extension against manhole and casting surfaces to make a watertight seal.
    - b) 16 gage ASTM A 240/A 240M, Type 304 stainless steel, minimum 1 3/4 inch (45 25 mm) width, minimum adjustment range of 2 inches (50 mm) more than the manhole inside diameter.
    - c) ~~Stainless steel locking mechanism of studs and nuts complying with ASTM F 593 and ASTM F 594, Type 304.~~ Positive stainless steel locking mechanism permanently securing band in its expanded position after tightening.
- c. **Molded Shield.**
  - 1) **Barrier Shield.**
    - a) Medium Density polyethylene, according to ASTM D 1248.
    - b) Certified for 40,000 pound (18,150 kg) proof-load according to AASHTO M 306.
    - c) Diameter to match cone section and internal dimension of casting.
  - 2) **Sealant.**  
Butyl material according to ~~AASHTO M 198~~ ASTM C 990/C 990M.

**Section 4150****4150.02, E, 2, a.**

Replace the Article:

~~Tracer Wire: #12 AWG solid single copper conductor.~~

- 1) ~~Insulation Material:~~ Linear low-density polyethylene (LLDPE) installation suitable for direct burial applications.  
**Solid Single Copper Conductor.**
  - a) **Size:** #12 AWG.
  - b) **Insulation Material:** Linear low-density polyethylene (LLDPE) installation suitable for direct burial applications.
  - c) **Insulation Thickness:** 0.045 inches (1 mm), minimum.

- 2) ~~Insulation Thickness: 0.045 inches, minimum.~~  
**Bimetallic Copper Clad Steel Conductor.**  
 a) **Size:** #12 AWG.  
 b) **Rating:** Direct burial.  
 c) **Operating Voltage:** 30 volts.  
 d) **Conductivity:** 21%.  
 e) **Copper Cladding:** 3% of conductor diameter, minimum.  
 f) **Insulation Material:** High density polyethylene.  
 g) **Insulation Thickness:** 0.030 inches (0.75 mm), minimum.

#### 4150.02, E, 2, d.

Replace the Article:

**Splice Kit:** Inline resin splice kit with split bolt for (1 kV and 5 kV). ~~Insulates and seals~~ for use with single conductor and unshielded cable splices for in direct bury and submersible applications.

### Section 4151

#### 4151.02, B, Pavement Dowel Bars.

Replace Article 3:

3. Furnish dowels, with the exceptions of end of run and header joints, in approved assemblies, ~~suitable for skewed or perpendicular joints~~ as shown in the contract documents. Ensure all dowels, including end of run and header dowels, have an epoxy coating. Ensure the coating is applied by the electrostatic spray method complying with the requirements of AASHTO M 254, Type B, with a minimum coating thickness of 6 mils (150 µm) after cure. Epoxy powders approved for use are listed in Materials I.M. 451.03B, Appendix B. Perform welding and tack welding on reinforcement according to Article 4151.06.

Add the Article:

6. Protect epoxy coated dowels in dowel assemblies stored outdoors, longer than 2 months either at fabricator or project site, from weather exposure and salt spray. Cover coated dowels in dowel assembly with a non-transparent or other suitable opaque protective material. Provide adequate ventilation to minimize condensation. Record on an identification tag the date coated dowels assemblies were placed outdoors. Do not use weathered, discolored, or faded dowel bars. Store dowel assemblies off the ground on pavement or wood supports. When stacking is necessary, place wood supports between assemblies or other method to ensure a stable stack.

#### 4151.03, Reinforcement for Structures.

Replace the Article:

##### A. General.

1. Unless otherwise specified, use deformed bars meeting the requirements of ASTM A 615/A 615M, ASTM A 706/A 706M or ASTM A 996/A996M. Use bars fabricated according to Article 2404.03, B.
2. Spirals of No. 5 (15) bars or smaller and any bars No. 3 (10) or smaller for stirrups or hoops of a specified shape may, at the Contractor's option, be:
  - Material meeting requirements of ASTM A 82 1064 reinforcement specified above, or
  - Steel meeting physical and chemical requirements of ASTM A 615/A 615M, Grade 40 (300).
3. For spirals in precast and prestressed concrete piling and all wire ties, use steel wire with a minimum tensile strength of 40,000 psi (300 MPa), with other properties such as to permit bending as shown in the contract documents.
4. When required by the contract documents, coat steel wire supports with:
  - PVC according to ASTM A 933, or
  - Epoxy according to ASTM A 884.

**B. Galvanized Reinforcement.**

1. ~~Perform~~ Comply with ASTM A 767, Class I coating with cutting and bending done prior to galvanizing and according to the requirements of Section 2404. ~~After cutting and bending, galvanize all reinforcement required to be galvanized according to the requirements of ASTM A 123. Take precautionary measures to prevent loss in the height of the deformation pattern.~~
2. ~~Apply a chromate conversion coating immediately after galvanizing. This may be accomplished by either: 1) quenching the bars, immediately after galvanizing, in a solution containing at least 0.2% (by weight (mass)) of sodium dichromate in water; or 2) quench chromating in a minimum 0.2% chromic acid solution. The quench water should be at least 90°F (32°C). Proprietary chromate solutions of equivalent effectiveness may be substituted for the above procedure. If the reinforcing material is allowed to cool before chromate treating as specified above, 0.5% to 1.0% concentration of sulfuric acid should be added as an activator to the chromate solution.~~
3. Galvanize tie wires and wire or pressed steel chairs to be used with galvanized reinforcing steel. Either turn up or coat the ends of chairs which may be exposed in the finished concrete. Stainless steel chairs, plastic coated carbon steel chairs, or other types of chairs may be approved by the Engineer. Galvanizing of hangers is optional (required only when to remain exposed), according Article 2412.03, A.
4. Handle bars according to ASTM A 767 in a manner to prevent damage to the galvanized coating. When coating damage is 2% or less of the surface area, repair it according to Materials I.M. 410. Replace bars with more than 2% of the surface area damaged.

**C. Epoxy Coated Reinforcement.**

1. Ensure reinforcement (deformed and plain) required to be epoxy-coated has a protective coating of epoxy applied by electrostatic spray method according to the requirements of ASTM A 775/A 775M.
2. Acceptance and handling of epoxy-coated reinforcing steel reinforcement bars at the project site are to be according to the requirements of these specifications and the requirements of Materials I.M. 451.03B.

**D. Stainless Steel Reinforcement.**

1. Unless otherwise specified in the contract documents, stainless steel reinforcement bars shall be deformed and meet requirements of ASTM A 955 and be the grade, UNS designations, and types listed in Materials I.M. 452.
2. Bar sizes will be specified in the contract documents.
3. Bars shall be heat treated using one of the three methods listed in ASTM A 955.
4. If welding and/or tack welding is employed in the placement of stainless steel reinforcement, the following requirements shall be met prior to welding:
  - a. Welding shall not be performed without prior approval of Engineer.
  - b. Welding procedure suitable for the chemical composition and intended use shall be submitted for approval prior to welding.
  - c. Welding shall be performed by a state certified welder.
  - d. Welding and/or tack welding shall be performed in accordance with the requirements of the contract documents, and latest edition of the American Welding Society, AWS D1.6, including requirements for minimum preheat and interpass temperature.

**D E. Surface Preparation.**

1. Thoroughly blast (near-white) clean reinforcing steel surfaces to be coated. Remove mill scale, rust, and foreign matter. Ensure the blast media produces a suitable anchor pattern profile (a depth of 2.0 to 4.0 mils (50 µm to 100 µm)). Apply the coating within 0.5 hour after cleaning.

2. Ensure blast media meets the requirements of ~~Materials I.M. 451.03B~~ ASTM A 775. A maximum of 10% steel shot may be added to blast media.

**E F. Repair to Damage Incurred During Fabrication.**

Ensure coating damage due to fabrication or handling at the fabricator facility is repaired using patching material meeting the requirements of Section 3.1 of ASTM D 3963/D 3963M. The fabricator is responsible for the repair.

**F G. Repair of Damage Incurred during Shipment and Handling at the Job Site.**

Comply with the following:

1. Repair visible damage incurred during shipment, storage, and /or placement of epoxy-coated bars at the job site.
2. Use coating patch materials of organic composition consisting of a two-component liquid properly mixed that hardens to a solid form upon curing. Approved repair/patch compounds are listed in Materials I.M. 451.03B.
3. Repair damage to the coating caused by shipment, storage, and/or placement at the job site.
4. Ensure sheared ends/saw-cut ends of the coated bars have adequate coating, have no signs of surface rust or damage, and are repaired and/or coated with the same patching material that is used for repairing damaged coating.
5. The maximum amount of repaired, damaged areas is not to exceed 2% of the total surface area in each 1.0 linear foot (0.3 m) of the bar. Should the amount of damage exceed the 2% in 1.0 linear foot (0.3 m), then remove that bar and replace with an acceptable bar. Coating the cut ends will not be included in the repair percentage.
6. Apply a minimum coating thickness of 7 mils (175 µm) to areas to be repaired.
7. Allow patches to cure (dry to the touch) before placing concrete over the coated bars.
8. Prepare the surface, repair it, and apply patches according to the resin manufacturer's recommendations.

**G H. Storage, Handling, and Placement at the Job Site.**

1. Comply with the following:
  - a. Store coated bars or bundles above ground on wooden or padded supports with padded timbers placed between bundles when stacking is necessary. Place supports to prevent sags in the bundles.
  - b. Ensure systems for handling (loading, unloading, storing) the coated bars at the job site have padded contact areas. Do not drop or drag coated bars or bundles.
  - c. Store coated and uncoated steel reinforcing bars separately.
  - d. Minimize handling and re-handling of the coated bars.
  - e. Tie coated bars using tie wire coated with epoxy, plastic, Nylon, or other non-conductive Materials that will not damage or cut the coating.
  - f. Use a non-conductive Material compatible with concrete to coat or fabricate bar supports or spacers.
2. Use a non-transparent material to cover coated bars if they will be exposed for 2 months or more. Ensure adequate ventilation is provided to minimize condensation under the cover.

**4151.04, Wire Mesh Reinforcement.**

**Replace the Article:**

Comply with size and spacing and one of the following classifications, as required by the contract documents:

**A. Uncoated Wire Mesh.**

~~Use the size and spacing shown in the contract documents. Ensure it meets the requirements of ASTM A 485 1064.~~

**B. Vinyl Coated Wire Mesh.**

Meet requirements of ASTM A 933.

**C. Epoxy Coated Wire Mesh.**

Meet requirements of ASTM A 884, Class A coating for concrete applications and ASTM A 884, Class B coating for mechanically stabilized earth applications.

**4151, Steel Reinforcement.**

Add the Articles:

**4151.06 WELDING REINFORCEMENT.**

- A. Unless specified elsewhere in the contract documents, comply with the following for welding and tack welding steel reinforcement or wire mesh:
- B. Weld and/or tack weld according to Materials I.M. 558 and latest edition of the AWS D1.4 including table 5.2 for minimum preheat and interpass temperatures.
- C. Engineer will review weld procedures. Do not start welding process until Engineer has approved weld procedures. Request a new review of weld procedures if any one variable of the essential procedure has been changed.
- D. Use qualified/certified welders and tack welders.
- E. Calculate carbon equivalent of reinforcing steel bars or wire fabric. Do not weld reinforcement with a carbon equivalent exceeding 0.55%.
- F. Weld with Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), or Flux Core Arc Welding (FCAW).
- G. Use other welding processes if approved by Engineer.

**4151.07 Reinforcement Couplers.**

Mechanical reinforcement couplers may be used when allowed by the contract documents or with the Engineer's approval. Use couplers that meet requirements of Materials I.M. 451 and the following:

**A. Strength Requirements.**

- 1. Withstand 80,000 cycles of fatigue tensile loading from 5000 psi (35 MPa) to 30,000 psi (210 MPa) at a maximum frequency of 5 cycles per second.
- 2. Develop in tension at least 125% of the specified yield strength of the bars being spliced both before and after fatigue loading.
- 3. Maximum slip of coupler after being loaded to 30,000 psi (210 MPa) tension and unloaded to 3000 psi (21 MPa) tension:
  - For bar size up to No. 14 (45) - 0.01 inches (0.25mm)
  - For No. 18 (60) Bars - 0.03 inches (0.75mm)
- B. Couplers shall be made of steel conforming to one of the following:
  - ASTM A 108, Level one or Level two,
  - ASTM A 519 Grade 1025, or
  - ASTM A 576.
- C. Epoxy coated couplers shall be coated according to ASTM A 934. Other couplers shall have similar steel properties and same coating properties as reinforcement being spliced.

- D. Install couplers following manufacturer's requirements.

### Section 4152

#### 4152, Structural Steel.

Add the Article:

##### 4152.03 Shear Connector Studs

- A. Comply with ASTM A 108 for steel bars, carbon cold-finished, standard quality, Grades 1010 through 1020 inclusive either semi-killed or killed deoxidation. Inspection and acceptance of shear connector studs will be according to Materials I.M. 453.10.
- B. Provide an arc shield (ferrule) of heat-resistant ceramic or other suitable material when approved by the Engineer. Ferrules shall be kept dry and protected from moisture or oven dried at 250°F (120°C) for 2 hours.

### Section 4153

#### 4153.01, A.

Replace the first sentence of the Article:

Meet the requirements of ASTM A 688 668/A 688M 668M, Class C for forgings, from which pins, rollers, trunnions, or other forged parts 7 inches (175 mm) or more in diameter are made.

#### 4153.06, A, Non-High Strength Bolts and Nuts.

Replace the Article:

1. Bolts and nuts meet the requirements of ASTM A 307, ~~Class~~ Grade A or Grade B, with full diameter body. Hexagonal bolt heads and nuts.
2. Threads meet the requirements of ANSI B1.1, Unified Coarse Thread Series, Class 1A and Class 1B fit.
3. Where galvanized fasteners are specified, zinc is applied by hot dipped galvanizing to meet the requirements of ASTM F 2329 with a zinc bath temperature not exceeding 850°F (455°C). Fasteners may be mechanically galvanized to meet the requirements of ASTM B 695, Class 50 55 Type 1.
4. Where stainless steel fasteners are specified, use stainless steel fasteners meeting requirements of Article 4187.01, C, 1. Use lock type washers or jam nuts with stainless steel fasteners.

#### 4153.06, B, 1.

Replace the Article:

Ensure the following:

- a. High strength bolts, nuts, and washers meet the requirements of the appropriate ASTM Specifications as follows:
 

bolts	A 325
nuts	A 563 Grade DH3
washers	F 436
- b. For galvanized high strength fasteners, the fasteners meet the requirements of ASTM B 695, Class 50 55 Type I or ASTM F 2329 with a zinc bath temperature not exceeding 850°F (455°C).
- c. For weathering steel, bolts are ASTM A 325 Type III, nuts are ASTM A 563 Grade DH3, and washers are ASTM F 436 Type III.
- d. For quenched and tempered steel bolts and studs with diameters greater than 1 1/2 inch, but with similar mechanical properties as ASTM A 325, refer to ASTM A 449.

#### 4153.06, B, 3.

Replace the Article:

**NOTE:** ASTM A 490 bolts are specifically excluded from this specification.

**4153.07, D, 4.**

**Replace** the Article:

Ensure the galvanized coating meets the requirements of ASTM F 2329.

**4153.07, E, Lag Bolts.**

**Replace** the Article:

Use lag bolts meeting the requirements of ANSI B18.2.1, galvanized according to ASTM F 2329.

**Section 4154****4154, Fence Materials.**

**Replace** the Section:

**4154.01 DESCRIPTION.**

- A. Materials covered by this section include woven wire farm field fabric, chain link fabric, barbed wire, steel fence posts, wood fence posts, tie and brace wire, gates, and special fittings.
- B. Use material of the size and type designated in the contract documents. Use new material meeting the requirements of the following provisions.
- C. Inspection and acceptance of fence materials will be according to Materials I.M. 454.10.
- D. Ensure similar parts with different shapes or protective coatings are not intermingled within the project limits.

**4154.02 FIELD FENCE AND DEER FENCE.**

- A. ~~Field Fence.~~ Field fence shall conform to AASHTO M 279 and ASTM A 116 and shall be, unless otherwise specified:
  - 1. ~~Use fabric meeting the requirements of ASTM A 116, Class 3 coating. Type Z, Class 3.~~
    - ~~For Type 47 fence, the fabric design is ASTM Design Number 1047-6-11 grade 60 wire or 1047-6-12 1/2 grade 125 wire.~~
    - ~~For Type 39 fence, the fabric design is ASTM Design Number 939-6-11 grade 60 wire or 939-6-12 1/2 grade 125 wire.~~
  - 2. ~~When the type is not designated, furnish one of the above 1047 fabrics.~~ Design numbers 1047-6-11 or 939-6-11 for grade 60 wire or design numbers 1047-6-12 1/2 or 939-6-12 1/2 for grade 125 wire.
  - 3. ~~Fabric may be furnished in lengths greater than 20 rods (100 m).~~
  - 4 3. Use galvanized (as determined by visual inspection) steel rod for splicing fence material.
- B. ~~Deer Fence~~ Deer fence shall be woven wire that meets the following requirements:
  - ~~Use woven wire fence fabric that:~~
  - ~~Meets the requirements (excluding wire spacing and fence height) for 12.5 gage wire according to ASTM A 116, and~~
  - ~~Has wires spaced horizontally and vertically as shown in the contract documents or closer.~~
  - 1. 12.5 gauge wire according to ASTM A 116 (excluding wire spacing and fence height).
  - 2. Wires are spaced horizontally and vertically as shown in the contract documents or closer.

**4154.03 CHAIN LINK FABRIC.**

- A. When chain link fence is specified in the contract documents, ~~use either~~ chain link fabric shall conform to one of the following:
  - ~~Zinc coated fabric meeting the requirements of ASTM A 392, Class 2 coating, or~~

• ~~Aluminum coated fabric meeting the requirements of ASTM A 491.~~

1. Zinc coated fabric meeting requirements of ASTM A 392, Class 2 (2.0 ounces per square foot (610 g/m<sup>2</sup>)) or AASHTO M 181 Type I, Class D.
2. Aluminum coated fabric meeting the requirements of ASTM A 491 or AASHTO M 181, Type II.
3. PVC coated fabric meeting requirements of ASTM F 668, Class 2b or AASHTO M 181, Type IV, Class B Fused.

**B.** ~~Knuckle the salvage top and bottom, except as indicated. Use material 72 inches (1.8 m) high (unless specified otherwise) and fabricated from No. 9 (3.76 mm diameter) wires.~~ Unless otherwise specified in contract documents, use:

1. 9 gauge coated wire with a breaking strength of 1290 pounds (5.740 kN).
2. Height of fabric of 72 inches (1.8 m).
3. Selvage knuckled at both the top and bottom.
4. Mesh size 2 +/- 1/8 inches (50.8 +/- 3.18 mm).

#### 4154.04 BARBED WIRE.

~~Use barbed wire meeting the requirements of ASTM A 121 for 950 pounds (4.23 kN) force minimum strand breaking strength and 4 barbs at nominal 5 inch (125 mm) centers. Ensure the zinc coating is at least 0.80 ounce per square foot (244 g/m<sup>2</sup>).~~ Unless otherwise specified in contract documents, use barbed wire conforming to AASHTO M 280, Design Number 12-4-5-14R, Type Z Class 3.

#### 4154.05 BRACE WIRE, TENSION WIRE, AND TIE WIRE.

**A.** ~~Use galvanized wire meeting requirements of ASTM A 116, Class 3 coating, or an aluminum coated steel wire with a coating of not less than 0.25 ounce per square foot (76 g/m<sup>2</sup>). Use tension wire at the bottom of chain link fence that meets the requirements of ASTM A 641/641 M, hard grade, with a Class 3 zinc coating or an aluminum coating of no less than 0.25 ounce per square foot (76 g/m<sup>2</sup>).~~ Tension wire shall meet requirements of AASHTO M 181 or one of the following:

1. ASTM A 817, Type II, Class 3.
2. ASTM A 121, Type Z, Class 3 zinc coated or aluminum coated.
3. ASTM A 817, Type I.
4. ASTM F 1664, PVC (Vinyl) Coated, Class 2b.

**B.** Brace and tie wire shall meet the requirements of ASTM F 626 zinc coated or aluminum coated.

1. Where specified, round metallic-coated tie wires, clips, and hog rings shall be polymer coated to match the color of the chain-link fabric as selected from ASTM F 934
2. The coating process and metallic-coated core wire materials shall be in accordance with ASTM F 668.

**B C.** Unless designated otherwise, use wire sizes no smaller than the following diameters:

**Table 4154.05-1: Wire Sizes**

Use	Wire Size
Tension wire	No. 7 (4.49 mm)
Brace wire	No. 9 (3.76 mm)
Tie wires or clips for fastening field fence to steel posts	No. 12 (2.68 mm)

Use tie wires for chain link fence that are the size and type the manufacturer recommends, but no smaller than No. 9 (3.76 mm) diameter for post ties or No. 12 (2.68 mm) diameter for rail and brace ties. Equivalent steel clips or aluminum wires or clips may be used if the Engineer approves.

#### 4154.06 STAPLES.

Use plain, class 3 zinc coated, No. 9 (3.76 mm), 1 3/4 inch (45 mm) long wire staples, unless specified otherwise in the contract documents. Obtain Engineer's approval for the staples to be used.

- A. Unless otherwise specified in the contract documents, use fence staples conforming to ASTM F 1667 - 13, Table 57: F 1667 ST FN - 06 Z.
- B. Obtain Engineer's approval for the staples to be used.

#### 4154.07 WOOD POSTS.

- A. Use pine posts of the size and length designated in the contract documents that:
  - Meet the requirements of Section 4164 with pressure preservative treatment meeting the requirements of Section 4161.
  - Are of the size and length designated in the contract documents.
- B. Unless specified otherwise, use round stock posts of the following sizes and lengths:

**Table 4154.07-1: Post Sizes and Lengths**

Use	Length, feet (meters)
Line posts, 4 inch (100 mm) top	7 (2.1 m)
End, corner, gate, pull, angle, and brace posts, 6 inch (150 mm) top	8 (2.4 m)

- C. If contemplating driving the line posts, the tip of the post may have a blunt point made before treatment and located near the center line of the post.

#### 4154.08 BRACES FOR FIELD FENCE.

- A. Use steel angle (or other approved bracing systems) weighing (with a mass of) no less than 1.94 pounds per foot (2.9 kg/m). Unless otherwise specified in the contract documents, use either of the following between wood pull posts:
  1. 2 3/8 inch (60.3 mm) SS-40 steel pipe.
  2. 5 inch (127 mm) diameter wood posts.
- B. Use angles no less than 2 inches by 1 1/2 inches by 3/16 inches (50 mm by 40 mm by 5 mm). Use braces shown in the contract documents. Use diagonal trussing with a double-wrapped 9 gauge, Class 3 steel brace wire.
- C. Ensure ends are flattened to fit squarely against the posts with brace approximately horizontal.
- D. For steel line posts, use coated braces as required.

#### 4154.09 STEEL LINE POSTS FOR FIELD FENCE AND DEER FENCE.

- A. Use T-section (or other approved sections) steel posts, of the length specified, as line posts with wood posts, as shown in the contract documents. Do not use T-section steel posts for corner, brace, pull, end, or gate posts.
- B. Only one type of steel post may be used in any installation 1,000 feet (300 m) or less in length.
- C. Equip posts with lugs or other approved means to prevent the fence fabric from moving vertically.

- ~~D. Use posts that weigh (have a mass of) no less than 1.3 pounds per foot (1.9 kg/m), exclusive of anchor plate. Use nominal 1.33 pounds per foot (1.98 kg/m) T-section post meeting requirements of ASTM A 702 and hot dip galvanizing requirements of ASTM A 123.~~
- ~~E. Provide each post with a steel anchor plate of adequate size, firmly attached. After the anchor plate is attached, c~~Completely paint the finished post with a prime coat and an enamel finish coat, with no limitation on color or tip identification except as provided for 1,000 foot (300 m) installations. Ensure the paint is thoroughly dry before posts are bundled for shipment. ~~Unless specified otherwise, use steel line posts that are 7 feet (2.1 m) in length.~~

#### 4154.10 STEEL POSTS, BRACES, AND RAILS FOR CHAIN LINK FENCE.

- ~~A. Use galvanized standard weight (schedule 40) pipe meeting the requirements of ASTM F 1083 of the lengths designated in the contract documents. Posts, braces, and rails of alternate cross sectional shape, material, or protective coating may be used if approved according to Materials I.M. 454.10. Ensure similar parts with different shapes or protective coatings are not intermingled within the project limits. Steel pipe length shall be designated in the contract documents and shall conform to AASHTO M 181 (ASTM) requirements:~~
- ~~1. Grade 1 (ASTM F 1083); minimum average zinc coating weight of 1.8 ounces per square foot (549 g/m<sup>2</sup>).~~
  - ~~2. Grade 2 (ASTM F 1043, Group I-C); external zinc coating minimum of 0.9 ounces per square foot (275 g/m<sup>2</sup>) and internal zinc coating minimum 0.9 ounces per square foot (275 g/m<sup>2</sup>).~~
- ~~B. Ensure protective coatings for steel posts, braces, and rails of alternate shapes or alloys comply with one of the following methods. Other protective coatings, including polymeric, metallic, or combinations of the two, that provide protection equivalent to a zinc coating meeting ASTM A 123, may be approved. When specified, PVC thermoplastic coating shall be fused and adhered to zinc-coated posts with a minimum coating thickness of 0.010 inch (0.254 mm) conforming to ASTM F 934 & ASTM F 1043 Sections 7 and 8.~~
- ~~1. Zinc coatings meeting the requirements of ASTM A 123.~~
  - ~~2. Hot dipped pure aluminum coating with a minimum coating of 0.75 ounce per square foot (228 g/m<sup>2</sup>) of surface, triple spot test, 0.70 ounce per square foot (213 g/m<sup>2</sup>) of surface, single spot test, as measured according to ASTM A 428. Both outer and inner surfaces of pipe or tubing coated with a chromate chemical treatment and a thin resin film for protection during storage or handling.~~
- ~~C. With the posts, provide approved caps that, for 3 inch and 4 inch (75 mm and 100 mm) posts, either:~~
- ~~• Make a driving fit over the upper 1/2 inch (13 mm) of the post, or~~
  - ~~• Have other approved means for holding the cap securely in place.~~

#### 4154.11 SPECIAL FITTINGS FOR CHAIN LINK FENCE.

- A. Comply with the following:
1. Attach braces to posts using fittings which will hold both the post and brace rigidly.
  2. Use diagonal ~~tension~~ truss rods of 3/8 inch (9.5 mm) diameter, round steel rods with an appropriate commercial means for tightening.
  3. Furnish a locknut or other device to hold the tightening device in place.
  - ~~4. Use wire ties meeting requirements of Article 4154.05.~~
  - ~~5~~ 4. Furnish a suitable sleeve or coupling device, recommended by the manufacturer, to connect sections of top rail and to provide for expansion and contraction.
  - ~~6~~ 5. Use stretcher bars no less than 3/8 inch (9.5 mm) diameter, or equivalent cross section area, with suitable clamps for attaching fabric to corner, end, or gate posts.

- B.** ~~Ensure all special fittings, except aluminum fittings, have a galvanized coating of no less than 0.8 ounce per square foot (244 g/m<sup>2</sup>) applied by the hot dip process also conform to AASHTO M 181.~~

#### **4154.12 GATES.**

##### **A. Field Fence and Chain Link Fence.**

1. Ensure gates provide the width of opening shown in the contract documents. Install a vertical stay in gates more than 6 feet (1.8 m) wide. Where the width of opening specified is:
  - 16 feet (5 m) or less, provide a single gate frame.
  - More than 16 feet (5 m), provide two gate frames using a drop bar locking device allowing operation as a double gate.
2. Ensure each gate is furnished complete with necessary hinges, latch, and other special fittings recommended for the type of gate and gate post being installed.
3. For chain link fence gates, use the pipe size shown in the contract documents or approved by the Engineer. When size is not shown in the contract documents, use:
  - 1 1/2 inch (40 mm) nominal diameter pipe for gates 6 feet (1.8 m) wide or more, and
  - 1 1/4 inch (30 mm) nominal diameter pipe for gates less than 6 feet (1.8 m) wide.
4. Use gate fabric similar to that used for the fence. Attach using stretcher bars.
5. Use adjustable rods to cross truss gates 6 feet (1.8 m) wide or more.
6. Ensure materials are galvanized with no less than 0.8 ounce per square foot (244 g/m<sup>2</sup>) of surface. Gates for field fence may be painted with a prime coat and an enamel finish coat.

##### **B. Deer Fence.**

Furnish the following, galvanized according to Article 4154.10:

1. Tines molded in one piece of steel with no welds.
2. Structural steel tubes with wall thickness of 0.1875 inches (4.75 mm) and unit weight of 4.32 pounds per foot (6.43 kg/m).
3. Support plates, hinges, and top braces.

#### **Section 4167**

#### **4167.02, B.**

**Replace** the second sentence:

Approved pile points are listed in Materials I.M. ~~467.02~~ 468, Appendix A.

#### **Section 4169**

#### **4169.07, A, Straw Mulch.**

**Add** as the last sentence:

Bail cereal or native grass straw the same growing season as the grain was harvested from the plant.

#### **4169.07, B, 2, Bonded Fiber Matrix.**

**Add** the Articles:

- f. All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.
- g. Other products not meeting requirements of Article 4169.07, B, 2, e, may be approved if they meet the following requirements:

- 1) Contain non-toxic tackifiers that upon drying become insoluble and non-dispersible to eliminate direct raindrop impact on soil according to ASTM D 7101 and EPA 2021.0-1.
- 2) Contain no germination or growth inhibiting factors and do not form a water-resistant crust that can inhibit plant growth.
- 3) Hydraulic mulch that is completely photo-degradable or biodegradable.
- 4) Contain a minimum 90% organic material according to ASTM D 2974.
- 5) Have a rainfall event (R-factor) of  $140 < R$  according to ASTM D 6459.
- 6) Have a cover factor of  $C \leq 0.03$  according to ASTM D 6459.
- 7) Vegetation Establishment of 400% minimum according to ASTM D 7322.
- 8) Water Holding Capacity 600% minimum according to ASTM D 7367.

#### 4169.07, B, 3, Mechanically-Bonded Fiber Matrix.

Add the Articles:

- f. All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.
- g. Other products not meeting requirements in Article 4169.07, B, 3, e, may be approved if they meet the following requirements:
  - 1) Contain non-toxic tackifiers that upon drying become insoluble and non-dispersible to eliminate direct raindrop impact on soil according to ASTM D 7101 and EPA 2021.0-1.
  - 2) Contain no germination or growth inhibiting factors and do not form a water-resistant crust that can inhibit plant growth.
  - 3) Hydraulic mulch that is completely photo-degradable or biodegradable.
  - 4) Contain a minimum 90% organic material according to ASTM D 2974.
  - 5) Have a rainfall event (R-factor) of  $175 < R$  according to ASTM D 6459.
  - 6) Have a cover factor of  $C \leq 0.01$  according to ASTM D 6459.
  - 7) Vegetation Establishment of 500% minimum according to ASTM D 7322.
  - 8) Water Holding Capacity of 700% minimum according to ASTM D 7367.

#### 4169.10, Special Ditch Control, Turf Reinforced Mat, and Slope Protection.

Replace the title and first paragraph:

##### **SPECIAL DITCH CONTROL, TURF REINFORCEMENT MAT, AND SLOPE PROTECTION, AND OUTLET OR CHANNEL SCOUR PROTECTION (TRANSITION MAT).**

~~For plastic netting, wood excelsior mat, coconut fiber mat, straw-coconut mat, straw mat, and wire staples,~~  
Comply with the following and meet the requirements of Materials I.M. 469.10.

Add the Article:

##### **F. Outlet or Channel Scour Protection (Transition Mat)**

1. **Mat.**
  - a. Constructed of 85% minimum UV resistant material with a maximum ground cover of 80%.
  - b. Meet the requirements of Table 4169.10-2:

**Table 4196.10-2: Material Property and Performance Requirements**

Property	Test Method	Value
Mass/Unit Area (max)	ASTM D 6566	3 lbs/ft <sup>2</sup> (15 kg/m <sup>2</sup> )
Thickness (min)	ASTM D 6525	0.4 in (10 mm)
Thickness (max)	ASTM D 6525	1.1 in (28 mm)
Tensile Strength (TD)	ASTM D 6818	550 lbs/ft (820 kg/m)
Percent Open Area (min)	ASTM D 6567	20%
UV Stability	ASTM D 4355	85%

2. **Anchoring Devices.**
  - a. Furnish bullet tip style anchors made of a metal alloy attached to a wire rope.
  - b. Anchors capable of withstanding a minimum 300 pounds (136 kg) of pull out resistance in cohesive soils.
  - c. Wire rope a minimum of 30 inches (762 mm) in length with a minimum breaking strength of at least 300 pounds (136 kg).
  - d. The top washer a minimum of 3 inches (76 mm) in diameter and constructed of a UV resistant plastic.

- e. Each anchor equipped to allow the retightening of the anchor when deemed necessary by the Engineer.

#### 4169.12, Perimeter and Slope Sediment Control Device.

Replace the Article:

##### A. General.

1. Provide wattles, sediment logs, and filter socks consisting of wood products (including wood mulch), cereal grain straw, or native grass straw contained in a tube of photo degradable fabric or synthetic netting.
2. Fill wattles, sediment logs, and filter socks using a mechanical device. Hand filling of wattles, sediment logs, and filter socks will not be allowed.
3. Ensure wattles, sediment logs, and filter socks do not contain:
  - A visible admixture of refuse or other physical contaminants,
  - Germination or growth inhibiting factors, or
  - Material toxic to plant growth.
4. Ensure wattles, sediment logs, and filter socks have waterproof identification tags printed using permanent ink and containing manufacturer's name and address. For wattles and sediment logs, tags shall be attached to the inside of the netting of each wattle or sediment log. For filter socks, tags shall be attached to the outside of each sock.
5. Approved perimeter and slope sediment control devices are listed in Materials I.M. 469.10, Appendix E.

##### A B. Wattles and Sediment Logs.

~~Wood excelsior or straw contained in a tube of photodegradable open weave fabric (synthetic netting). Install according to manufacturer's recommendations.~~

1. Ensure cereal grain straw for wattles or sediment logs is Certified Noxious Weed Seed Free Mulch certified by the Iowa Crop Improvement Association or other state's Crop Improvement Associations.
2. Wattles or sediment logs with observed unharvested seed heads will not be accepted.
3. For wood excelsior sediment logs and straw wattles, meet the following minimum weight (mass) requirements:
  - 20 inch (510 mm) sediment logs and straw wattles: 3 pounds per foot (4.45 kg/m) with tolerance of 0.25 pounds per foot (0.40 kg/m).
  - 12 inch (300 mm) sediment logs and straw wattles: 2 pounds per foot (3.00 kg/m) with tolerance of 0.25 pounds per foot (0.40 kg/m).
  - 9 inch (230 mm) sediment logs and straw wattles: 1 pound per foot (1.50 kg/m) with a tolerance of 0.1 pounds per foot (0.15 kg/m).
  - 6 inch (150 mm) sediment logs and straw wattles: 0.5 pounds per foot (0.75 kg/m) with a tolerance of 0.1 pounds per foot (0.15 kg/m).

##### B C. Filter Socks.

~~Continuous, tubular, knitted photodegradable, synthetic mesh netting. Provide filter socks with a maximum 3/8 inch (10 mm) opening fabricated using 5 mil (0.125 mm) thickness photodegradable HDPE and filled with a compost/wood blend filter material consisting of compost from an approved source meeting Article 4169.08. Fill sock by blowing filter material into tube with a pneumatic blower truck or similar device. Hand filling will not be allowed. Install according to manufacturer's recommendations.~~

~~C. Approved perimeter and slope sediment control devices are listed in Materials I.M. 469.10, Appendix E.~~

**Section 4170****4170.02, Materials.**

Add the Article:

- C. Comply with rules and regulations of State Entomologist of Iowa relative to nursery inspection of Nursery Stock according to provisions set forth in Section 177A.5 of Iowa Crop Pest Act, Chapter 177A, Code of Iowa

**4170.09, D, Mulch.**

Replace the Article:

~~As specified in the contract documents.~~

1. Unless stated elsewhere on the contract documents, use material consisting of shredded bark or shredded wood, or a mixture containing no more than 50% wood chips. Allow Engineer to visually inspect material prior to application.
2. Comply with the following requirements:
  - Use tree bark and wood chips consisting of either hardwood or softwood as produced by a mechanical debarker or chipping machine.
  - Ensure mulch is reasonably free from leaves, twigs, dust, toxic substances, and other foreign materials.
3. Mulch material consistently delivered in excessively wet condition may be rejected by Engineer.

**Section 4171****4171, Detectable Warnings.**

Add the Section:

**4171.01 DESCRIPTION.**

Detectable warning panels shall be modular and/or prefabricated composite polymer, cast iron, or steel.

**4171.02 GENERAL.**

- A. Detectable warning panels shall meet the requirements of American with Disabilities Act Accessibility Guidelines (ADAAG).
- B. Anchors used in detectable warning panels shall meet the minimum dome size requirements when anchors are located where they replace a dome.
- C. Surface applied detectable warning panels shall have an adhesive and mechanical attachment to the hard surface.
- D. Detectable warnings shall contrast visibly with adjoining surfaces, either light on dark or dark on light. Acceptable colors for panels shall be Federal Yellow #33538 and Federal Brick Red #22144 (or approved equals). Detectable warning panels shall have a uniform color. Surface applied coating shall be applied to panel at time of manufacture and shall be powder type and baked on the surface per manufacturer's recommendations. Field-applied surface coatings and/or paint will not be acceptable.
- E. Variations from dimensions shown in contract documents shall be no more than 1/8 inch (3 mm).

**4171.03. POLYMER DETECTABLE WARNING PANELS.**

Detectable warning panels with truncated dome inserts in prefabricated panels of vitrified polymer shall include integral embedment flanges for securing the panels to the concrete. Embedment flange cells shall include vent holes for a cast in place installation. Panels shall meet the following specifications:

- ~~Warpage of Edge - 0.5% maximum.~~
- Water Absorption - ASTM D 570-98 less than 0.05% **0.2**.
- Slip Resistance - ASTM C 1028-96 greater than 0.80.

- Compressive Strength - ASTM D 695-02a greater than 28,000 psi (193 MPa).
- Tensile Strength - ASTM D 638-03 greater than 19,000 11,600 psi (131 80 MPa).
- Flexural Strength - ASTM D 790-03 greater than 25,000 psi (172 MPa).
- Chemical Stain Resistance - ASTM D 543-95 no discoloration or staining.
- Abrasive Wear - ASTM D 2486-00 less than 0.060 after 1000 cycles.
- Wear Resistance - ASTM C 501-84 greater than 500.
- Fire Resistance - ASTM E 84-05 flame spread less than 45 20.
- Impact Resistance - ASTM D 5420-04 greater than 550 inch-pounds per inch (24.5 J/cm).
- Accelerated Weathering - ASTM G 155-05a for 3000 hours  $\Delta E < 4.5$  tile color 33538, no fading or chalking.
- Accelerated Aging Cycle testing - ASTM D 1037 no change in color, gloss or delamination.
- Freeze Thaw - ASTM D 1037-99 1026 no cracking, delamination, or other defects.
- Salt Spray - ASTM B 117-03 for 200 hours or no deterioration after 200 hours of exposure.

#### 4171.04. CAST IRON DETECTABLE WARNING PANELS.

Detectable warning panels with truncated dome inserts in cast iron panels shall meet the following requirements:

- Slip resistance - ASTM C 1028 greater than 0.8.
- ~~Tensile strength of gray cast iron conforming to ASTM A 48.~~
- Wear resistance - ASTM A 532 C 501 greater than 8500.
- Impact resistance - ASTM A 327 greater than 550 inch-pounds per inch (24.5 J/cm). Resistance to impact from Falling Tub NCHRP Report 670: Draft T4-33, Part II. No Substantial damage.
- ~~Warpage of edge 0.5% maximum.~~
- Meet Article 4153.04.

#### 4171.05. STEEL DETECTABLE WARNING PANELS.

Detectable warning panels with truncated dome inserts in steel panels shall meet the following requirements:

- Slip resistance - ASTM C 1028 greater than 0.8.
- Wear resistance - ASTM A 532 C 501 greater than 8500.
- Impact resistance - ASTM A 327 greater than 550 inch-pounds per inch (24.5 J/cm). Resistance to impact from Falling Tub NCHRP Report 670: Draft T4-33, Part II. No Substantial damage.
- ~~Warpage of edge 0.5% maximum.~~
- Meet Article 4153.03.

### Section 4183

#### 4183.06, A, Removable Marking Tape.

Rename and Replace the Article:

##### **Wet, Retroreflective Removable Marking Tape Markings.**

Comply with Materials I.M. 483.06 and meet the following requirements:

##### **1. ~~Thickness.~~**

~~Average thickness of the film, including glass spheres, no less than 30 mils (0.76 mm) or more than 70 mils (1.78 mm).~~

##### **2. ~~Retroreflectance.~~**

~~For white or yellow tapes, meet the following initial minimum retroreflectance values at 1.05 degree observation angle and 88.76 degree entrance angle, measured by a LTL 2000 retroreflectometer.~~

~~Specific luminance, mcd/sq.ft./ft. cdL. (lux • m<sup>2</sup>)~~ ~~550~~ ~~325~~

1. Ensure film is free of lead, chrome, and other heavy metals as defined by the EPA.
2. Precoat markings with pressure sensitive adhesive capable of adhering to the pavement at temperatures as low as 50°F (10°C) in accordance with the manufacturer's recommendations.
3. **Retroreflectance.**
  - a. Ensure white and yellow markings have initial expected retroreflectance values as shown in Table 4 4183.06-1 under dry, wet, and rainy conditions.

- b. Measure wet retroreflectance values under a “condition of wetness” according to ASTM E 2177. Test may be performed with marking installed on road. Perform laboratory measurements using a 3 to 5 degree lateral slope. Use wetting agent to improve wetting of pavement marking with water. Use of a 0.1% (by volume) liquid soap solution is recommended. Report measurements as an average for each roll tested, in a minimum of three locations.
- c. Measure wet retroreflectance values under a “condition of continuous wetting” (simulated rain) according to ASTM E 2176, in a controlled laboratory environment while the marking is positioned with a 3 to 5 degree lateral slope. Use wetting agent to improve wetting of pavement marking with water. Use of a 0.1% (by volume) liquid soap solution is recommended. Report measurements as an average for each roll tested, in a minimum of three locations.

**Table 4183.06-1: Expected Initial  $R_L$  under dry, wet, and rainy conditions**

<b>WHITE</b>	<b>Dry, Wet, &amp; Rainy</b>
Entrance Angle	88.76 degrees
Observation Angle	1.05 degrees
Retroreflected Luminance $R_L [(mcd \bullet ft^{-2}) \bullet fc^{-1}]$ ( $R_L [(mcd \bullet m^{-2}) \bullet lx^{-1}]$ )	150
<b>YELLOW</b>	<b>Dry, Wet, &amp; Rainy</b>
Entrance Angle	88.76 degrees
Observation Angle	1.05 degrees
Retroreflected Luminance $R_L [(mcd \bullet ft^{-2}) \bullet fc^{-1}]$ ( $R_L [(mcd \bullet m^{-2}) \bullet lx^{-1}]$ )	100

**4. Removability.**

Pavement markings shall be removable from the pavement intact or in large pieces, at temperatures above freezing without the use of heat, solvents, grinding, or blasting; and with no permanent scarring of the roadway surface.

**5. Patchability.**

Pavement marking material shall be capable of being patched in accordance with manufacturer's instructions.

**Section 4185****4185, Highway Lighting Materials.**

**Replace the Section:**

**4185.01 DESCRIPTION.**

- A. Furnish materials for highway lighting of the size and type specified.
- B. When more than one unit of any item is required for installation, furnish units that are all the same make and design. Furnish apparatus and materials that meet the following:
  - Are new products of manufacturers regularly engaged in production of items of this type,
  - Are the manufacturer's latest approved design,
  - Carry the UL seal of approval, if listed, and
  - Are recommended by the manufacturer for the intended use.

**4185.02 POLES AND SUPPORTS.****A. General.**

1. Furnish steel, aluminum, or wood poles of the size and type specified.
2. Each lighting pole is to include provisions for supporting the luminaire or luminaires. If furnishing metal poles, furnish poles consisting of:

- A tapered round shaft, complete with a base, and removable pole top,
  - Nameplate or other identification displaying the manufacturer's name, type, height, and shop order number, and
  - Appurtenant supporting devices.
3. Dimensions and other details will be shown in the contract documents. Furnish poles and mastarms meeting the mounting height and mastarm length shown in the contract documents. Ensure the structural design of the light pole is based on the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.
  4. The assembled lighting unit, consisting of the pole and all attachments including mastarms, luminaires, and breakaway base or slip base, as specified, complete and in place in the footing anchor bolts, is required to withstand windloading equal to a wind of 80 mph (130 km/h) without fracture or apparent deformation of components. Furnish poles in one section. Ensure each standard is designed for a luminaire dead load of 75 pounds (35 kg) and a projected area of 1.5 square feet (0.10 m<sup>2</sup>), except that in the case of twin mastarms, these values are applied to each mastarm.
  5. Furnish castings incidental to poles that are smooth and clean, with all details well defined and true to pattern.
  6. Furnish pole bases that telescope the pole shaft and are attached to the pole shaft by two welds (top and bottom) subject to approval of the Engineer. Ensure bases other than slip base poles have four anchor bolt holes located 90 degrees apart in the bolt circle. If slip bases are furnished, ensure they have three anchor bolt holes located 120 degrees apart in the bolt circle, oriented as shown in the contract documents. For poles with mastarms, ensure the centers of two adjacent anchor bolt holes are on a line parallel with the neutral plane of the pole shaft with respect to one mastarm, designated as the standard mastarm.
  7. Obtain a template from the manufacturer for placement of anchor bolts.
  8. With the pole, furnish metal ornamental covers for the upper ends of the anchor or attachment bolts for breakaway base poles.
  9. Provide a wiring handhole, no less than 4 inches by 6 inches (100 mm by 150 mm), with a weatherproof metal cover, for all metal poles not mounted on transformer bases, or as shown in the contract documents. Center the handhole on a point no less than 14 inches (350 mm) or no more than 18 inches (450 mm) above the bottom surface of the pole base mounting flange, and 90 degrees clockwise from the center line of the standard mastarm, as viewed from above. Ensure the pole shaft has a J-hook at the top for supporting cables.
  10. Ensure each pole has an approved grounding lug. When a handhole is furnished, ensure the grounding lug is readily accessible through the handhole. Ensure grounding lugs for breakaway base poles are accessible from the bottom of the pole shaft.

**B. Anchor Bolt and Slip-Base Plate Fasteners for Lighting Poles.**

1. Furnish all bolts, nuts, and washers for pole attachment and anchoring according to the details in the contract documents. Ensure assembled fasteners are capable of withstanding the forces corresponding to a moment that will cause failure of the pole, transformer base, or other applicable mounting device.
2. Furnish anchor bolts that:
  - Meet the requirements of ASTM F 1554, Grade 105 (724 MPa),
  - Are full-length galvanized according to ASTM F 2329, and
  - Are Unified Coarse Thread Series with Class 2A tolerance.
3. Color code the end of each anchor bolt intended to project from the concrete in red to identify the grade.
4. If slip bases are furnished, furnish 1 inch by 4 1/2 inch (25 mm by 112 mm) bolts that:
  - Are high-strength bolts meeting the requirements of ASTM A 325, and
  - Are fully mechanically galvanized to ASTM B 695, Class 50 55, Type 4 I.

5. Furnish washers that:
  - Meet the requirements of ASTM F 436, and
  - Are galvanized.
6. Furnish nuts that:
  - Meet the requirements of ASTM A 563, ~~DH~~,
  - Are grade DH,
  - Are heavy hex, and
  - Are galvanized according to the requirements of ASTM ~~A-153~~ F 2329, ~~Class C~~, or ASTM B 695, Class ~~50~~ 55, Type I.
7. Nuts may be over-tapped according to the allowance requirements of ASTM A 563. Nuts may be tapped oversize only enough to provide a finger free fit.

#### C. Mastarms and Accessories.

1. When indicated in the contract documents, furnish single or twin mastarms as luminaire supports. The contract documents will show the horizontal span of the mastarm and the included angle between the center lines of twin mastarms. Such angles are defined as rotating from the standard mastarm, as viewed from above.
2. Furnish mastarms meeting the following requirements:
  - a. Aluminum tube or galvanized steel to match the pole, with smooth openings into the pole shaft to provide an electrical raceway.
  - b. Capable of accommodating a 2 inch (50 mm) slipfitter type luminaire.
  - c. **Type A mastarms:** no braces or truss members.
  - d. **Type B mastarms:** a single underbrace attached to the mastarm at no less than two locations.
3. Furnish mastarm bolts, nuts, and washers that are stainless steel and meet the requirements of Article 4187.01.

#### D. Breakaway (Transformer) Base.

Furnish bases meeting the following requirements:

1. ~~Cast aluminum meeting requirements of ASTM B 108, 356 T6 or B 26, 356 T6 aluminum alloy. Two piece weldments with internally welded inside corners/material 356 T6 complying with ASTM B 108-87 aluminum alloy permanent mold castings.~~
2. ~~Compliance with AASHTO breakaway criteria.~~ Designed according to AASHTO Standards and Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.
3. Meet or exceed NCHRP Report 350, or AASHTO MASH criteria for any assembly system evaluated after January 1, 2011.
- 3 4. ~~Capable of withstanding an applied moment at the top equal to the design moment of the applicable pole, and no less than 35,000 foot-pounds (47,500 N·m). Capable of supporting the pole mounting height and mastarm length shown in the contract documents.~~
4. ~~Yields to an applied momentum of 1,100 pound-seconds (4.9 kNs) when tested with an automobile or 400 pound-seconds (1.8 kN·s) when tested with a solid mass. The manufacturer should conduct the tests and certify the results to comply with requirements of current AASHTO requirements for breakaway luminaire supports.~~
5. Equipped with a ~~weatherproof~~ manufacturer furnished, other than aluminum (in other words, having no scrap value), access door with door opening area of no less than 100 square inches (0.065 m<sup>2</sup>), unless shown otherwise.

#### E. Steel Poles and Mastarms.

1. Furnish poles meeting the following requirements:

- a. Shafts manufactured with a taper of approximately 0.14 inch per foot (12 mm/m) of length.
  - b. Steel that is no less than 11 gage (3.03 mm), with a minimum yield strength of 48,000 psi (330 MPa), after fabrication.
  - c. Steel galvanized according to ASTM A 123. Steel 1/8 inch (3 mm) thick or less shall be galvanized to comply with requirements for 1/8 inch (3 mm) thick steel as described in ASTM A 123.
2. Furnish Type A and B mastarms meeting the following:
- a. Fabricated from standard weight, welded steel, 2 inch (50 mm) pipe meeting the requirements of ASTM A 53, Grade B, and galvanized according to ASTM A 123.
  - b. Underbrace for a Type B mastarm complying with requirements of the mastarm and connected to the mastarm by welded steel braces to form a truss type assembly.
  - c. Mastarm to shaft brackets that provide a water tight connection.

#### **F. Aluminum Poles and Mastarms.**

1. Furnish poles meeting the following requirements:
- a. Fabricated from ASTM B 221 6063-T6 or 6061-T6 aluminum alloy tube or ASTM B 209 5086-H34 aluminum sheet.
  - b. Minimum nominal wall thickness of 3/16 inch (5 mm) unless indicated otherwise in the contract documents.
  - c. Shafts tapered approximately 0.14 inch per foot (12 mm/m) of length.
  - d. Castings of ASTM A 356/A 356M-T6 aluminum alloy meeting the requirements of Article 4187.01.
  - e. Approved dampening device included.
  - f. Blocked and paper-wrapped prior to shipment.
2. Furnish Type A and B mastarms meeting the following:
- a. Fabricated from alloy complying with requirements for the pole shaft.
  - b. Types A and B mastarms fabricated from tubing or pipe with a minimum outside diameter of 2.375 inches (60.325 mm), and swaged, when required, to accommodate a 2 inch (50 mm) slipfitter type luminaire.
  - c. Welded braces used to connect the underbrace for a Type B mastarm to the mastarm in order to form a truss type assembly.

#### **G. Wood Poles.**

1. Furnish poles meeting the following requirements:
- a. ANSI ~~05.4~~ (ATIS) O5.1, Group D.
  - b. Pressure treated with pentachlorophenol according to AASHTO M 133.
2. The size and class of wood poles will be specified in the contract documents.

### **4185.03 LUMINAIRES.**

#### **A. Roadway Luminaire.**

1. Furnish roadway luminaire assemblies consisting of the following:
- a. A weatherproof, die cast aluminum or aluminum alloy housing and slipfitter with internally mounted ballast.
  - b. A hinged, detachable, glass refractor manufactured from high-transmission-factor, highly shockproof, prismatic glass.
  - c. A snap-in aluminum reflector.
  - d. A high grade porcelain enclosed socket and terminal block with pressure type terminals for connecting leads entering from the mounting bracket or mastarm.
2. Fit a heat resistant gasket between the reflector and a shoulder in the socket support plate to seal the optical system at this point.
3. Furnish a slipfitter that consists of bracket clamps and provides for vertical adjustment and horizontal leveling of the luminaire. Arrange the slipfitter to accommodate a 2 inch (50 mm) standard pipe bracket.

4. Furnish a weatherproof, hinged, access door for quick access to the terminal block and mounting arrangement. Ensure exposed metal parts are made from nonferrous metal or stainless steel.
5. With the high pressure sodium lamp, furnish a regulated high-power-factor type ballast with starting current lower than operating current. Ensure it will maintain lamp wattage within 10% variation with a line voltage regulation of  $\pm 10\%$ , with no less than 90% power factor. Ballast for use with other light sources will be specified in the contract documents.
6. The contract documents will specify the luminaire according to the type of lamp to be used and its size in watts. Unless specified otherwise, furnish only the light sources for roadway luminaires listed in Table 4185.03-1:

**Table 4185.03-1: High Pressure Sodium Lamp**

<b>Wattage</b>	<b>ANSI C78.42-2009 Designation</b>	<b>Bulb</b>
400 Watt	ANSI Code S51WA 400 S51/O-EJ	E18
250 Watt	ANSI Code S50VA 250 S50/O-EJ	E18
200 Watt	ANSI Code S66MN 200 S66/O-EJ	E18
150 Watt	ANSI Code S55SC 150 S55/O-NV	E23.5
100 Watt	ANSI Code S54SB 100 S54/O-NV	E23.5
70 Watt	ANSI Code S62ME 70 S62/O-NV	E23.5
Furnish high pressure sodium lamps for appropriate burning positions, as required by the luminaire.		

#### **B. Underdeck Lighting and Low Mounting Height Luminaires.**

1. Furnish complete low mounting height luminaires consisting of the following:
  - a. An optical train which includes a single piece, prismatic refractor mounted in an aluminum door assembly.
  - b. An asymmetric, specular processed aluminum reflector.
  - c. An anodized aluminum visor.
  - d. An attached or integral ballast housing.
  - e. A cast aluminum luminaire housing.
  - f. When specified, an adaptor mount and shield for sign lighting.
2. Furnish a door assembly equipped with noncorrosive metal pressure latches, hinges, and safety chain.
3. Furnish a luminaire housing complete with:
  - Captive neoprene and felt double gasketing,
  - A rear access hole in a gasketed aluminum cover plate, and
  - Tapped conduit entries as shown in the contract documents.
4. Furnish a refractor that meets the following:
  - a. Fabricated from molded, high-transmission-factor, thermal shock resisting, crystal glass.
  - b. Is of adequate size to properly house the specified lamp and to produce the required light distribution.
  - c. Inner and outer surface are covered with an array of reflecting and refracting prisms and diffusing flutes which are designed to provide an asymmetric light distribution.
5. With a high pressure sodium lamp, furnish a regulated high-power-factor type ballast with starting current lower than operating current. Ensure it will maintain lamp wattage within 10% variation with a line voltage regulation of  $\pm 10\%$ , with no less than a 90% power factor. The contract documents will specify the ballast for use with other light sources.
6. Ensure maximum luminous intensity (candela) output occurs at 60 degrees from the vertical. Ensure the unit provides a 180 degree horizontal spread in the maximum luminous intensity (candela) plane.
7. Ensure entire luminaire is designed to be attached to a wall outlet box mounted to a stud, a metal channel framing, or a sign lighting adaptor and shield. Unless specified otherwise in the contract documents, furnish the light source for the luminaire listed in Table 4185.03-2:

**Table 4185.03-2: High Pressure Sodium Lamp  
(Underdeck Lighting and Low Mounting Height Luminaires)**

<b>Wattage</b>	<b>ANSI C78.42-2009 Designation</b>	<b>Bulb</b>
250 Watt	ANSI Code S50VA-250 S50/O-EJ	E18
150 Watt	ANSI Code S55SC-150 S55/O-NV	E23.5
100 Watt	ANSI Code S54SB-100 S54/O-NV	E23.5
70 Watt	ANSI Code S62ME-70 S62/O-NV	E23.5
Furnish high pressure sodium lamps for appropriate burning positions, as required by the luminaire.		

#### **4185.04 GROUND RODS.**

- A. Furnish approved, copper clad, steel rods of the diameter and length designated in the contract documents.
- B. Unless designated otherwise, furnish rods of a minimum nominal 5/8 inch (16 mm) diameter, and a minimum length of 12 feet (3.6 m) for control stations cabinets and 8 feet (2.4 m) for installations at lighting units.
- C. Include pressure type clamps and bonding jumpers as required. Unless shown otherwise in the contract documents, furnish bare solid conductor copper wire, No. 6 AWG or larger, bonding jumpers.

#### **4185.05 CONTACTORS.**

- A. Lighting contactors may be housed within control cabinets as shown in the contract documents.
- B. Meet the following requirements for contacts:
  - 1. Two pole, single throw, magnetically held, normally open relays rated at 480 volts AC or greater.
  - 2. Double break, self cleaning type with interrupting ratings as shown in the contract documents.
  - 3. Material designed for lighting ballast loads and requiring no maintenance, such as filing, burnishing, or dressing at any time the contactor is in service.
  - 4. A permanent instruction contained within the cabinet housing stating, "Contacts shall not be filed, burnished, or dressed".
  - 5. Movable contact holders of one piece, molded construction. Opening action obtained by free fall from gravitational forces or by use of noncorrosive springs. The Contractor may use pivots of the hardened, knife edge type.
- C. Meet the following requirements for operating coils:
  - 1. A 60 hertz frequency supply.
  - 2. Removable from the front of the contactor assembly without disturbing other components or wiring.
  - 3. Each designed to prevent any expansion, bubbling, or melting that would render the remainder of the unit inoperative in event of a coil burnout.

#### **4185.06 PHOTO-ELECTRIC CONTROL.**

Furnish controls meeting the following requirements:

- A. Weatherproof.
- B. Fits the standard 3 prong EEI/NEMA twist-lock socket.
- C. Operates with a 60 hertz frequency control circuit.

- D. Designed so that any failure under normal conditions will cause the lighting circuits to be energized.
- E. All ratings in compliance with the control requirements of the contactor.
- F. Time delay type set to turn on at 2.0 footcandles (20 lux) and off at 6.0 footcandles (60 lux).

#### **4185.07 CONTROL CABINETS.**

- A. Furnish cabinets meeting the following requirements:
  - 1. Type 304 stainless steel minimum 14 gage, or 0.125 inch (3.17 mm) aluminum, weatherproof NEMA Type 3R enclosures.
  - 2. Full-sized door gasket.
  - 3. Drip shield.
  - 4. Top-mounted 3 prong photo-electric control socket.
  - 5. Insect-proof breather.
  - 6. Labyrinth type breather drain.
  - 7. An internal back panel for component mounting.
  - 8. Door with a single external padlock handle to operate a door latch. Latch mechanism to include no less than two approved roller latches.
  - 9. Cabinet size adequate to provide access to all components for maintenance and replacement without disturbing other components or wiring.
  - 10. Unless detailed otherwise in the contract documents, space provided for no less than one line (main) circuit breaker and four branch circuit breakers, one contactor, two surge ~~suppressors~~ protection devices, and a test switch.
  - 11. Each pole-mounted cabinet equipped with pole mounting brackets, conduit, and hubs.
  - 12. Each pad-mounted cabinet equipped with a removable bottom plate and an internal flange with hold-down clamps for attachment to a concrete base.
- B. The contract documents will show the location, type, and other details of control cabinets.
- C. Include the following appurtenances:
  - 1. A line circuit breaker that may also serve as main disconnect means.
  - 2. A photo-electric control.
  - 3. Two surge ~~suppressors~~ protection devices.
  - 4. A maintained contact, three position switch (with all functions labeled as shown in the contract documents) to provide a means of overriding automatic operation of the lighting system for testing purposes.
- D. The contract documents will show the quantity and ratings of circuit breakers and other details of individual installations.
- E. Apply all requirements for a pad mounted control cabinet with contactor. Provide cabinets with continuously welded seams and minimum interior dimensions of 2 feet 6 inches high by 3 feet wide by 2 feet deep (760 mm high by 600 mm wide by 200 mm wide).

**4185.08 HANDHOLES AND JUNCTION BOXES.**

Provide four galvanized steel cable hooks with a minimum diameter of 3/8 inch (10 mm) and a minimum length of 5 inches (125 mm).

**A. Precast Concrete Handholes.**

The contract documents will show locations and other details. Meet the following requirements:

**1. Pipe.**

~~Ensure the body of the precast handhole meets the requirements for Class 1500D (75D) concrete pipe. Comply with ASTM C 76. Minimum 2000D (Class III), Wall B. Four 8 inch (200 mm) knockouts (conduit entrance points) equally spaced around the handhole.~~

**2. Casting.**

~~For the handhole cover, furnish a heavy duty cast iron frame and lid that sits inside the pipe end. Gray cast iron and certified according to requirements of AASHTO M 306 for a 16,000 pound (7260 kg) proof load (HS-20).~~

**3. Cover.**

~~The contract documents will show handhole locations and other details. Include "ELECTRIC" as a message on the cover unless specified otherwise in the contract documents.~~

**B. ~~Preformed Precast Concrete Composite Handholes and Junction Boxes.~~**

~~Furnish handholes boxes meeting~~ The contract documents will show locations and other details. Meet the following requirements:

~~1. Constructed to the dimensions shown in the contract documents.~~

~~2~~ **1.** ~~Constructed with~~ Handhole (or junction box) and cover fabricated using mortar consisting of sand, gravel, and polyester resin reinforced by a woven glass fiber mat or of resin mortar and fiberglass. Include "ROADWAY LIGHTING" as a message on the cover unless specified otherwise in the contract documents.

~~3~~ **2.** ~~Constructed~~ Fabricated to withstand a load of 20,000 pounds (9,000 kg).

~~4~~ **3.** ~~Each handhole equipped with a bolt down cover of the same material.~~ Provide two 3/8-16 UNC stainless steel hex head bolts with washers.

~~5. Lock down bolts of stainless steel with penta head.~~

**C. Cast Iron Junction Boxes.**

The contract documents will show locations and other details. Meet the following requirements:

1. Cast iron boxes and covers galvanized according to ASTM A 153.

2. Boxes classified by the manufacturer as meeting the requirements for NEMA 4, Watertight.

3. UL approved boxes.

4. Apply applicable provisions of Article 314 of the current NEC.

5. Raised buttons (blind drilled, tapped, and fitted with screws as specified) of the specified size and location cast into the surface of the box floor and cover for grounding purposes.

6. Neoprene gaskets used.

**~~4185.09 JUNCTION BOXES.~~****~~A. Preformed Junction Boxes.~~**

~~Furnish boxes meeting the following requirements:~~

- ~~1. Constructed to the dimensions shown in the contract documents.~~
- ~~2. Constructed with mortar consisting of sand, gravel, and polyester resin reinforced by a woven glass fiber mat or of resin mortar and fiberglass.~~
- ~~3. Each junction box equipped with a bolt down cover of the same material.~~
- ~~4. Stainless steel screws.~~

**~~B. Cast Iron Junction Boxes.~~**

- ~~1. Furnish boxes meeting the following requirements:~~
  - ~~a. Cast iron boxes and covers galvanized according to ASTM A 153.~~
  - ~~b. Boxes classified by the manufacturer as meeting the requirements for NEMA 4, Watertight.~~
  - ~~c. UL approved boxes.~~
  - ~~d. Apply applicable provisions of Article 370 of the current NEC.~~
  - ~~e. Raised buttons (blind drilled, tapped, and fitted with screws as specified) of the specified size and location cast into the surface of the box floor and cover for grounding purposes.~~
  - ~~f. Neoprene gaskets used.~~
- ~~2. The contract documents will show locations and other details.~~

**4185.10 09 CONDUIT AND FITTINGS.**

**A. General.**

1. The type, size, and location of all conduit will be indicated in the contract documents. Do not substitute types of conduit material.
2. Furnish weatherproof fittings of identical or compatible material to the conduit. Use standard factory elbows, couplings, and other fittings when possible.
3. Limit the inside radius of all field bends to no less than 6 times the internal diameter of the conduit. Bend so as not to kink, flatten, or otherwise significantly reduce the effective cross sectional area of the conduit.

**B. Rigid Steel Conduit.**

Furnish conduit meeting the following requirements:

1. Compliance with ~~ANSI~~ NEMA C80.1.
2. Identified with the manufacturer's name and trade mark and the words "rigid steel conduit" or "rigid metal conduit."
3. Weatherproof expansion fittings with galvanized, malleable iron, fixed and expansion heads jointed by rigid steel conduit sleeves. As an option, the fixed head may be integral with the sleeve, forming a one piece body of galvanized malleable iron.

**C. Rigid Aluminum Conduit.**

Furnish conduit meeting the requirements of ~~ANSI~~ NEMA C80.5.

**D. Plastic Conduit and Fittings.**

Furnish conduit and fittings meeting the following requirements:

1. PVC Schedule 40 and 80 plastic conduit and fittings meeting the requirements of NEMA TC-2, TC-3, and UL 651 for Schedule 40 heavy wall type.
2. Solvent welded, socket type fittings, except where indicated otherwise in the contract documents.
3. Threaded adaptors for jointing plastic conduit to rigid metal ducts.

4. Compliance with applicable requirements of NEMA TC-3 and UL 514B and the manufacturer's recommendation for all materials and methods for attaching and making fittings. Obtain the Engineer's approval.

#### **4185.41 10 CONNECTOR ASSEMBLIES.**

~~Details of connector assemblies will be shown in the contract documents.~~ Furnish connectors with complete instructions, assembly devices, a disposable mounting pin (when required), and silicone lubricant for all mating surfaces. Ensure connector assemblies are: 1) waterproof; 2) designed for both direct burial in the earth and exposure to sunlight; and 3) are capable of repeated disconnections without damage to the watertight seals and terminals or reduction of conductivity below specifications. Furnish connectors recommended for the required cable sizes. Meet the following requirements for the type specified:

##### **A. Type Y-1 Connector.**

1. Furnish fused Y-1, quick disconnecting type tap connectors consisting of:
  - a. Two spring loaded, fully annealed copper contacts of 90% minimum conductivity suitable for gripping a 13/32 inch by 1 1/2 inch (10.3 mm by 38 mm) midget fuse, two terminal lugs, a bolt, and a locknut.
    - One contact adapted to be crimped to the cable and retained securely within a rubber load side tap housing.
    - The second contact preassembled and retained in a rubber Y-insert-body with provision for connecting the terminal lugs securely in place.
  - b. A permanently marked, load side tap housing, a Y-insert-body, and a Y-housing, each made of water resistant synthetic rubber. Ensure the load side housing:
    - Provides a section to form a watertight seal around the cable,
    - Has an interior arrangement to suitably receive and retain one fuse contact,
    - Is constructed to retain the fuse when disconnected, and
    - Has a section to provide a watertight seal between itself and the Y-insert-body at the point of disconnection.
2. Ensure the Y-insert-body retains the second fuse contact and provides a watertight seal for the load side housing at the point of disassembly. Ensure the Y-housing provides sections to form a watertight seal around two cables and for Y-insert-body. When both through legs of the connection are not to be used, furnish an insulated plug with the same diameter as the cable to maintain an equivalent watertight seal.

##### **B. Type Y-2 Connector.**

1. Furnish unfused Y-2, quick disconnecting type tap connectors consisting of:
  - a. A copper pin to be crimped to the cable and a spring loaded copper receptacle, both of 90% minimum conductivity, two terminal lugs, a bolt, and a locknut. The receptacle and the crimping portion of the pin are to be fully annealed. The pin is to be adapted to be retained securely within a rubber load side tap housing. The receptacle is to be preassembled and retained on a rubber Y-insert-body with provision for bolting the terminal lugs securely in place.
  - b. A permanently marked load side tap housing, a Y-insert-body, a Y-housing, each made of water resistant synthetic rubber. Ensure the load side housing:
    - Provides a section to form a watertight seal around the cable,
    - Has an interior arrangement to suitably receive and retain the pin, and
    - Has a section to provide a watertight seal between itself and the Y-insert-body at the point of disconnection.
2. Ensure the Y-insert-body retains the receptacle and provides a watertight seal for the load side housing at the point of disconnection and a watertight seal for the Y-housing at the point of disassembly. Ensure the Y-housing provides sections to form a watertight seal around two cables and for the Y-insert-body. When both through-legs of the connection are not to be used, provide an insulated plug with the same diameter as the cable to maintain an equivalent watertight seal.

##### **C. Type Y-3 Connector.**

Furnish semi-permanent Y-3 tap connectors consisting of:

1. Three terminal lugs (each provided with a mounting hole by which all lugs are bolted securely together), a bolt, and a locknut.

2. A tap housing and a Y-housing, each made of water resistant synthetic rubber. Ensure the tap housing: 1) provides a section to form a watertight seal around the cable; and 2) includes a section to provide a watertight seal between itself and the Y-housing at the point of disassembly. Ensure the Y-housing provides sections to form a watertight seal around two cables and for the tap housing. When all legs of the connection are not to be used, provide an insulated plug with the same diameter as the cable to maintain an equivalent watertight seal.

#### **D. Type L-1 Connector.**

Furnish fused L-1, quick disconnecting in-line connectors consisting of:

1. Two spring loaded, fully annealed copper contacts of 90% minimum conductivity suitable for gripping a 13/32 inch by 1 1/2 inch (10.3 mm by 38 mm) midget fuse. Both contacts are to be adapted to be crimped to the cable and retained securely within rubber housings.
2. A permanently marked, load side and line side housing, each made of water resistant, synthetic rubber. Ensure each housing:
  - Provides a section to form a watertight seal around the cable,
  - Has an interior arrangement to suitably receive and retain the fuse contact, and
  - Has a section to provide a watertight seal between the two housings at the point of disconnection.

#### **E. Type L-2 Connector.**

Furnish L-2, unfused, quick disconnecting in-line connectors consisting of:

1. A copper pin and a spring loaded copper receptacle, both fully annealed and of 90% minimum conductivity, to be crimped to the cable. Both the pin and receptacle are to be adapted to be retained securely in rubber housings.
2. A permanently marked, load side and line side housing, each made of water resistant, synthetic rubber. Ensure each housing:
  - Provides a section to form a watertight seal around the cable,
  - Has an interior arrangement to suitably receive and retain the pin or receptacle, and
  - Has a section to provide a watertight seal between the two housings at the point of disconnection.

### **4185.12 11 WIRE AND CABLE.**

Wire and cable construction types, conductor sizes, and working voltage ratings will be specified in the contract documents.

#### **A. Single Conductor Wire and Cable.**

Furnish wire and cable meeting the following requirements:

1. **Insulation.**
  - Rated for 600 volts.
  - Thermosetting, cross linked polyethylene meeting the requirements of ICEA S-66-524 S-95-658 (ANSI/NEMA WG-7 WC 70).
  - Thickness meeting the requirements of Table No. 3-1 Column "A" 3-3.
  - ~~Unless specified otherwise in the contract documents, comply with applicable requirements of UL Standard No. 44.~~
  - UL listed for use at conductor temperatures of 167°F (75°C) or higher in wet or dry locations.
2. ~~Wire and Cable.~~
  - Bears required UL labeling repeated throughout their length.
  - UL Listed Type USE-2 per UL Standard 854 and Type RHH or RHW-2 per UL Standard 44.
- 3 **2. Conductors.**
  - Annealed copper meeting the requirements of ASTM B 3.
  - Sizes smaller than No. 8 AWG, may be solid or stranded.
  - Sizes No. 8 AWG and larger are to be stranded and are to meet the requirements of ASTM B 8, Class B.

**B. Aerial Power Cable.**

Furnish cable consisting of an assembly of individually insulated conductors with a messenger cable. The insulated conductors may be either laid about the messenger or secured to the messenger with a flat binding strip. Meet the following requirements:

**1. Conductors.**

Stranded aluminum or steel reinforced aluminum (ACSR).

**2. Messenger.**

Steel or ACSR. If using steel, use steel protected with copper, aluminum, or zinc coating.

**3. Binding strip.**

Copper, bronze, or steel. If using steel, use steel protected with copper, aluminum, or zinc coating.

**4. Insulation.**

Meet the requirements of Article 4185.12, A.

**C. Thermoplastic Wire and Cable.**

Use only where specified in the contract documents. Use conductors that meet the requirements of UL Standard No. 83 and are UL listed for Type THW or Type THHN (THWN).

**D. Control Cable.**

1. Use only where specified in the contract documents. Furnish cable consisting of either:

- An assembly of conductors individually covered with polyethylene insulation, or
- Polyethylene insulation with polyvinyl chloride jacket together with suitable fillers covered overall with polyester tape and a polyvinyl chloride jacket.

2. Ensure the cable complies with requirements for ~~Type~~ Class B Control Cable as described in ANSI/ICEA ~~S-61-402~~ S-73-532 (NEMA ~~WC-5~~ WC 57).

**E. Flexible Cord.**

Use cord that is UL listed for Type SO and complies with applicable requirements of UL Standard No. 62 (~~Table 3-14~~).

**F. Bare Copper Ground Wire.**

1. Use soft drawn wire meeting the requirements of ASTM B 3, or medium hard drawn wire meeting requirements of ASTM B 2.

2. For direct burial installation, use solid wire for sizes smaller than No. 4 AWG and stranded wire for sizes of No. 4 AWG and larger. For installation in raceways or ducts, use solid wire for sizes smaller than No. 8 AWG and stranded wire for sizes of No. 8 AWG and larger. Ensure stranding meets the requirements of ASTM B 8, Class B.

**4185.13 12 SURGE SUPPRESSOR PROTECTION DEVICE.**

Furnish ~~suppressors~~ surge protection devices (SPDs) meeting the following requirements:

**A.** Metal oxide varistor (MOV) type ~~suppressor~~ SPD, suitable for 120/240 volt single-phase line voltage, with an ANSI/UL1449 ~~Category B3 voltage rating of 500 volts (line-neutral)~~ 3rd edition Type 1 with 20kA I-Nominal and voltage protection rating (VPR) of 700 volts (line-neutral).

**B.** Single-pulse (8/20 microsecond) maximum surge current rating of 50,000 amperes per mode.

**C.** NEMA 1 ~~enclosure included~~ rating that is suitable for mounting inside a lighting control cabinet.

**D.** Each ~~line~~ MOV fused and an ~~visual indication light~~ LED installed to ~~show~~ indicate power and suppression status.

**4185.14 13 TEST SWITCH.**

Furnish switches meeting the following requirements:

- A. Heavy duty maintained contact, three position switch.
- B. 600V, 10 amperes, double break type contact.

**4185.15 14 CIRCUIT BREAKER.**

Furnish breakers meeting the following requirements:

- A. Rated for 240 volts and 480 volts, with minimum interrupting ratings of 25,000 amperes, symmetrical, at 240 volts, and 18,000 amperes, symmetrical, at 480 volts.
- B. Thermal magnetic trip mechanism with a trip-free toggle operator.
- C. Frame and trip ratings as shown in the contract documents.

**Section 4186****4186.02, A, 2.**

**Replace the second sentence:**

A non chromate conversion coating conforming to ASTM B 921 may be applied to the aluminum according to the sheeting manufacturer's recommendations.

**4186.03, A, 3.**

**Replace Table 4186.03-1:**

**Table 4186.03-1: Retro Reflective Sheeting Classification**

Type I	A medium retroreflective sheeting referred to as "engineering grade". This sheeting is typically enclosed lens glass bead material.
Type II	A medium high intensity retroreflective sheeting sometimes referred to as "super engineering grade". This sheeting is typically enclosed lens glass bead material.
Type III	A high intensity retroreflective sheeting. This sheeting is typically an encapsulated glass bead retroreflective material.
Type IV	A high intensity retroreflective sheeting. This sheeting is typically an unmetallized microprismatic retroreflective element material.
Type VI (Iowa)	A flexible, very high intensity retroreflective sheeting for use on roll-up signs. This sheeting is typically a microprismatic retroreflective material.
Type VII (Iowa)	A prismatic, very high intensity retroreflective sheeting. This sheeting is typically a microprismatic retroreflective material.
Type XI	A prismatic, very high intensity retro reflective sheeting having highest retro reflective characteristics at wide range of distances.

**4186.03, B, Utilization of Reflective Sheeting.**

**Replace the Article:**

~~Use Type III or IV sheeting for all signs with white background, unless specified otherwise.~~

**1. Permanent Signs and Devices.****a. Meet the following requirements:**

- 1) Type III or IV sheeting is used for all signs with white, yellow, green, red, blue, or brown background, unless otherwise specified.
- 2) Type XI Fluorescent sheeting is used for signs with yellow or yellow-green background.
- 3) The legend on white, and yellow, and yellow-green signs is fabricated using black nonreflective sheeting that is applied directly, or by silk screening with black opaque ink.
- 4) The legend on green signs is fabricated using white Type III or IV sheeting that is applied directly.
- 5) The legend on red signs is fabricated using transparent red ink that is reverse silk screened on white Type III or IV sheeting, or is fabricated using white Type III or IV sheeting that is applied directly on a red Type III or IV sheeting background.
- 6) The legend on blue and brown signs is fabricated using transparent ink that is reverse silk screened on white Type III or IV sheeting, or white Type III or IV sheeting that is applied directly.

- b. Use Type ~~III~~ IV sheeting for permanent road closure barricades.

## 2. Work Zone Signs and Devices.

### a. Interstate and Primary Highways.

Meet the following requirements:

- 1) Type VII (Iowa) sheeting is used for all rigid signs with orange backgrounds. The legend is fabricated using black nonreflective sheeting that is applied directly or by silk screening with black opaque ink.
- 2) Type VI (Iowa) sheeting is used for all flexible roll-up signs with orange backgrounds. The legend is fabricated by silk screening with black opaque ink.
- 3) Type VII (Iowa) sheeting is used for STOP/SLOW paddles. The black legend is fabricated using black nonreflective sheeting that is applied directly or by silk screening with black opaque ink on orange Type VII (Iowa) sheeting. The white legend is fabricated using transparent red ink that is reverse silk screened on white Type VII (Iowa) sheeting.
- 4) Type VII (Iowa) non-fluorescent sheeting is used for barricades, vertical panels, and all other work zone traffic control devices that use premanufactured barricade sheeting.
- 5) Type VII (Iowa) fluorescent orange and Type ~~III~~ IV white sheeting is used for drums, 42 inch (1050 mm) channelizers, tubular markers, and all other work zone traffic control devices that use horizontal sheeting.
- 6) For reboundable traffic control devices, Type ~~III~~ IV or Type VII (Iowa) sheeting designed for this application is used.

### b. Other Highways.

- 1) Meet the following requirements:
  - a) Type ~~III~~ IV sheeting is used for all rigid post mounted signs with orange backgrounds. Unless specified otherwise, Type ~~I~~ ~~or~~ ~~II~~ IV sheeting is used for all skid mounted signs with orange backgrounds. The legend is fabricated using black nonreflective sheeting that is applied directly or by silk screening with black opaque ink.
  - b) Type ~~I~~ ~~or~~ ~~II~~ IV sheeting is used for STOP/SLOW paddles. The black legend is fabricated using black nonreflective sheeting that is applied directly or by silk screening with black opaque ink. The white legend is fabricated using transparent red ink that is reverse silk screened on white retroreflective sheeting.
  - c) Type ~~III~~ IV sheeting is used for barricades and vertical panels.
  - d) Type ~~III~~ IV sheeting designed for reboundable devices is used for reboundable drums, tubular markers, and other reboundable markers.
- 2) At the Contractor's option, work zone signs and devices using retroreflective sheeting according to Article 4186.03, B, 2, a, above may be used on all other highways.

## 4186.03, C, Durability of Reflective Sheeting.

Replace Articles 1 and 2:

1. **White, yellow, yellow-green, green, red, blue and brown reflective sheeting used for permanent signing and traffic control devices:** 3 year outdoor ~~Iowa~~ NTPEP Minnesota test deck exposure at 45 degrees facing south.
2. **Orange and White reflective sheeting used for temporary traffic control signing and traffic control devices:** 1 year outdoor ~~Iowa~~ NTPEP Minnesota test deck exposure at 45 degrees facing south.

## 4186.04, Nonreflective Sheeting.

Replace the second bullet:

Color properties are the same as for Type ~~III~~ IV reflective sheeting found in ASTM D 4956.

**4186.10, B, 5.****Replace the Article:**

Furnish bolts (including the entire length of the anchor bolts), nuts, and washers that are galvanized according to ASTM F 2329 or B 695 Class 50 55, Type 1 ~~coating~~.

**4186.10, Sign Posts.****Add the Article:****D. Perforated Square Steel Tube (PSST) Posts and Anchors**

Use PSST posts and anchors on the approved list in Materials I.M. 486.10 and meet the following. When not specified elsewhere in the contract documents, the post and anchor system shall meet the minimum manufacturer's size requirements for 90 mph (145 km/hr) wind load criteria and be approved by the Engineer.

**1. PSST Posts.**

- a. Provide PSST posts of the dimensions and gauge required by the contract documents.
- b. Posts shall be designated "crashworthy" as defined by NCHRP Report 350 Category 2, Level 3 or by AASHTO *Manual for Assessing Safety Hardware* (MASH) for post systems evaluated after January 1, 2011 and be FHWA accepted.
- c. Galvanized posts shall conform ASTM A 653, SS, Grade 50, Designation G-90 or greater.
- d. Cross section of post shall be a square tube roll formed and corner welded. Corner weld shall be zinc coated after scarfing operation.
- e. Pre-punch 7/16 inch (11 mm) holes on 1 inch (25 mm) centers on all sides, vertically aligned and centered horizontally.
- f. Furnished post shall be straight and have a smooth uniform finish. It must be possible to freely insert post into anchors and telescope consecutive sizes with a minimum amount of play.
- g. If post is to be field cut, cut ends shall be coated with zinc rich paint as required per specification.

**2. PSST Post Anchors.**

- a. Break-away, soil installation.  
42 inch (1065 mm) minimum length, 7 gauge (4.76 mm) heavy duty winged anchor.
- b. Break-away, concrete installation.  
Posts installed in a concrete island, use a 48 inch (1220 mm) minimum length, 7 gauge (4.76 mm) heavy duty anchor. Core an 8 inch (200 mm) diameter hole through pavement at least 8 inches (200 mm) deep. After placing anchor, fill hole with concrete mix approved by the Engineer and level off top of concrete.
- c. Triangular Slip Base Assembly.
  - 1) Ensure design is in accordance with the AASHTO Standards and Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, current edition and meets or exceeds NCHRP Report 350 or the AASHTO MASH criteria for any assembly system evaluated after January 1, 2011 and be FHWA accepted.
  - 2) Triangular Slip Base Assembly consists of four parts: one-piece anchor, top half slip base, hardware, and concrete foundation.
    - a) One-piece anchor shall meet the following requirements:
      - Anchor shall have a triangular slip plate (1 inch (25 mm) thick) welded directly to anchor leg.
      - Anchoring portion shall be 3 inches (75 mm) square 7 gauge (4.76 mm) material and 42 inches (1065 mm) long.
      - Galvanize by hot dip process, complying with ASTM A 123, grade 85 F 2329 with zinc temperature bath limited to 850°F (455°C) or ASTM B 695, Class 55, Type 1 coating.
    - b) Top-half slip base shall meet the following requirements:
      - Cast unit from Ductile Iron meeting ASTM A 536 Class 65-45-12.
      - Top half slip base shall have a triangular dimension to match 8 inch (200 mm) standard triangular slip plate, and shall receive 2.5 inch (63 mm) square sign support.
      - Galvanize by hot dip process, complying with ASTM A 123, grade 85.
    - c) Hardware shall meet requirements of ~~Article 4186.09~~ the manufacturer and metal hardware shall be stainless steel or galvanized steel. Ensure galvanizing meets the

- requirements of ASTM F 2329 with zinc temperature bath limited to 850°F (455°C) or ASTM B 695, Class 55, Type 1 coating.
- d) Concrete Footings: Apply Section 2403.

## Section 4187

### 4187, Materials for Support Structures.

Rename the Section:

**Materials for Sign Support Structures**

#### 4187.01, General Requirements.

Replace the first sentence of the Article:

Furnish materials for aluminum alloy or galvanized overhead steel sign support structures meeting the following requirements:

#### 4187.01, A, Material for Aluminum Alloy Superstructure.

Rename the Article:

**Materials for Aluminum Alloy Superstructures.**

#### 4187.01, C, Fasteners for Aluminum Alloy and Galvanized Steel Superstructures and Anchor Bolts.

Replace the Article:

##### 1. Material Fasteners for Aluminum Superstructures.

###### a. Stainless Steel Bolts and Studs.

- 1) Use the size specified in the contract documents.
- 2) ~~Meet the requirements of~~ Comply with ASTM A 320/A 320M Type 304 Class 1 Grade B8, Class 1A Grade B8A, or Class 2 Grade B8; or ASTM F 593 Alloy Group 1 Alloy 304 or 304L, Group 2 Alloy 316 or 316L, or Group 3 Alloy 321 or 347 meeting Condition A, CW1 or CW2.
- 2 3) Use hexagonal bolt heads complying with ASTM A 320/A 320M Class 4. Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A fit tolerance. Use the stress area to compute the tensile strength.

###### b. Stainless Steel Nuts and Jam Nuts.

Use the size specified in the contract documents.

- 2) ~~Meet the requirements of~~ Comply with ASTM A 194/A 194M Grade 8, 8A, 8C, 8CA, 8M, 8MA, 8T, or 8TA; or ASTM F 594 Alloy Group 1 Alloy 304 or 304L, Group 2 Alloy 316 or 316L, or Group 3 Alloy 321 or 347 meeting Condition A, CW1 or CW2. Use same alloy properties (i.e. group, alloy, class and condition) as those of the bolts specified. ~~Meet a minimum proof load of 75,000 psi (517MPa).~~
- 2 3) Use hexagonal nuts and jam nuts complying with the requirements of ASTM F 594. Threads are to comply with ANSI/ASME B 1.1 for UNC thread series, Class 2B fit tolerance. ~~In lieu of jam nuts, stainless steel lockwashers may be used.~~
- 4) Unless otherwise specified, use dimensions in accordance with the requirements of ANSI/ASME B 18.22.2.

###### c. Stainless Steel Washers.

- 1) Comply with ANSI B18.22.1 for the bolts specified.
- 2) The Engineer may approve washers with dimensions other than those specified.
- 3) Meet requirements of ASTM A 240/A 240M. Use same alloy properties (i.e. group, alloy, class and condition) as those of the bolts specified.

###### d. Stainless Steel U-Bolts.

- 1) Use the size specified in the contract documents.
- 2) ~~Meet the requirements of~~ Comply with ASTM A 320/A 320M Type 304 Class 1 Grade B8, Class 1A Grade B8A, or Class 2 Grade B8; or ASTM F 593 Alloy Group 1 Alloy 304 or 304L, Group 2 Alloy 316 or 316L, or Group 3 Alloy 321 or 347 meeting Condition A, CW1 or CW2.
- 3) Threads shall comply with ANSI/ASME B 1.1 for UNC thread series, Class 2A tolerance.
- 4) Use nuts as specified in Article 4187.01, C.1.b.
- 5) Use washers as specified in Article 4187.01, C.1.c.

**2. Fasteners for Galvanized Steel Superstructures.****a. Galvanized Steel High Strength Bolts.**

- 1) Use size specified in the contract documents.
- 2) Galvanize according to requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F (455°C).
- 3) Bolts shall be ASTM A 325 Type 1 or ASTM A 449 Type 1.
- 4) Threads are to comply with ANSI/ASME B 1.1 for UNC thread series, Class 2A tolerance.

**b. Galvanized Steel Nuts and Jam Nuts.**

- 1) Use size specified in the contract documents.
- 2) Galvanize according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F (455°C).
- 3) Regular nuts shall be ASTM A 563 Grade DH heavy hex.
- 4) Jam nuts shall be ASTM A 563 Grade DH heavy hex.
- 5) Threads are to comply with ANSI/ASME B 1.1 for UNC thread series, Class 2B tolerance.

**c. Galvanized Steel Washers.**

- 1) Comply with ANSI B18.22.1 for the bolts specified.
- 2) Galvanize according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F (455°C).
- 3) Washers shall be ASTM F 436 Type 1.

**d. Galvanized Steel U-Bolts.**

- 1) Use size specified in the contract documents.
- 2) Galvanize according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F (455°C).
- 3) U-bolts shall be ASTM A 449 Type 1, ASTM A 307 Grade B or ASTM F 1554, Grade 36 or 55.
- 4) Threads are to comply with ANSI/ASME B 1.1 for UNC thread series, Class 2A tolerance.
- 5) Bend and thread U-bolts prior to galvanizing.

**e. Stainless Steel U-Bolts.**

- 1) Use size specified in the contract documents.
- 2) Comply with ASTM A 320/A 320M Class 1 Grade B8, Class 1A Grade B8A, or Class 2 Grade B8; or ASTM F 593 Group 1 Alloy 304 or 304L, Group 2 Alloy 316 or 316L, or Group 3 Alloy 321 or 347 meeting Condition A, CW1 or CW2.
- 3) Threads are to comply with ANSI/ASME B 1.1 for UNC thread series, Class 2A tolerance.
- 4) Use nuts as specified in Article 4187.01, C, 1, b.
- 5) Use washers as specified in Article 4187.01, C, 1, c.

**2.3. Anchor Bolts, Nuts, and Washers.**

~~Use bolts, nuts, and washers galvanized according to the requirements of ASTM F 2329 or ASTM B 695, Class 50, Type I coating.~~ Meet the following requirements:

**a. Anchor Bolts.**

- 1) Use full-length galvanized bolts.
- 2) Comply with ASTM F 1554, Grade 36, Grade 55, S1 or Grade 105, S5 (724 MPa) as specified.
- 3) ~~Use Unified Coarse Thread Series~~ Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A tolerance.
- 4) ~~Use Class 2A tolerance.~~
- 5) The end of each anchor bolt intended to project from the concrete is to be color coded in red to identify the grade.
- 6) Do not bend or weld anchor bolts.

**b. Nuts.**

- 1) Comply with ASTM A 563, Grade DH.
- 2) Use heavy hex.
- 3) Use ANSI/ASME B1.1 for UNC thread series, Class 2B tolerance.
- 4) Nuts may be over-tapped according to the allowance requirements of ASTM A 563.

**c. Washers.**

Comply with ASTM F 436 Type 1.

**d. Galvanizing.**

Galvanize entire anchor bolt assembly (anchor bolt, nuts and washers) according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F (455°C). Galvanize entire assembly by the same zinc-coating process, with no mixed processes in a lot of fastener assemblies.

## Section 4188

### 4188, Traffic Control Devices.

Add the Articles:

#### **4188.05 Temporary LED Floodlighting Luminaires.**

Furnish luminaires made for portable, mobile self contained, floodlights for temporary traffic control zones. Luminaire shall have IES LM-79-08 report from qualified independent laboratory verifying luminaire performance, including the following requirements:

- L70 @ 25°C of 70,000 hours.
- LED color temperature of 4,000 cct - 5,000 cct.
- LED light engines meet dust and moisture rating of IP-66.
- Designed and tested to comply with ANSI C136.31 2001 for 100,000 cycles at 3G acceleration for normal and bridge applications.
- Surge protection for LED driver and electronics - category C high (20kV, 10kA).
- Totally enclosed glass refractor lenses with type IV distribution.
- IES glare control rating of "full cut off".
- Minimum initial output rating of 7,200 lumens.
- Meets State of Iowa Energy Code requirements for LED roadway lighting (66 lm/W).
- Photoelectric controlled for dusk to dawn operation.
- Comply with Materials I.M. 488.06 for inspection and acceptance of Temporary LED Floodlighting Luminaires.

#### **4188.06 PORTABLE DYNAMIC MESSAGE SIGN.**

##### **A. Sign Design.**

1. A PDMS is defined as all components working together to accomplish the requirements of the specifications. These components include, but are not limited to, LED pixel boards, on-board computer, cellular modem (when specified), trailer, mounting equipment, solar panels, batteries, charge controller, etc.
2. The message panel shall be trailer mounted. Message panel shall be mounted at a height of at least 7 feet (2.2 m), measured from bottom of sign to ground directly below. Sign presents a level appearance. Sign is capable of displaying three lines of up to eight characters at one time. Character height is 18 inches (450 mm) and configured using a 7 pixel tall by 5 pixel wide font. Message panel may be configured as character matrix, line matrix, or full matrix.
3. Message panel visible from 1/2 mile (800 m) under both day and night conditions. Letters legible from 750 feet (225 m). Message sign shall include automatic dimming for nighttime operation and a power supply capable of providing service for 7 continuous days without recharging.
4. Message panel controlled by an onboard computer capable of:
  - Storing a minimum of 99 programmed messages for instant recall,
  - Being programmed to accept messages created by the operator via an alpha-numeric keyboard, and
  - Being programmed remotely by National Transportation Communication for Intelligent Transportation Systems Protocols (NTCIP) DMS software (when specified).
5. Physical access to the onboard computer protected by a padlock or other locking handle mechanism. Electronic access to the onboard computer protected by a username and password.

##### **B. Cellular Communications.**

On Interstate and Primary projects, PDMS shall be equipped with a cellular modem for remote communications.

1. Cellular service provider shall have data coverage within project limits. Contractor shall be responsible for integrating cellular modem with the PDMS.

2. Upon confirmation that remote communication has been successfully setup, the IP address, communications port, software, and username/password for web interface shall be supplied to Engineer for integration into the statewide ITS control software.
3. Cellular modem shall be capable of obtaining its location by GPS. Current location from GPS coordinates shall be stored in cellular modem's memory for retrieval by ITS control software. Modem shall have firewall security protections that limit who and what can communicate to it.
4. Typical monthly data usage by Contracting Authority is 5 Mb when PDMS is in good working condition. Additional data usage is possible if PDMS requires remote troubleshooting or maintenance.

**C. NTCIP Compliance.**

On Interstate and Primary projects, PDMS onboard computer and operating firmware shall be compliant with at least NTCIP 1203 v1.15 supplemented with NTCIP 1203 Amendment 1 v07, (dated July 3, 2001) for the following commands:

- Read configuration data from sign,
- Send configuration data to sign,
- Poll sign (retrieve sign status) both manual and automated with software,
- Activate a message,
- Blank or remove a message,
- Upload fonts, and
- Reset controller/onboard computer.

**Section 4196**

**4196.01, B, 3, Embankment Erosion Control.**

**Replace** the first sentence:

Under concrete and stone revetment, erosion stone, or gabions used for embankment or erosion control, use fabric that:

**Rename** Table 4196.01-3:

**Table 4196.01-3: Fabric for use under ~~Erosion Stone~~ as Embankment Erosion Control**

**4196.01, B, 6, Concrete and Stone Revetment and Bridge Abutment Backfill Fabric.**

**Rename** the Article:

**~~Concrete and Stone Revetment and Bridge Abutment Backfill Fabric.~~**

**Rename** Table 4196.01-6:

**Table 4196.01-6: Fabric for use under ~~conc./stone revetment &~~ in bridge abutment backfill**

## Appendix.

**Replace** the note at the bottom of Table 2501.03-1:

For ~~design~~ nominal bearings resistances under 40 105 tons, minimum diesel hammer energies listed may be reduced by 20% for concrete pile and 10% for steel pile.

**Replace** the notes at the bottom of Table 2501.03-2:

<sup>(a)</sup> Wave equation analysis.

For ~~design~~ nominal bearings resistances under 355 930 kN, minimum diesel hammer energies listed may be reduced by 20% for concrete pile and 10% for steel pile.

**Replace** the Aggregate Gradation Table- English:

AGGREGATE GRADATION TABLE - ENGLISH														
Grad. No.	Section No.	Std. Sieve Sz.	1 1/2"	1.00"	3/4"	1/2"	3/8"	4	8	30	50	100	200	Notes
		Intended Use	Percent Passing											
1	4110, 4125, 4133, 4134	PCC FA, Cover Agg.					100	90-100	70-100	10-60			0-1.5	1
2	4112	PCC Intermediate				95-100			0-10					
3	4115 (57, 2-8), 4118	PCC CA	100	95-100		25-60		0-10	0-5				0-1.5	2, 10
4	4115 (2-8)	PCC CA	100	50-100	30-100	20-75	5-55	0-10	0-5				0-1.5	10
5	4115 (67, 2-8)	PCC CA		100	90-100		20-55	0-10	0-5				0-1.5	10
6	4115.06 (Repair & Overlay)	PCC CA			100	97-90-100	40-90	0-30					0-1.5	10
7	4117 (Class V)	PCC FA & CA	100					80-92	60-75	20-40				
8	4117.03 (Class V)	Fine Limestone					100	90-100					0-30	
10	4119, 4120.02, 4120.03 (C gravel)	Granular Surface			100			50-80	25-60					3, 11
11	4119, 4120.02, 4120.04, 4120.05, 4120.07, (A, B Cr. St.)	Granular Surface & Shoulder		100	95-100	70-90		30-55	15-40				6-16	4, 5, 11
12a	4121 (Cr. St.)	Granular Subbase	100			40-80			5-25				0-6	6, 40 11
12b	4121 (Cr. Gravel)	Granular Subbase	100			50-80			10-30		5-15		3-7	7, 11
13	4122.02 (Cr. St.)	Macadam St. Base	3" nominal maximum size screened over 3/4" or 1.00" screen.											
14	4123	Modified Subbase	100		70-90				10-40				3-10	5, 7, 11
19	4125 (1/2") Cr. Gr. or Cr. St.)	Cover Aggregate			100	97-100	40-90	0-30	0-15				0-2 1.5	11
20	4125 (1/2" Scr. Gr.)	Cover Aggregate			100	95-100	40-80	0-15	0-7				0-1.5	11
21	4125 (3/8")	Cover Aggregate				100	90-100	10-55	0-20	0-7			0-1.5	11
22	4124	Fine Slurry Mixture					100	85-100	40-95	20-60	14-35	10-25	5-25	9, 11

23	4124 (Cr. St.)	Coarse Slurry Mixture					100	70-90	40-70	19-42			5-15	11
29	4131	Porous Backfill			100	95-100	50-100	0-50	0-8					11
30	4132.02 (Cr. St.)	Special Backfill	100						10-40				0-10	5, 11
31	4132.03 (Gravel)	Special Backfill		100	90-100	75-100			30-55				3-7	11
32	4133 (Sand/Gr./Cr. St.)	Granular Backfill	100% passing the 3" screen						10-100				0-10	8, 11
35	4134 (Natural Sand/Gr.)	Floodable Backfill	100						20-90				0-4	11
36	4134 (Natural Sand)	Floodable Backfill						100	400				0-2	11

Notes: (Gradations No. 2, 9, 15, 16, 17, 18, 24, 25, 26, 27, 28, 33, and 34 have been deleted)

- For Section 4110, when the fine aggregate is sieved through the following numbered sieves - 4, 8, 16, 30, 50, and 100 - no more than 40% shall pass one sieve and be retained on the sieve with the next higher number.
- When used in precast and prestressed concrete bridge beams, 100% shall pass the 1.00" sieve. When used for pipe bedding the No. 200 restriction does not apply.
- When compaction of material is a specification requirement, the minimum percent passing the No. 200 sieve is 6%.
- See specifications for combination of gravel and limestone.
- Unwashed air dried samples of crushed composite material shall be tested for gradation compliance except that no gradation determination will be made for material passing the No. 200 sieve.
- The gradation requirement for the No. 8 sieve shall be 5% to 20% when recycled material is supplied.
- For Section 4121 gravel, one fractured face on 30% or more of the particles retained on the 3/8 inch sieve. For Section 4123 gravel, one fractured face on 75% or more of the particles retained on the 3/8 inch sieve.
- Crushed stone shall have 100% passing the 1½" sieve.
- Gradation limitations for the 30, 50, and 100 sieves shall not apply when slurry mixture is applied by hand lutes, such as for slurry leveling.
- Maximum of 2.5% passing the No. 200 sieve allowed if generated from the parent material for crushed limestone or dolomite when documented production is 1% or less as determined by the Office of Materials.
- When Producer gradation test results are used for acceptance, test results representing at least 90% of the material being produced shall be within the gradation limits and the average of all gradation results shall be within the gradations limits. Stockpiled material not meeting the criteria may, at the District Materials Engineer's discretion, be resampled using Materials I.M. 301 procedures. One hundred percent of the stockpile quality control and verification test results shall be within the gradation limits.

**Replace the Aggregate Gradation Table- Metric:**

AGGREGATE GRADATION TABLE - METRIC														
Grad. No.	Section No.	Std. Sieve Sz.	37.5mm	25mm	19mm	12.5mm	9.5mm	4.75mm	2.36mm	600µm	300µm	150µm	75µm	
		Intended Use	Percent Passing											
1	4110, 4125, 4133, 4134	PCC FA, Cover Agg.					100	90-100	70-100	10-60			0-1.5	1
2	4112	PCC Intermediate				95-100			0-10					
3	4115 (57, 2-8), 4118	PCC CA	100	95-100		25-60		0-10	0-5				0-1.5	2, 10
4	4115 (2-8)	PCC CA	100	50-100	30-100	20-75	5-55	0-10	0-5				0-1.5	10
5	4115 (67, 2-8)	PCC CA		100	90-100		20-55	0-10	0-5				0-1.5	10
6	4115.06 (Repair & Overlay)	PCC CA			100	97 90-100	40-90	0-30					0-1.5	10
7	4117 (Class V)	PCC FA & CA	100					80-92	60-75	20-40				
8	4117.03 (Class V)	Fine Limestone					100	90-100					0-30	
10	4119, 4120.02, 4120.03 (C gravel)	Granular Surface			100			50-80	25-60					3, 11
11	4119, 4120.02, 4120.04, 4120.05, 4120.07 (A, B Cr. St.)	Granular Surface & Shoulder		100	95-100	70-90		30-55	15-40				6-16	4, 5, 11
12a	4121 (Cr. St.)	Granular Subbase	100			40-80			5-25				0-6	6, 11
12b	4121 (Cr. Gravel)	Granular Subbase	100			50-80			10-30		5-15		3-7	7, 11
13	4122.02 (Cr. St.)	Macadam St. Base	75 mm nominal maximum size screened over 19 mm or 25 mm screen.											
14	4123	Modified Subbase	100		70-90				10-40				3-10	5, 7, 11
19	4125 (12.5mm Cr. Gr. or Cr. St.)	Cover Aggregate			100	97-100	40-90	0-30	0-15				0-2 1.5	11
20	4125 (12.5mm Scr. Gr.)	Cover Aggregate			100	95-100	40-80	0-15	0-7				0-1.5	11
21	4125 (9.5mm)	Cover Aggregate				100	90-100	10-55	0-20	0-7			0-1.5	11
22	4124.02B	Fine Slurry Mixture					100	85-100	40-95	20-60	14-35	10-25	5-25	9, 11

23	4124.02B (Cr. St.)	Coarse Slurry Mixture					100	70-90	40-70	19-42			5-15	11
29	4131	Porous Backfill			100	95-100	50-100	0-50	0-8					11
30	4132.02 (Cr. St.)	Special Backfill	100						10-40				0-10	5, 11
31	4132.03 (Gravel)	Special Backfill		100	90-100	75-100			30-55				3-7	11
32	4133 (Sand/Gr./Cr. St.)	Granular Backfill	100% passing the 76.2 mm screen						10-100				0-10	8, 11
35	4134 (Natural Sand/Gr.)	Floodable Backfill	100						20-90				0-4	11
36	41334 (Natural Sand)	Floodable Backfill						100	100				0-2	11

Notes: (Gradations No. 2, 9, 15, 16, 17, 18, 24, 25, 26, 27, 28, 33, and 34 have been deleted)

- For Section 4110, when the fine aggregate is sieved through the following numbered sieves - 4.75 mm, 2.36 mm, 1.18 mm, 600 µm, 300 µm, and 150 µm - not more than 40% shall pass one sieve and be retained on the sieve with the next higher number.
- When used in precast and prestressed concrete bridge beams, 100% shall pass the 25 mm sieve. When used for pipe bedding the 75µm restriction does not apply.
- When compaction of material is a specification requirement, the minimum percent passing the 75 µm sieve is 6%.
- See specifications for combination of gravel and limestone.
- Unwashed air dried samples of crushed composite material shall be tested for gradation compliance except that no gradation determination will be made for material passing the 75 µm sieve.
- The gradation requirement for the 2.36 mm sieve shall be 5% to 20% when recycled material is supplied.
- For Section 4121 gravel, one fractured face on 30% or more of the particles retained on the 9.5 mm sieve. For Section 4123 gravel, one fractured face on 75% or more of the particles retained on the 9.5 mm sieve.
- Crushed stone shall have 100% passing the 37.5 mm sieve.
- Gradation limitations for the (600 µm, 300 µm, and 150 µm) sieves shall not apply when slurry mixture is applied by hand lutes such as for slurry leveling.
- Maximum of 2.5% passing the 75 µm sieve allowed if generated from the parent material for crushed limestone or dolomite when documented production is 1% or less as determined by the Office of Materials.
- When Producer gradation test results are used for acceptance, test results representing at least 90% of the material being produced shall be within the gradation limits and the average of all gradation results shall be within the gradations limits. Stockpiled material not meeting the criteria may, at the District Materials Engineer's discretion, be resampled using Materials I.M. 301 procedures. One hundred percent of the stockpile quality control and verification test results shall be within the gradation limits.