



GS-15014

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General Supplemental Specifications for Highway and Bridge Construction

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THE STANDARD SPECIFICATIONS, SERIES 2015, 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

1101.03, Definition of Terms.

Add to the definition of Contract (also Contract Documents):

- Digital contract files specified in the contract documents.

Add the Article:

Holidays.

The following holidays are observed by the Department:

- New Year's Day, January 1,
- Martin Luther King, Jr.'s Birthday, third Monday in January,
- Memorial Day, last Monday in May,
- Independence Day, July 4,
- Labor Day, first Monday in September,
- Veterans Day, November 11,
- Thanksgiving Day, fourth Thursday in November,
- Friday after Thanksgiving, and
- Christmas Day, December 25.

Section 1102

1102.01, Competency and Qualification of Bidders.

Replace the second sentence of Article A:

To prequalify, a prospective bidder shall complete the required sections, including Bidder Status Form, of the "Contractor's Financial - Experience - Equipment Statement" (Form 650004) and submit it to the Department.

Replace Article D, 1, b:

When an Individually Prepared Statement is submitted to the Department, the maximum prequalification amount will be ~~\$200,000~~ \$400,000.

Replace Article D, 2, b:

When a CPA Reviewed Statement is submitted to the Department, an experience factor (F) ranging from 0.0 to 12.5, depending on the prospective bidder's past performance with projects let by the Department, will be used in the prequalification formula. A prospective bidder, who has been qualified to submit proposals with this type of statement, shall be limited to individual proposal sizes that do not exceed the lesser of ~~\$1 million~~ \$2 million or the maximum prequalification amount minus the bidder's amount of uncompleted work currently under contract. Any combination of proposals, however, may total more than ~~\$1 million~~ \$2 million - as long as that total does not exceed the maximum prequalification amount minus the currently uncompleted work.

Add the Article and **renumber** following Articles:

- E.** The maximum prequalification amount may be increased for a CPA Reviewed or CPA Audited Statement by providing an Authorization to Loan form and/or by obtaining an equipment appraisal. The Authorization to Loan form and equipment appraisal would be subject to the following respective restrictions;
1. The Authorization to Loan shall not exceed \$1 million. The Authorization to Loan shall be signed by a duly authorized officer of a banking institution.
 2. The equipment appraisal shall be cross-referenced with the depreciation schedule and shall be accompanied by a signed certification letter on the appraisal company's letterhead.

E F.

F G.

G H.

H I.

Replace Article I:

For proposals involving only the furnishing of materials, granular surfacing, lighting, buildings, asbestos removal, salvage and removal, debris removal, wells, traffic signals, pavement marking, traffic signs, clearing and grubbing, 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 Department of the bidder's ability to perform and complete the contract. Bidders shall complete Bidder Status Form portion of Form 650004.

1102.03, A, 2, f.

Replace the Article:

The Contractor fails to pay the subcontractor progress payments and subcontractor retainage as required by Article 1109.05, or

1102.05, Issuance of Proposals.

Replace the first sentence:

Requests for proposal forms to bid construction and maintenance contracts must and a Bidder Status Form shall be filed by noon of the working day prior to the letting.

1102.09, B.

Delete the third through sixth sentences:

All the unit price figures shall be in ink, typed, or computer printed. The bidder may also specify the extension for each proposal line item and or the total amount of the bid. However, if there is a discrepancy between the unit bid prices, extensions, or total amount of bid, the unit prices shall govern. The bidder shall not alter the quantity, unit price, or the extension which has been provided for items which have been predetermined by the Contracting Authority.

1102.09, E.

Replace Articles 5 and 6 and **add** the Article:

5. For Federal-aid contracts, certifies acknowledgment of the limitations of lobby activities shown in the bidding documents, and
6. For Federal-aid contracts, certifies the bidder does not maintain segregated facilities., and
7. Certifies Bidder Status Form on file with the Office of Contracts is accurate.

1102.11, Proposal Guaranty.

Replace the second sentence of Article A:

The proposal guaranty shall be filed received, prior to the time advertised for opening of bids.

Replace Article 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 Signature of Contractor: In case of joint venture bid, all contractors must sign.~~
- ~~Name of the Surety Company~~
- ~~Original Signature of Surety (if Surety's limitation is less than the amount of the bid bond, a certificate of reinsurance must be attached).~~

Delete Article D:

A Contractor's Annual Bid Bond (Form 650043) may also be used for the proposal guaranty in lieu of that specified above. The Annual Bid Bond shall contain the following items:, using the electronic bid bond verification feature authorized by the Department. Annual Bid Bonds will be declared invalid and bid proposals will not be considered if any of the following items are omitted or incorrect:

- ~~Name of Contractor~~
- ~~Digital Signature of Contractor: In the case of joint venture bid, all Contractors shall sign.~~
- ~~Date of signature~~
- ~~Name of Surety Company~~
- ~~Digital Signature of Surety (if Surety's limitation is less than the amount of the bid bond, a certificate of reinsurance shall be attached).~~
- ~~Expiration Date of Bond shall not exceed 365 calendar days from the effective date of bond.~~

1102.17, D, 2, g, 1.**Replace** the Article:

The DBE shall be responsible for management and supervision of the entire trucking operation ~~that is to count toward the commitment.~~ The DBE shall maintain strict records to verify the amount of hauling done by each trucker for the duration of the contract. These records shall be available to the Engineer, upon request.

1102.19, C, Contractor's/Subcontractor's EEO/AA Policy.**Replace** the first paragraph:

The Contractor/subcontractor, with the exception of manufacturers, suppliers, and hauling firms, shall have an EEO/AA policy approved by the Department prior to being awarded a contract or subcontract that equals or exceeds \$10,000.00. The Contractor's/subcontractor's EEO/AA policy shall be re-approved on an annual basis through ~~either the preparation of and completion of a new EEO/AA policy or the review of an existing policy. When requesting re-approval under the latter option, the Contractor/subcontractor shall submit a written statement indicating that the existing policy has been reviewed. It shall further state that the policy is current with no revisions or, if revisions have been made, the revisions shall be signed and dated by their EEO/AA Officer and another company officer.~~ The Contractor's/subcontractor's EEO/AA policy shall also include the following items:

1102.20, Title VI Assurance.**Add** to the end of the Article:**APPENDIX E**

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees to comply with the following on discrimination statutes and authorities; including but not limited to:

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin); and 49 CFR Part 21;
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Federal-Aid Highway Act of 1973, (23 U.S.C. § 324 et seq.), (prohibits discrimination on the basis of sex);
- Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 et seq.), as amended, (prohibits discrimination on the basis of disability); and 49 CFR Part 27;
- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 et seq.), (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982, (49 USC § 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131 -- 12189) as implemented by Department of Transportation regulations at 49 C.F.R. parts 37 and 38;
- The Federal Aviation Administration's Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures non-discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;
- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq).

Section 1103**1103.01, Consideration of Bids.****Add** the Article:

- K.** For failure to have Bidder Status Form on file with Office of Contracts.

Section 1104**1104.09, Right-of-Way.**

Add to the beginning of the second paragraph:

Contractor shall not remove trees outside the construction limits, including areas in divided medians and inside of interchanges, without approval of the Engineer.

Section 1105**1105.03, Working Drawings.**

Delete Article B and Renumber Articles C, D, and 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 B.

D C.

E D.

Replace and Renumber Articles F and G:

F E. Electronic Submittals.

1. For projects on the Secondary Road System (non-Primary and Interstate projects), working drawings shall be submitted to the Engineer unless noted otherwise in the contract documents.
- 4 2. For Primary and Interstate projects (and when specified for Secondary Road System 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 shall be made via an electronic document management system (Doc Express unless specified otherwise in the contract documents). or If noted in the contract documents, submittals shall also be made 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 a. 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 b. Provide project number and submittal description in the email subject line for the document title in Doc Express. The email Doc Express submittal will serve as the transmittal log and shall include, by virtue of the user login, 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 c. Shop drawings submitted electronically via email Doc Express will be tracked, processed, and returned to the Contractor via email Doc Express. 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 Bureaus for Working Drawings

| DESCRIPTION | REVIEW OFFICE BUREAU | NUMBER OF COPIES ^(a) | REVIEW TIME (calendar days) |
|--|---|--|------------------------------------|
| Falsework for slab bridges | Bridges and Structures | 2-(6) | 30 |
| Transparent Stay-In-Place Deck Forms | Bridges and Structures | | 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 | 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 Standard support structures for overhead highway signs (i.e. bridge-type trusses, cantilever-type trusses, & and bridge mounts mounted supports) | Bridges and Structures Traffic and Safety ^(c) | 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 Traffic and Safety | 2-(7) | 30 |
| Highway lighting | Traffic & and Safety | 2 | 30 |
| Bridge mounted light pole base plates and anchor bolts | Bridges and Structures | | 30 |
| Highway signing steel breakaway posts | Traffic and Safety | 2 | 30 |
| Traffic signalization ^(b) | Traffic and Safety | 2 | 30 |
| Highway signing - Type A and B signs | Traffic and Safety | 2 | 30 |
| Reference Location Signs | Traffic and Safety | | 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 (Preliminary and final submittals shall include design calculations, shop drawings, and field construction drawings) | Design (Soils Design Section) | Preliminary submittal: 3 design calculations, 3 shop drawings, & and 3 field construction drawings Final submittal: 3 design calculations, 3 shop drawings, & and 3 field construction drawings | 30 (preliminary) 14 (final) |
| Soil nail and tie-back retaining walls (Submittal includes final design plans) | Design (Soils Design Section) | 6 final design plans | 60 |
| Intermediate foundation improvement (IFI) (i.e. stone columns, geopiers, etc.) (Submittal shall include design calculations and field construction drawings) | 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 |

| | | | |
|---|------------------------|---|----|
| Architectural mock-ups ^(a) | Bridges and Structures | 4 | 30 |
| Architectural paving ^(a) | Bridges and Structures | 4 | 30 |
| Architectural paint color samples and manufacturer data ^(a) | Bridges and Structures | 3 | 30 |
| Architectural concrete texture form liner samples and drawings ^(a) | Bridges and Structures | 3 | 30 |
| Architectural concrete sealer samples and manufacturer data ^(a) | Bridges and Structures | 3 | 30 |
| Architectural ornamental brick ^(a) | Bridges and Structures | 3 | 30 |
| <p>(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). Submittals of physical samples shall be through the Engineer.</p> <p>(b) Submittal time shall be within 45 calendar days from the date of award of contract.</p> <p>(c) Working drawings for nonstandard support structures of overhead highway signs shall be reviewed through the Bridges and Structures Bureau.</p> | | | |

1105.04, A.

Add the Article and renumber following Articles:

4. Digital Contract Files. Shall apply only when digital files are available and the Contractor uses automated machine control guidance.
- ~~4~~ 5.
- ~~5~~ 6.
- ~~6~~ 7.
- ~~7~~ 8.
- ~~8~~ 9.
- ~~9~~ 10.
- ~~10~~ 11.
- ~~11~~ 12.

1105.04, Conformity with and Coordination of the Contract Documents.

Add the Article and **Renumber** subsequent Articles:

- D. Should there be a discrepancy between a contract document and a document (e.g.: ASTM, AASHTO, MUTCD, etc.) referenced by a contract document, the referenced document shall carry the same hierarchy as the contract document from which it is referenced. Should there be a discrepancy between the contract documents and a referenced document, the contract documents govern unless obviously incorrect.

- ~~D~~ E.
- ~~E~~ F.
- ~~F~~ G.
- ~~G~~ H.

1105.04, E.

Add as the last sentence:

Field adjustment of digital contract files, if necessary, will be completed by the Engineer.

1105.11, D.

Replace the Article:

For structures, the following equipment and material loads shall apply:

1. Only legal load vehicles and equipment with legal load axle configuration will be permitted on structures unless specifically allowed by the contract documents or approved by the Engineer.
2. Legal load ~~v~~vehicles and equipment will be subject to weight restrictions according to the posted limits.
3. All loads in spans where critical or damaged members, as indicated in the contract documents or identified by the Engineer, are being repaired or replaced shall be subject to the approval of the Engineer.
4. Material loads stored on the structure shall be limited to a maximum weight of 20 tons. Distribution of load shall be governed by the following:
 - a. If the material load is greater than 200 pounds per square foot and less than 500 pounds per square foot, the loaded area will be restricted to an area 5 feet by 10 feet (50 square feet) with a clear spacing of 15 feet between loaded areas.

- b. If the material load is less than or equal to 200 pounds per square foot, the loaded area is only restricted by the 20 ton maximum.
5. Construction vehicles and equipment not involved with the loading and unloading of stored material shall be restricted from operating within 10 feet of the area where the material is stored.
 6. All vehicle, equipment, and material loads exceeding the limitations as stated above shall be submitted to the Engineer for checking and review prior to subjecting the loads to the structure subject to the Engineer's review and approval. The Contractor shall include in their submittal submit all details, calculations, and assumptions necessary to determine that the structure is capable of supporting the proposed loading. Unless waived by the Engineer, the calculations shall be certified by a Professional Engineer licensed to practice engineering in the State of Iowa.

The above submittal requirements shall also apply to cranes or other construction equipments when:

- a. Other components are added resulting in overall weight greater than legally allowed or granted by special permit.
- b. The operational weight including construction loads is greater than legally allowed or granted by special permit.
- c. Load distribution is altered during operation due to the use of outriggers or other devices.

1105.11, G.

Replace the first sentence:

Crawler type equipment shall not be moved on or off a pavement or base course except at places where the compacted earth adjacent to slab is at least 2 inches (50 mm) higher than the surface of the pavement or base course.

1105.13, Protection of Water Quality and Wetlands.

Renumber, Retitle, and Replace the Article:

~~1105.13 PROTECTION OF WATER QUALITY AND WETLANDS.~~ 1107.18 ENVIRONMENTAL PROTECTION.

A. Protection of Water Quality and Wetlands.

- A 1.** The Contractor shall comply with the requirements of the Clean Water Act (33 U.S.C. 1344 and 33 CFR 323) and Executive Order 11990. When it becomes necessary for the Contractor to work in waters of the United States, the Contractor shall be aware that a Section 404 permit and Section 401 Water Quality Certification may be required.
- B 2.** When required, the Contracting Authority will obtain a Section 404 permit and Section 401 Water Quality Certification for essential work on the right-of-way prior to the award of the contract. The Contractor shall adhere to the requirements of the permit. Activities occurring in or across waters of the United States not specifically reviewed and approved in the permit are not authorized. If the Contractor desires to use construction methods that are not specifically approved by the permit, the Contractor shall be responsible for obtaining approval in the form of a new Section 404 permit from the U.S. Army Corps of Engineers and possibly DNR. The Contractor shall not use construction methods that require additional mitigation by the Contracting Authority. The Contractor will not be granted additional compensation or contract time due to their request for a new permit. If, however, due to no fault of the Contractor, a Section 404 permit modification involving activities within the right-of-way is deemed necessary by the Engineer, additional contract time and/or compensation may be considered.
- C 3.** Projects regulated by the requirements of a Clean Water Act Section 404/401 Permit will be identified in the contract documents. The Contractor shall comply with the following requirements in order to meet the general conditions of Clean Water Act Section 404/401 Permits.
 - 1. ~~Historic or Archaeological Remains.~~**
The Contractor shall comply with Article 2102.03, J.
 - 2 a. Inspection.**
The Contractor shall allow representatives from the DNR or U.S. Army Corps of Engineers to inspect the work any time deemed necessary to ensure that the work is being accomplished in accordance with the terms and conditions of the contract documents and permit.
 - 3 b. Timing.**
The Contractor is encouraged to conduct construction activities during a period of low flow unless otherwise agreed upon by the Engineer.
 - 4 c. Vegetation Clearing.**
Clearing of vegetation, including trees located in or immediately adjacent to waters of the state, shall be limited to that which is absolutely necessary for construction of the project as indicated in the contract documents. Vegetative clearing material shall not be disposed of in a waterway or wetlands unless otherwise indicated in the contract documents.
 - 5 d. Disposal and Handling.**
Construction debris shall be disposed of at upland, non-wetland locations so that it cannot enter a waterway or wetland. Construction equipment, activities, and materials shall be kept out of the water to the maximum extent possible. Equipment for handling and conveying materials during construction shall be operated to prevent dumping or spilling the materials into waterbodies, streams, or wetlands except as approved by the Engineer. Care shall be

taken to prevent petroleum products, chemicals, or other deleterious materials from entering waterbodies, streams, or wetlands.

6 e. Erosion Control and Sediment Controls.

Erosion control features shall be installed by the Contractor in accordance with Sections 2601 and 2602.

7 f. Revegetation.

Disturbed areas not covered with revetment shall be seeded in accordance with Section 2601.

8 g. Temporary Fills.

If temporary crossings, causeways, or work pads are needed for the work, then temporary structures and fills shall be constructed in accordance with Section 2547.

9 h. Flowable Mortar.

Flowable mortar shall be installed in accordance with Section 2506.

10 i. Bridge Removal.

When bridge removal is identified in the contract documents, the bridge and piers shall be removed in accordance with Section 2401. Debris from bridge removal that falls into the water shall remain there only temporarily and shall be removed by the Contractor.

14 j. Revetment.

Revetment materials shall comply with Section 4130.

12. Threatened/Endangered Bats.

~~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.~~

13 k. Navigation.

No activity shall cause more than a minimal adverse effect on navigation. Safety lights and signals required by the contract documents shall be installed on authorized facilities in navigable waters of the United States. Payment will be made in accordance with Article 1109.03.

14 l. Aquatic Life Movements.

When indigenous aquatic life has been identified in the contract documents, no activity shall substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area.

15 m. Spawning Areas.

When spawning areas and spawning seasons have been identified in the contract documents, the Contractor shall limit activities in spawning areas during spawning seasons and avoid these areas. Contractor's activities that result in physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area will be prohibited, unless otherwise indicated in the contract documents.

16. Migratory Bird Breeding Areas

~~When migratory bird breeding areas have been identified in the contract documents, activities in waters of the United States that serve as breeding areas for migratory birds shall be avoided by the Contractor.~~

17. Shellfish Beds.

~~When shellfish beds have been identified in the contract documents, no construction activity shall occur in areas of concentrated shellfish populations.~~

18 n. Suitable Material.

No activity shall use undesirable material (e.g. trash, debris, car bodies, asphalt, etc.). Discharged material or material used for construction shall be free from toxic pollutants in toxic amounts in accordance with Section 307 of the Clean Water Act.

19 o. Water Supply Intakes.

Unless otherwise indicated in the contract documents, no activity shall occur in the proximity of a public water supply intake, except where the activity is for repair or improvement of public water supply intake structures or adjacent bank stabilization.

20 p. Adverse Effects From Impoundments.

If construction activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, or restricting its flow shall be minimized.

21 q. Management of Water Flows.

To the maximum extent practical; the pre-construction course, condition, capacity, and location of open waters shall be maintained by the Contractor during construction, including stream channelization and storm water management activities. Temporary stream diversion shall be done in accordance with Section 2418.

22 r. Equipment.

- 1) Heavy equipment working in wetlands or mudflats shall be placed on mats, or other measures shall be taken to minimize soil disturbance.
- 2) Unless otherwise indicated in the contract documents, heavy equipment shall not be used or operated within the stream channel. If in-stream work is unavoidable, it shall be performed in such a manner as to minimize the duration of the disturbance, turbidity increases, substrate disturbance, bank disturbance, and disturbance to vegetation.

23 s. Threatened and Endangered Species.

~~No activity will be authorized which will jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act, or will destroy or adversely modify the critical habitat of such species. Activities shall be completed in accordance with Article 1107.18, B, 1.~~

24 t. Historic Properties.

No activity will be authorized which violates the requirements of Section 106 of the National Historic Preservation Act.

25 u. Mitigation.

The work shall be constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States at the project site (i.e., on site).

26. Active Nests of Migratory Birds.

To protect migratory birds, do not conduct construction activities where active nests are present between the dates of April 1 and July 15, inclusive or until the birds have fledged and left the nest. Active nests are nests containing eggs or young of migratory birds.

~~Beginning on the date the contract is fully executed, the contractor shall remove all non-active, existing migratory bird nests and monitor to prevent the establishment of active nests. Prior to that date, the Contracting Authority is responsible to remove all non-active, existing migratory bird nests and monitor to prevent the establishment of active nests.~~

~~If evidence of migratory bird nesting is discovered after beginning work, or in the event that migratory birds nests become established, immediately stop work and notify the Engineer.~~

4. Dewatering.

- a. For projects regulated by Iowa DNR National Pollutant Discharge Elimination System (NPDES) General Permit No. 2, discharges from dewatering activities, including from trenches and excavations, will be prohibited unless managed by appropriate controls.
- b. Contractor shall be responsible for obtaining any additional necessary permits or approvals.

B. Threatened and Endangered Species.**1. Threatened and Endangered Species.**

No activity will be authorized which jeopardizes the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act, or will destroy or adversely modify the critical habitat of such species.

2. Threatened and Endangered Bats.

To protect threatened/endangered bats, trees deemed suitable habitat shall be removed in accordance with Article 2101.01, A, 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. Areas of suitable habitat for threatened and endangered bats shall be determined by the Contracting Authority.

3. Working in Topeka Shiner Watersheds.

When critical habitat for Topeka shiner is identified in the contract documents, the following special conditions shall be implemented:

- a. The Contractor shall not deposit sweepings, washings, treatment chemicals, or grouting and bonding materials in the stream or into any location where such pollutants can be washed in the stream by runoff water.
- b. To protect Topeka Shiners during their peak spawning period, Contractor shall not conduct project activity within the stream bed between the dates of May 15 and July 31, inclusive. Constructing or removing temporary crossings, causeways, and weirs is prohibited between those dates as well. Previously constructed crossings, causeways, and weirs may remain in place between those dates.
- c. Prompt attention is required for placing and maintaining temporary erosion control measures to minimize unnecessary sediment loading of the stream. Within one week of land disturbance at the project site, place appropriate temporary erosion control measures (e.g. silt fencing, hay bale ditch checks, erosion control blankets, rock ditch checks, etc.) and/or temporary grass seeding.
- d. Within one month (or during the next appropriate seeding period) following completion of construction, reseed all areas denuded of vegetation as a result of the permitted action, including all borrow areas that drain into the stream, using a permanent seed mix.
- e. The Contractor shall not take sand for use in mixing concrete and/or asphalt from the project site, unless indicated otherwise in the contract documents.
- f. The Contractor shall protect off-channel wetland complexes, such as old oxbow meanders, that are present near the project area.
- g. The Contractor shall locate and protect temporary storage and/or staging facilities for waterways, tributaries, or drainageways within the project areas. In the event of an accidental spill, follow established state and federal spill reporting procedures. For Iowa DOT projects, immediately notify the Office of Location and Environment.

4. Mussel/Shellfish Beds.

When mussel/shellfish beds have been identified in the contract documents, no construction activity shall occur in areas of concentrated shellfish populations.

C. Active Nests of Migratory Birds.

1. To protect migratory birds, the Contractor shall not conduct construction activities where active nests are present. Active nests are likely to be present between the dates of April 1 and July 15. Active nests are nests containing eggs or young of migratory birds.
2. Prior to the date the contract is fully executed, the Contracting Authority will be responsible to remove non-active, existing migratory bird nests and monitor to prevent the establishment of active nests.
3. Beginning on the date the contract is fully executed, the Contractor shall remove non-active, existing migratory bird nests and monitor to prevent establishment of active nests. Only costs associated with removing nests prior to initial mobilization will be paid as extra work as per Article 1109.03, B.
4. In the event that active nests are discovered, stop work and notify the Engineer.

D. Cultural Resources.

1. No activity will be authorized which violates the requirements of Section 106 of the National Historic Preservation Act.
2. When required, the Contracting Authority will obtain Section 106 authorization for essential work on the right-of-way prior to the award of the contract. The Contractor shall adhere to the requirements of the authorization.
3. The Contractor shall comply with Article 2102.03, J, if historic, cultural or archeological remains and artifacts are discovered while accomplishing the work under contract.

E. Regulated Materials.

1. The Contractor shall comply with Article 1107.07, C.
2. The removal, transport, and disposal of asbestos from buildings and structures scheduled for demolition or renovation shall be done in accordance with Section 2536.
3. The removal of underground tanks and remediation of petroleum contaminated soil shall be done in accordance with Section 2537.
4. The salvage, removal, and disposal of buildings and other obstructions from the project site shall be done according to in accordance with Section 2538.

F. Noise.

The Contractor shall comply with Article 1107.07, D.

G. Loess Hills Protection.

1. The following definitions apply to this specification:
 - a. **Loess Hills.**

A distinctive topographic landform encompassing over 640,000 acres in portions of seven Iowa counties: Plymouth, Woodbury, Monona, Harrison, Pottawattamie, Mills, and Fremont. The Loess Hills extend nearly 200 miles in a narrow band adjacent to the Missouri River floodplain, and are characterized by distinctive topographic features such as steep, narrow ridge crests, peaks, saddles, and numerous steep side slopes, branching spurs, and precipitous bluffs. The western boundary of the Loess Hills is generally defined by the sheer, nearly vertical faces rising from the adjoining Missouri River floodplain. The topography along the eastern boundary is more gradual and the soil types tend to be gradational; therefore, soil borings will be used to define Loess soils material, using a 50 foot or greater measurement to refine boundaries. Less than 50 foot Loess soils depths will not be considered Loess Hills.
 - b. **Special Landscape Areas.**

Twelve areas within the Loess Hills encompassing approximately 92,000 acres, and provide clusters of exemplary remnant prairie and geological/topographical features. The Special Landscape Areas are found along the western margins of the Loess Hills where the loess is the deepest, the topographic relief is greatest, and the exposure to sun and wind provide favorable conditions for prairie communities. The rugged topography within these areas also has served to protect inaccessible prairies from intensive livestock grazing and other human-induced disturbance. The Special Landscape Areas were identified by National Park Service, in coordination with advocacy organizations and Iowa DNR staff, while conducting the Loess Hills of Western Iowa Special Resources Study in 2002.
 - c. **Glenwood Locality.**

The Glenwood Locality, located in Mills County, contains a rich and diverse prehistoric archeological record that spans 12,000 to 13,000 years.
2. The Contractor shall ensure areas (including haul roads and staging areas) selected for furnishing borrow or for waste or disposal of excess material (excavated material or broken concrete), do not impact or encroach upon the

western face of the Loess Hills landform, any of the twelve Special Landscape Areas located within the Loess Hills landform, or the Glenwood Locality.

3. The Contractor shall avoid areas (including haul roads and staging areas) for furnishing borrow or for waste or disposal of excess material (excavated material or broken concrete), that exhibit natural vegetation, which is defined as herbaceous or woody vegetation that is unmodified by human activities, vegetation that has been altered by humans but has retained or regained characteristics of an undisturbed community, or vegetation that has been planted by humans but is not actively maintained for agricultural/commercial purposes. Areas that have been cultivated and planted to non-native grasses, legumes, or grass-legume mixtures for purposes of livestock grazing, seed production, or hay crops shall not be given consideration as natural vegetation, except in cases where threatened or endangered species are present.

1105, Control of Work.

Add the Articles:

1105.17, Subsoil Tillage.

Prior to placement of topsoil and/or stabilizing crop seeding, perform subsoil tillage to an average depth of 16 to 20 inches on stockpile areas, haul roads, and areas used for storage of equipment. Till at 3 foot maximum centers and at right angles to finished slope.

Equip tillage equipment with arrowhead type shoe providing lateral displacement and limit movement of subsoil to the surface. Obtain Engineer's approval for equipment.

It is intended that following subsoil tillage, the area remain in a loosened condition. Additional compaction or operation of heavy equipment, other than that required for topsoil placement and shaping, will not be allowed on areas tilled. This work shall be considered incidental to other work on the project and will not be paid for separately.

1105.18, Topsoil on Haul Road.

Before placing a construction haul road, strip topsoil from within proposed haul road footprint to a depth of 8 inches and stockpile. After haul road has been removed, prepare disturbed area according to Article 1105.17, and place topsoil over disturbed area to a minimum depth of 4 inches.

This work shall be considered incidental to Mobilization and will not be paid for separately.

Section 1106

1106.07, B.

Add as the fifth bullet:

- Regulated Materials.

1106.07, C.

Delete the first sentence:

~~No payment for overhaul will be allowed for material hauled to or from these sites.~~

Section 1107

1107.06, B, Buy America.

Replace the Article:

~~On all contracts Per Materials I.M. 107 On Federal aid contracts and contracts where the Department is the Contracting Authority, all products of iron, steel, or a coating of steel which are permanently incorporated into the work shall be of domestic origin and shall be melted and manufactured in the United States, according to Materials I.M. 107. 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. 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.~~

1107.06, Federal Requirement.

Add the Article:

C. Use of United States-Flag Vessels.

In accordance with 46 CFR 381.7(b), on all Federal-Aid contracts, the Contractor agrees:

1. To utilize privately owned United States-flag commercial vessels to ship at least 50% of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any

equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.

2. To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, 'on-board' commercial ocean bill-of-lading in English for each shipment of cargo described in Article 1107.06, C, 1, to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.
3. To insert the substance of the provisions of this clause in all subcontracts issued pursuant to this contract.

1107.08, Public Convenience and Safety.

Replace the Article:

- A. The schedule for removal of existing guardrail, ~~warning devices~~, and other traffic control devices requires Engineer's approval. The Contractor may be required to place temporary warning devices at locations where replacement features are not installed the same day as removal takes place.
- B. The Contractor shall conduct the work to assure the least possible obstruction to access by the residents along the project. The Contractor shall schedule and conduct the work in such a way as to provide for their safety and convenience. The Contractor shall submit a construction staging plan to the Engineer for local access required to remain open. Relocated accesses shall be completed prior to removal of existing accesses. If a permanent access cannot be completed prior to removal of an existing access, the Contractor shall provide and maintain an alternate access. Work and materials required by the Engineer for public convenience and safety in excess of that provided for in the contract documents will be paid for per Article 1109.03, B.
- C. Whenever it is practical to do so, the Contracting Authority will close the portion of the road under construction, provide a detour, and cause suitable detour signs to be erected to mark such detour.
- D. When it is not practical for the Contracting Authority to close the road for construction, the Contractor will be expected to perform the work under traffic. The contract documents will ~~indicate this fact and~~ provide instructions for handling traffic through the work area. Unless otherwise stated in the contract documents, all work shall be performed by the Contractor between the hours of 30 minutes after sunrise to 30 minutes before sunset.
- E. Except when the contract documents indicate the road is to be closed, ~~during all pavement widening, base widening, and HMA resurfacing work~~, traffic will be permitted to use the ~~routes~~ roads involved at all times and shall not be delayed unnecessarily. ~~Where a pavement or base is being widened, the machine depositing material shall operate within the designated work area.~~ Construction equipment and materials may be stored within the right-of-way, ~~as far from the traveled way as is practical, but~~ at least 15 feet from the edge of the traveled way, and the roadbed shall be free of Contractor's equipment during non-working hours. The work shall be planned and conducted to cause a minimum delay or interference with traffic.
- F. When work on a traveled way necessitates diverting traffic from a work lane to another lane, material, personnel, ~~mobile~~ equipment, and vehicles shall occupy the work lane to the minimum extent and for the minimum time necessary, and non-mobile equipment shall be removed from the work lane promptly after its operation is completed in that lane.
- G. On two-lane roadways, a work area shall be established only on one side of the roadway and there shall be no parking of vehicles or equipment on the opposite shoulder within 500 feet of the work area.
- ~~H.~~—The location for storage of materials and equipment by the Contractor during nonworking hours shall be ~~as reviewed~~ at least 15 feet from the edge of the traveled way and approved by the Engineer prior to use.
- ~~I H.~~ ~~Parking of private vehicles on Interstate right-of-way will not be allowed.~~ On divided highways, ~~P~~parking of unattended equipment within the median or storage of equipment within 50 feet of the edge of ~~pavement~~ the traveled way will not be allowed.
- ~~J I.~~ Materials stored within the highway right-of-way shall be placed to cause a minimum obstruction to traffic. Sidewalks, gutters, sewer inlets, and portions of highway adjoining the roadway under construction shall not be obstructed more than is necessary.
- ~~K J.~~When the shoulder work is a part of the contract for work on a project open to public traffic during construction, the Contractor shall coordinate the operations so that the length and degree of pavement edge drop-off caused or partly caused by the operations are minimized.
- ~~L K.~~Shoulder construction in conjunction with PCC overlay or HMA resurfacing shall meet the following:

1. Paved Shoulders (Partial or Full Width).

Construction shall be staged so no drop-offs exist at the pavement or shoulder edge when the adjacent lane is to be opened to traffic. The pavement edge drop-off requirement shall be satisfied with an HMA shoulder fillet. This fillet shall extend into the shoulder area a minimum of six times the thickness of the drop-off and shall be placed prior to the adjacent lane being opened to traffic. Compaction of the HMA fillet shall be a minimum of one coverage with a pneumatic tired roller per 1 inch of thickness. The fillet shall be removed prior to start of shoulder paving. The shoulder edge drop-off requirement shall be satisfied with a granular fillet, meeting the requirements of the following paragraph.

2. Granular Shoulders.

Construction shall be staged so no drop-offs exist at the pavement edge when the adjacent lane is to be opened to traffic. The drop-off requirements shall be satisfied with a shoulder fillet or full shoulder width of granular material according to Article 2121.03. The fillet shall extend into the shoulder area a minimum of six times the thickness of the drop-off and shall be placed prior to the adjacent lane being opened to traffic. Compaction of the fillet shall be a minimum of one coverage with a pneumatic tired roller per 1 inch of thickness.

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

1. HMA Shoulder.

- Drop-offs greater than 2 inches 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.

N M. When the Contractor works on a bridge spanning a roadway or passageway, the Contractor shall take all necessary steps to protect the public using the facility below the bridge from falling debris, material, or construction equipment. The Contractor shall submit a safety procedure written plan to the Engineer prior to starting work. The plan shall include the following:

- Design of the means and methods used to provide protection.
- All assumptions used in the design.

Evaluation of the plan and design may require its preparation by a Professional Engineer licensed in the State of Iowa. If so, the costs will be paid for in accordance with Article 1109.03, B.

1107.09, Barricades and Warning Signs.

Replace the Title of the Article:

~~**Barricades and Warning Signs Contracting Authority and Contractor Traffic Control Responsibilities.**~~

1107.09, A.

Replace the first paragraph:

Barricades, channelizing devices, warning signs, and other aspects of traffic control shall be in accordance with the contract documents. In providing adequate and proper traffic control, both the Contracting Authority and the Contractor have certain responsibilities.

1107.09, A, 1, d, Availability.

Delete the last sentence:

~~Replacement materials will also be furnished as necessary.~~

1107.09, A, 2, a, 1.

Replace the third sentence:

When traffic is to be maintained through the construction, the Contractor shall erect and maintain all signs; furnish, erect, and maintain all other traffic control devices and other safeguards pilot cars; and provide all flaggers necessary to protect the traveling public.

1107.09, A, 2, c, Entrance from Local Public Roads.

Delete the second and third sentences:

~~When scarification is part of the contract, ROUGH ROAD signs shall also be erected on the shoulder of the road under construction at local public road intersections. These signs shall be erected, moved when appropriate, and maintained by the Contractor until the scarified areas are covered with the new surface material.~~

1107.09, A, 2, j, Cleaning.**Replace** the Article:

The reflective surfaces of signs and traffic control devices shall be washed, as described in ~~Article 2528.03, L Article 2528.03, O, 6,~~ and shall be clean at the time of initial installation on a project.

Section 1108**1108.02, A, 1.****Replace** the second sentence:

The proposal form may also indicate the contract period by a Completion Date ~~for non-highway type contracts (e.g. buildings, furnishing materials, etc.).~~

1108.02, C, 1, Specified Start Date.**Replace** the Article:

Except as noted in Article 1108.02, E, 2, f, ~~W~~working days will be charged to the Contractor starting on the Specified Start Date, ~~but not prior to 15 calendar days after the contract has been signed by the Contracting Authority.~~ Starting work prior to the Specified Start Date will be considered upon request, and working days will be charged when work starts.

1108.02, E, 2.**Replace** the Article:

Working days will be charged beginning with the following circumstances:

- ~~a.~~ **a.** On the date specified for projects with a Specified Start Date.
- ~~b.~~ **a.** On the date that has been agreed to at the preconstruction conference for projects contracts with an Approximate Start Date.
- ~~c.~~ **b.** On the start date indicated in the Notice to Proceed for projects contracts with an Approximate Start Date.
- ~~d.~~ **c.** On the day following the date the site becomes available if the Contractor is already working on the site onsite for projects contracts with an Approximate Start Date.
- ~~e.~~ **d.** On the date the Contractor begins work prior to the Late Start Date.
- ~~f.~~ **e.** On the date specified for projects contracts with a Late Start Date or Specified Start Date, and the Contractor has not ~~begun~~ started work prior to that date. However, working days will not be charged prior to 15 calendar days after the contract has been signed by the Contracting Authority all required entities, ~~as long as~~ provided the Contractor furnished the signed contract, performance bond, and proof of insurance within the time allowed by Article 1103.07; and has not ~~begun~~ started work on the contract.

1108.03, C.**Delete** the second sentence:

~~The Contractor should request a determination of the holidays to be observed at the beginning of each calendar year.~~

1108.03, D.**Add** the Articles:

- 3. Thanksgiving Day** – No work will be allowed the preceding Wednesday and the Friday, Saturday, and Sunday following Thanksgiving Day.
- 4. Christmas Day and New Year's Day** – When Christmas Day and New Year's Day are observed as a State Holiday on Monday, no work will be allowed beginning the preceding Friday through the holiday. When Christmas Day and New Year's Day are observed as a State Holiday on Friday, no work will be allowed the preceding Thursday through the following Sunday.

Section 1109**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 rental rate published in the ~~RENTAL RATE BLUE BOOK~~ by Equipment Watch Cost Recovery.

1109.04, H.**Replace** the third sentence of the Article:

For all items, materials ordered and delivered for the unfinished portion of such canceled or omitted items, the Contracting Authority will pay invoiced cost, not to exceed 80% of the authorized amount of associated bid item, plus 10% as an overhead charge.

1109.05, Prompt Payment.

Replace Article A, 2:

On contracts for which the contract sum is \$10,000 or more, payments may be allowed based on value of processed or fabricated materials or rolled steel products which have been delivered on the work or 90% of the value of processed or fabricated material, or rolled steel products, reserved for the project and stored elsewhere ~~within Iowa or in other locations where there is routine inspection by Departmental personnel~~, provided the materials are of acceptable quality conform to the requirements of the contract and the manner of storage is satisfactory to the Engineer. Payment of this materials allowance will not exceed 80% of the authorized amount of the associated bid item. Contractor is responsible for damages and material losses until the material is incorporated into the work and the work is accepted.

Replace Articles B and C:

B. Prompt Payment to Subcontractors.

1. The Contractor shall promptly pay each subcontractor. Any delay or postponement of payment among the parties may take place only for good cause, with written notification to the subcontractor. A payment, excluding subcontractor retainage, to a subcontractor for satisfactory performance of the subcontractor's work shall be made by the Contractor no later than one of the following, as applicable:
 - a. 7 calendar days after the Contractor receives payment for the subcontractor's work.
 - b. 7 calendar days after the Contractor could have received payment for the subcontractor's work, if the reason for nonpayment is not the subcontractor's fault.
2. The Contractor may withhold up to 5% of each progress estimate on work performed by subcontractors as subcontractor retainage.
3. ~~Retained funds due a subcontractor~~ Subcontractor retainage shall be payable by the Contractor within 30 calendar days after satisfactory completion of the work by the subcontractor. Subcontractor's work is satisfactorily completed when all requirements called for in the subcontract have been accomplished and required documentation provided by subcontractor. Non-bonded subcontractors may be required to submit proof of payment for all material bills and wages to the Contractor before the Contractor is required to pay the subcontractor retainage.
4. The use of joint checks for payment to subcontractors for their materials is acceptable under the following conditions:
 - a. The request for a joint check from the prime contractor is made by the subcontractor.
 - b. The joint check issued by the prime contractor is for an amount not to exceed the cost of unpaid invoice(s) from the materials supplier to a subcontractor on that contract.
 - c. The joint check is given to the subcontractor and the subcontractor must release the joint check to the material supplier.
 - d. The use of a joint check by the prime contractor is applicable to all their subcontractors.

C. Contractor Retainage.

1. Three percent of each progress estimate will be deducted and held as Contractor retainage on the first \$1,000,000 paid on a contract. Additional Contractor retainage will be withheld to a maximum of \$30,000 following Contractor retainage release if subsequent work is performed. This Contractor retainage is held exclusively for claims filed in accordance with Iowa Code 573 and shall not be considered as an encumbrance on work performed by a subcontractor.
2. ~~Retained funds~~ Contractor retainage held by the Contracting Authority for the contract will not be due and payable prior to 30 calendar days after the date of final acceptance of the entire contract or following the release or adjudication of claims that may have been filed, or until the Contractor has filed the signed final voucher with the Contracting Authority.

Replace Article E:

1. The Contractor shall maintain a system for tracking the status of subcontractor work and payments. The Contractor shall retain records that document the date of field completion, date of satisfactory completion of the work and the date of final payment (including ~~funds retained~~ subcontractor retainage in accordance with Article 1109.05, B, 2) to each subcontractor. Copies of the records to verify compliance with Article 1109.05, B shall be provided to the Contracting Authority, if requested.
2. Prior to receiving final payment, the Contractor shall provide to the Engineer the "Certification of Subcontractor Payments" (Form 518002). This form shall include the names of each approved subcontractor, the date of field

completion, the date of satisfactory completion of the work, the date of final payment, the number of days between satisfactory completion and final payment, and the date of payment by the Contracting Authority. Explanations for any final payments made after the 30 calendar day period following field completion shall be included with Form 518002.

3. Failure to comply with Article 1109.05, B may result in price adjustment credits, or suspension of bidding qualification in accord with Article 1102.03, A, 2.

1109.07, Certified Statement of Sales Tax and Use Tax Paid.

Replace the Article:

Contractors and approved subcontractors will be provided an Iowa Sales Tax Exemption Certification. This applies to the purchase of building materials, supplies, or equipment in the performance of construction contracts let by the Department, in accordance with requirements of the Iowa Department of Revenue.

1109.13, A.

Replace the Article:

The Contracting Authority may, by written notice, with the approval of the FHWA where applicable, terminate the contract or a portion thereof when the Contractor is prevented from proceeding, directly or indirectly, with the construction contract as a direct result of an Executive Order of the President with respect to the prosecution of war or in the interest of national defense, as provided in Iowa Code 573A. work or construction upon a public improvement is stopped directly or indirectly by or as the result of an order or action of any federal or state authority or of any court because of the occurrence or existence of a situation which the President, Congress of the United States, Governor, or Iowa Legislature has declared to be a national or state emergency, and the circumstances or conditions are such that it is and will be impracticable to proceed with such work or construction, then the Contractor may, by written agreement terminate the contract. Such an agreement shall include terms and conditions of the termination of the contract and provisions for payment, if any, which any party shall pay to the other.

Section 1113

1113, Electronic Document Storage.

Add the Section:

1113.01 GENERAL.

Electronic Document Management shall be used for electronic document storage on contracts where let through the Department is the Contracting Authority. ~~This requirement may be used on other contracts when specified in the contract documents.~~

This specification contains requirements for collection and management of electronic documents through the use of Doc Express at <https://doexpress.com>. Doc Express is a web based document management program which accepts electronic documents and provides security as appropriate for each submittal.

The Contracting Authority will perform setup of Doc Express in accordance with project requirements. Doc Express is the complete and officially recognized construction document management system for contract documents required by the Contracting Authority.

Costs associated with the use of Doc Express are incidental to Mobilization. Contract item progress payments will be withheld until documentation is provided as defined in this specification.

A. Structure.

The framework utilizes basic contract drawers to store project documents.

Within each drawer are types used to group similar items together. A complete listing of the types in each drawer can be seen when submitting a document to that drawer in Doc Express.

For contracts where Contracting Authority is a county or city, files uploaded to Doc Express shall be named and filed according to current Doc Express Drawers, Document Types, and Naming Convention published by Local Systems Bureau in Local Systems Instructional Memorandum 6.000, Attachment F.

B. Security.

As requested, each user within an organization will be assigned an account within Doc Express by their own organization. Access to Doc Express will be tracked through the use of the user's unique email address and password. User permissions will be defined within Doc Express for each specific contract.

1. **Prime** - The Contractor will be assigned Prime permission to submit documents and view all documents submitted into Doc Express - including those submitted by the Contracting Authority and users with an Associate level permission.

The Prime can grant access to all associates to all drawers except the Payroll drawer to which only the Prime should have access.

2. **Associate** - Subcontractors and suppliers will be assigned Associate permission which will authorize any user associated with the respective subcontractor or supplier to submit documents but can view only those documents submitted by that respective entity. An Associate user is not able to view documents submitted by a Prime, Contracting Authority, or other Associate users.
3. **Reviewer** - Reviewer permission allows the user to only view all documents and will typically be assigned to those that will oversee the specific contract, but are not responsible for daily tasks.
4. **Contracting Authority** - A formal permission level is not assigned. Contracting Authority staff has the ability to submit, receive, audit, or reject a document.

Documents submitted into Doc Express are secure. Security of the program will not allow modifications to a submitted document by any user. The user, or another user within the organization, who submitted the document may delete the submittal from Doc Express as long as the document has not been received, rejected, or had a comment attached.

The Payroll drawer has a more restrictive security setting. Only the user who submits a payroll document or a Contracting Authority user specifically assigned to access payroll information for the specific contract can view the payroll document. Other Prime users will not be able to view the submitted payroll document nor will other Contracting Authority users.

C. Document Types.

Doc Express will accept all types of electronic documents including, but not limited to, Microsoft Excel files, Microsoft Word documents, Adobe Portable Document File (PDF), Tagged Image File (TIFF), and Joint Photographic Experts Group (JPEG). The maximum size limit of a file is 50 MB, but uploading and opening of the document will take longer as the file size increases. Preference should be given to smaller file sizes anytime they can be used.

1113.02 RESPONSIBILITIES.

A. Contracting Authority.

1. Contract set-up including drawer and type creation within a contract with applicable Prime, Associate, and Reviewer permissions.
2. The Construction Project File will be maintained in Doc Express. The Contracting Authority will submit to the appropriate drawer and type, all construction related documents generated by the Contracting Authority.
3. Review and verify that the documentation submitted meets the applicable submittal requirements. The review of documents will be made promptly from when the documents were able to be verified. Contractor payment may be withheld for contract documents not submitted.

B. Contractor.

1. Verify subcontractors and suppliers involved with the project have access to contract in Doc Express. Add any subcontractor or supplier which was omitted from the set-up performed by the Contracting Authority.
2. Submit electronic documentation per type defined in Doc Express. Each electronic submittal may contain multiple pages of documentation but shall provide information required for the specified type only.
3. Provide daily or weekly statements that show an itemized summary of the quantity of certified non-proportioned material delivered to the project site. The statement is to include a total for the day or week provided and a running total for the amount delivered to the project to date.
4. Submit the invoice, certified bill of materials, or bill of lading for each shipment as documentation to allow the Contracting Authority to authorize progress payments for:
 - Corrugated Metal Culvert Pipe – Materials I.M. 441.
 - Precast Concrete – Materials I.M. 445.
 - Plastic Pipe – Materials I.M. 446.

C. Shared Contracting Authority and Contractor/Supplier Responsibilities.

Doc Express will store final versions of documentation required for the contract. Some documents require involvement and coordination between the Contracting Authority and Contractor to reach a final version. This

shared responsibility will be coordinated to prevent incomplete or redundant data from being electronically stored.

Division 20. Equipment Requirements.

Section 2001

2001.07, A, 2.

Replace the second bullet:

Sensitive to a weight equal to 0.1% of the quantity being weighed but ~~no less~~ not more than 20 pounds and no less than a weight equal to one of the minimum graduations on a beam or dial scale.

2001.12, G.

Add to the end of the Article:

- Provide a manufacturer produced tank stick.

2001.12, H.

Delete the Article:

~~H. Calibrate distributors initially at the Iowa DOT Materials Laboratory. Verification of a manufacturer's calibration may be made by the Iowa DOT Materials Laboratory or by a District Materials Office. Have distributor calibrations certified annually by either the Iowa DOT Materials Laboratory or District materials personnel. If distributors are found to have inaccurate calibrations, have distributors recalibrated by the Iowa DOT Materials Laboratory before further use.~~

2001.19, B, 4.

Replace the Article:

A screed extension may be used, provided it has a screed plate with vibration.

a. Flush-mounted Screed Extension.

If the extension exceeds 1 foot, extend the auger as well.

b. Offset-mounted Screed Extension.

Operate screed unit to produce a uniform distribution of mixture ahead of the extension.

c. Other extensions will be allowed for placing fillets or short or irregular tapers.

Division 21. Earthwork, Subgrades, and Subbases.

Section 2101

2101.01, A.

Replace the Article:

Clearing: Cut and remove trees 3 inches or more in diameter. Cutting shall be performed between October 1st and March 31st. Tree felling will only require trees to be cut 3 to 4 feet above ground line.

2101.03. Construction.

Add the Article:

G. Perform tree felling in areas as shown in the contract documents. Grubbing and removal of felled trees or other material will be completed by others. Move felled trees to avoid interference with drainage ways and keep within the right-of-way, unless indicated otherwise in the contract documents.

2101.04, A, 2.

Add after the first sentence:

Units for tree felling will be equivalent to clearing units.

2101.04, B, 1.

Replace the Article:

The area in acres will be ~~based on that the quantity shown in the contract documents, computed from a need line, or computed from a right-of-way line if the limits are not shown for this item in the contract documents.~~ If limits for this item are not shown in the contract documents, they will be calculated from a need line or right-of-way line as indicated in the plans.

2101.05. Basis of Payment.

Replace the first sentence:

Payment for Clearing and Grubbing, removal of trees, stumps, logs and down timber, hedge rows, brush, field fence, and growing corn, and tree felling will be made at the contract unit price per unit or per acre as indicated below.

Section 2102**2102.03, D, Removal of Unsuitable or Unstable Soil and Placement of Backfill Material.**

Rename and replace the Article:

Removal of Unsuitable or Unstable Soil and Placement of ~~Selected or Special~~ Backfill Material.

1. Removal of unsuitable or unstable soil or placement of ~~selected or special~~ backfill material, or both, may be required in the contract documents or by the Engineer.
2. If the finished grade line leaves a subgrade of unsuitable or unstable soil, the Engineer may require the Contractor to remove that soil as below grade excavation and place backfill material to the finished grade line. Material encountered above the elevation of finished subgrade which cannot be properly consolidated in the embankment may be designated as unstable soil by the Engineer. If the surface on which the plans indicate that ~~selected or special~~ backfill material is to be placed is such that it will be seriously distorted by hauling equipment, the Engineer may designate this material as unstable.
3. Remove unsuitable or unstable soil and place ~~selected or special~~ backfill material according to the following requirements:
 - a. **Removal of Unsuitable or Unstable Soil.**
 - 1) Remove these soils to the elevation shown in the contracts documents or as directed by the Engineer. Remove and place them as directed in the contract documents or by the Engineer and, in the case of unsuitable soils, according to Article 2107.03, N.
 - 2) Conduct operations so that the Engineer is given the opportunity to take cross sectional measurements required before the backfill material is placed.
 - b. **Backfill Materials.**
 - 1) Obtain ~~selected~~ or other backfill materials from locations shown in the contract documents or as directed by the Engineer.
 - 2) Furnish special backfill material that meets the requirements of Article 2102.02, F. Place salvaged materials used as special backfill material in uniform lifts no more than 6 inches thick. Place salvaged composite material used as special backfill material in uniform lifts of no more than 6 inches thick.
 - c. **Placement of Backfill Material.**
 - 1) Place ~~special or selected~~ backfill material in areas shown in the contract documents or as directed by the Engineer. Place and compact as provided in Section 2107 with the following modifications:
 - a) **Where compaction with moisture and density control or with moisture control is required, ensure the moisture content of special backfill material is within the limits specified.**
 - b) When select backfill material is placed for subgrade treatment purposes, compact using moisture control.
 - 2) Ensure the moisture content of backfill material is uniform. If necessary, adjust by processing in an approved pugmill or by adding water and road mixing in place prior to spreading and compacting.
 - a) ~~Use selected backfill material that at the time of spreading and compacting is no drier than 2.5% below the optimum moisture shown in the contract documents. If not shown, the Engineer will determine the optimum moisture.~~
 - b) ~~Use special backfill material that at the time of spreading and rolling is no drier than 2% below, and does not exceed, the maximum amount that will permit obtaining required compaction without rutting.~~
 - 3) When 2 feet or more of ~~selected or special~~ backfill material is placed in areas where unstable soils have been excavated, the condition of the underlying soil may limit the amount of compaction to be done in the bottom 1 foot of subgrade treatment. In exceptionally wet or unstable areas, the Contractor may be permitted to end dump the first 1 foot of treatment material and doze it into position with only partial compaction, as directed by the Engineer. Compact the material above the bottom 1 foot as provided above.
 - 4) When less than 2 feet of ~~selected or special~~ backfill material is placed in areas of exceptionally wet or unstable soils, the Engineer may require a tamping type roller to be used for compaction of the material placed in the first foot of thickness.

2102.03, F, 3, a, 2.

Replace the Article:

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 soil 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. However, use the same type of select treatment material across a set of lanes being constructed.

2102.03, F, 3, a, General.

Add the Article:

- 4) To stabilize granular soil select treatments, incorporate 3 inches of special backfill into the top of the select treatment. Payment for this work is incidental to Contractor Furnished Select Treatment.

2102.04, A, 1, a.

Replace the second bullet:

- Borrow pits areas provided by the Contracting Authority,

2102.04, A, 1, c.

Replace the Article:

Payment will be made for the quantity of all Class 10 excavation items shown in the contract documents, adjusted by any increase or decrease in excavation from a borrow furnished by the Contracting Authority ~~borrow excavation~~ or change in backslope. Should the Contractor or the Engineer desire actual measurement, such as when a discrepancy in quantity is discovered, timely written notice shall be given to the other party at any time during the construction period. ~~Whenlf actual measurement is requested, the preliminary cross sections and the balance points shown in the contract documents or cross sections based on actual measurements of the project area will be used.~~ This method shall be used in conjunction with the quantities shown in the contract documents related to work as provided for in Articles 2107.04 and 2108.04.

2102.04, A, 1, d.

Replace the Article:

Payment will be made for the quantity of embankment-in-place shown in the contract documents, except as provided by this article. ~~When embankment-in-place is specified, the Engineer will determine the quantity of materials placed using cross section and end area methods.~~ Should the Contractor or the Engineer desire actual measurement, such as when a discrepancy in quantity is discovered, timely written notice shall be given at any time during the construction period. When actual measurement is requested, the preliminary cross sections or cross sections based on actual measurements of the project area will be used. The quantity for which payment is made will not exceed that necessary to construct the embankment to the neat cross section shown in the contract documents, adjusted for settlement. The Engineer may elect to measure the embankment after ~~selected backfill~~ subgrade treatment material and topsoil have been spread and deduct the computed quantities of ~~selected backfill material and topsoils~~ this material from the quantities of total embankment. Shrinkage will not be included in the quantity.

2102.04, A, 1, Excavation.

Delete Article e and **renumber** Article f:

- e. ~~Overhaul will not be measured or paid for when excavation is paid for as embankment-in-place. Prior to computation of embankment quantities, the original ground profile and original ground elevations shown on the cross sections will be adjusted to conform as nearly as practical to information obtained from taking elevations on settlement plates.~~
- f e. Measurement for boulders or rock fragments classified as Class 12 excavation will be as follows:

2102.04, A, 8, Contractor Furnished Select Treatment.

Add as the second sentence:

Shrinkage will not be included in the quantity.

2102.05, A, 1, c.

Add the Article:

3) Backfill.

- a) Special Backfill: Per Article 2102.05, A, 4.
- b) Class 10, Excavation: Per the following:
- When Waste is bid separately, any increase in Roadway and Borrow quantity will be paid per cubic yard. Waste quantity will be decreased by the same quantity.
 - When Waste is not bid separately, there will be no increase or decrease to Roadway and Borrow quantity for the backfill. Payment for the backfill will be made for the cut volume that is included in the Roadway and Borrow quantity.
- c) Contractor Furnished Embankment-in-Place: Increase in quantity will be paid per cubic yard. Shrinkage will not be included in the quantity.

2102.05, A, 1, d.

Replace the Article:

- d. Excavation involved in rebuilding embankments in accordance with Section 2107: by class of excavation involved.

2102.05, A, 8, Contractor Furnished Select Treatment.

Add as the third sentence:

Moisture control of select soil treatment is incidental to Contractor Furnished Select Treatment and will not be paid for separately.

Section 2105**2105.05, C.**

Delete the Article:

- ~~C. Overhaul will not be paid for this item.~~

Section 2106**2106.03, E.**

Replace the Article:

The Engineer will determine elevations of settlement plates in accordance with Article 2526.03, GE.

Section 2107**2107.03, C, 1.**

Replace the Article:

~~Where the height of proposed embankment at the center line is 5 feet or less, remove sod (after thorough disking) from the area. Place the sod on the area to be occupied by the outer portion of the embankment as provided in Article 2107.03, D. Strip topsoil as required by the contract documents.~~

2107.03, H, 1.

Replace the Article:

~~The contract documents will show indicate areas in which where to construct embankments shall be constructed with moisture and density control. The When a specific depth is required, the contract documents will also show indicate the distance below the elevation of the completed grading work to which such methods are to be applied. Unless specified otherwise in the contract documents, maintain moisture content within the limits of -2.0% and +2.0% of optimum moisture content for maximum dry density.~~

2107.03, I, 1.

Replace the Article:

The contract documents will show indicate:

- ~~a. Areas in which where to construct embankments are to be constructed with moisture control.~~
- ~~b. The When a specific depth is required, the contract documents will indicate the distance below the elevation of the completed grading work to which such methods are to be applied.~~
- ~~c. The moisture limits. Unless specified otherwise in the contract documents, maintain moisture content within the limits of -2.0% and +2.0% of optimum moisture content for maximum dry density.~~

2107.04, B, 4, Compacting Backfill Adjacent to Bridges, Culverts, or Structures.

Replace the equation for calculating H:

H = nominal height of structure opening, feet. If floodable backfill per Standard Road Plan DR-111 is used, H is the height from top of floodable backfill to top of structure.

Section 2108**2108, Overhaul.**

Delete the Section:

~~**Section 2108. Overhaul**~~

2108.01 DESCRIPTION.

Transport excavated material from roadway and borrow excavation, from channel excavation, and from excavation for structures a distance in excess of the free haul limit for the kind of excavation involved.

2108.02 MATERIALS.

Specified in the contract documents.

2108.03 CONSTRUCTION.

None.

2108.04 METHOD OF MEASUREMENT.

- A. In determining what constitutes necessary haul, it will be assumed that material taken from excavation will be deposited in embankment after having been hauled the minimum possible distance. The haul distance for material moved from borrow outside the roadway will be measured from the center of mass along the shortest route the Engineer determines to be feasible and satisfactory. The haul distance for material obtained from the roadway, including interchanges and intersections, and placed inside the main roadway will be measured along the center line of the roadway.
- B. If pavement equipment crossings are designated by the Contractor as provided in Article 1105.11, B, and the contract provides for payment of overhaul on the material involved, overhaul on the material obtained within the roadway will be computed and measured along the center line as described above. Overhaul will be computed and measured on the basis that material taken from excavation was deposited in adjacent embankment after having been hauled the minimum possible distance, irrespective of the number and location of equipment crossings designated by the Contractor. The haul distance for material moved from outside the roadway will be measured along the shortest route the Engineer determines feasible and satisfactory. It will be assumed that an equipment crossing was designated opposite the point where the haul road enters the roadway.
- C. The limits of free haul will be determined from a mass diagram by fixing two points on the volume curve, one on each side of the neutral grade point. One point is placed in excavation and the other in embankment so that the distance between them equals the free haul distance and the included quantity of excavation and embankment balance. Materials within the free haul limit will be eliminated from further consideration. The distance between the center of gravity of the remaining mass of excavation and the remaining mass of embankment, minus the free haul distance, will be the overhaul distance. The quantity of overhaul will be measured in station yards. A station yard is defined as the product of an overhaul distance of 1 station multiplied by 1 cubic yard of material hauled a distance greater than the free haul distance.
- D. Unless provided otherwise in the contract documents, the free haul distance will be 1000 feet.
- E. Payment for Overhaul will be for quantities shown in the contract documents in conjunction with quantities shown in the contract documents described in Article 2102.04 and under the conditions described therein. If Class 10 excavation quantities are changed, overhaul quantities will also be subject to change. The Engineer will compute the overhaul change if it can be identified. If not, it will be adjusted by the ratio of adjusted quantities to original quantities shown in the contract documents of Class 10 excavation.

2108.05 BASIS OF PAYMENT.

Payment for the quantity of overhaul, measured as provided above, will be the contract unit price per station yard with the following exceptions:

- A. Overhaul will not be paid for selected backfill material if it can be secured and used as shown in the contract documents. Should changes from the contract documents cause an increase or decrease in necessary haul, payment will be adjusted for such increase or decrease at the contract unit price per station yard.
- B. If no bid price appears in the contract for overhaul, increased overhaul will be paid for at a unit price agreed to by the Contractor and Engineer, but not to exceed \$0.02 per station yard.
- C. Overhaul will not be paid for Contractor furnished material (such as borrow or topsoil) and waste material.

Section 2109**2109.03, B, Treatment of Subgrade for Concrete Pavement.**

Delete the Article and renumber the following Article:

B. Treatment of Subgrade for Concrete Pavement.

Unless the Engineer orders otherwise, ensure the subgrade, at the time of placing concrete for Concrete Pavement (Section 2301) or Concrete Base (Section 2201), is either:

- In a uniform moist, but not muddy condition to a depth of not less than 1 inch, or

- ~~Covered with a single layer of plastic film meeting the requirements of Section 4107. Lap adjacent strips of plastic film by at least 12 inches. Do not stretch plastic film to the extent that its width is noticeably reduced. Plastic film which has been used for curing concrete, salvaged in usable condition, may be used for subgrade treatment.~~

C B. Special Compaction of Subgrade.

Section 2116

2116.02, A, 1, b.

Replace the Article:

Foamed Asphalt using PG 52 -34S or PG 46 -34 asphalt binder meeting requirements of Section 4137.

Section 2122

2122.01, A.

Replace the last sentence:

This work may include construction of an earth fill and a special backfill material layer for new construction or surface preparation for resurfacing or overlay construction.

2122.02, A, Hot Mix Asphalt Mixture (1,000,000 ESAL Base Mixture).

Replace the title and Article:

Hot Mix Asphalt Mixture (1,000,000 ESAL Base Mixture).

Use materials specified in a 1,000,000 ESAL Standard Traffic (ST) base mixture with PG 58-28S binder according to Section 2303.

2122.02, B, 3.

Replace the Article:

For shoulder construction in which PCC is placed over HMA asphalt, thoroughly clean the surface by brooming prior to placing concrete. When HMA asphalt is to be placed over HMA asphalt, prepare the surface according to Article 2303.03, C, 4.

2122.02, C, 1, Hot Mix Asphalt Mixture.

Replace the title and Article:

Hot Mix Asphalt Mixture.

- Prior to placement, tack coat the pavement edge.
- Proportion, mix, place, and compact HMA asphalt mixture to the width, thickness, grade, and slope shown in the contract documents, according to the requirements of Section 2303.

2122.03, B, Preparation of Shoulder Area.

Replace Articles 1 and 2:

- ~~This work may involve construction of an earth fill and a special backfill material to allow placement of paved shoulders. Spread and compact earth fill. Prepare subgrade according to the requirements of Section 2109.~~
- ~~Use select materials of Article 2102.02, D, 1, if available and coordinated with the Engineer, or suitable soils of Article 2102.02, D, 2. Do not use unsuitable soils of Article 2102.02, D, 3, or topsoil. Place special backfill material according to Article 2102.03, D, 3, c.~~

2122.03, C, 3, Special Backfill Material.

Delete the Article:

3. Special Backfill Material.

~~Place special backfill material according to Article 2102.03, D, 3, c.~~

2122.03, D, Finishing.

Replace the last sentence:

~~Finish the foreslope according to Article 2123.03, C. Complete earth shoulder as shown in the contract documents and according to Section 2123.~~

2122.05, A, Paved Shoulders.

Replace Article 2 and **renumber** Article 3:

2. Portland Cement Concrete Paved Shoulder.

- a. Article 2301.05, A, applies.
- b. Payment for paved shoulders constructed is full compensation for:
 - Preparing the area, including the earth fill, and furnishing and placing the paved shoulder, and finishing the shoulder edge and granular fillet (as required).
 - Furnishing all the material, equipment, tools, and labor to complete the work according the contract documents and this specification.

c 3. Separate payment will not be made for:

- ~~Construction of the earth fill.~~
- Asphalt binder.
- Tack coat bitumen.
- Placement, construction, or sawing and filling of joints for the PCC base.
- ~~Finishing of the shoulder edge and furnishing granular fillet material.~~

3 4. Furnish samples as specified in Section 2303 or 2301, with payment to be made as specified.

2122.05, C, Resurfacing or Overlay of Existing Paved Shoulders.

Replace the Article:

For HMA asphalt of the type, width, and thickness specified and satisfactorily constructed, payment will be according to Article 2303.05.

Section 2123**2123.01, A.**

Add as the last sentence:

In general, earth shoulder finishing relates to earthwork adjacent to curb and gutter.

2123.02, A.

Replace the last sentence:

Place topsoil meeting requirements of Article 2105.02 and as required by Article 2105.03, B.

2123.03, B, Constructing Earth Shoulders.

Replace Article title:

B. ~~Constructing Earth Shoulders Construction.~~

2123.03, B, 1, c.

Replace the Article:

- c. Placing material resulting from subgrade trimming operations (if available). and
- d. ~~e~~Completing construction with a minimum of 4 inches of topsoil.

2123.03, B, 2.

Add as the last sentence:

Topsoil shall be spread and smoothed.

2123.03, C, Finishing.

Replace Article title:

C. Earth Shoulder Finishing.

2123.03, C, 1.

Replace the Article:

After earth shoulders have been compacted and topsoil placed as required by contract documents, shape to the specified cross section and smooth to a condition acceptable to the Engineer.

2123.04, A, 1, c.

Delete the Article:

~~c. Unless provided otherwise in the contract documents, overhaul will be measured according to Article 2108.04.~~

2123.05, A, 1, a, 3.

Replace the Article:

~~Overhaul: per station yard, unless the contract provides otherwise.~~ **Topsoil: per cubic yard as provided in Article 2105.05.**

2123.05, A, 2, b.

Replace the Article:

Payment is full compensation for all costs including the cost of excavating, hauling, providing material, placing, compacting, rebuilding approaches, and finishing work.

Section 2126**2126.05, B.**

Delete the second sentence:

~~No overhaul will be paid on this material.~~

Section 2132**2132.04, C, 3.**

Delete the Article:

~~3. When removal and transportation of stripping involves a haul of more than 1000 feet, overhaul will be computed and paid according to Section 2108.~~

2132.05, C, 2.

Replace the Article:

If the contract provides a separate contract unit price for stripping, payment will be for the cubic yards of excavation and the number of station yards of overhaul, computed as specified above.

Division 22. Base Courses.**Section 2212****2212.05, I, Hot Mix Asphalt Mixture.**

Replace the Article:

In addition to the payment described in Paragraph C, HMA for partial depth repair patches will be paid for according to ~~Article 2530.05, B, 1, c~~ Article 2530.05, D, 1, c.

Section 2213**2213.02, A, 1, HMA Base Widening.**

Replace the title and Article:

HMA Asphalt Base Widening.

Use 1/2 inch or 3/4 inch 1,000,000 ESAL Standard Traffic (ST) Base mixture. For base widening for shoulders, use PG 58-28S binder.

~~a. Use mixture specified on the contract documents.~~

~~b. Meet requirements of Section 2303, as specified.~~

2213.03, E, Preparation of Subgrade.

Replace Articles 1 and 2:

1. Cut the trench to the width of the widening shown in the contract documents. Ensure if the existing pavement is HMA, saw or trim the a vertical edge of existing asphalt (if any) to a vertical line flush with the edge of the existing concrete pavement by sawing or milling, if needed. At the Contractors option, this trim line may be made at any uniform distance in from the edge of the existing concrete, but not to exceed 3 inches.

2. For HMA asphalt base widening, tack coat the edge of the old pavement at a rate of 0.10 to 0.15 gallon per square yard according to Article 2303.03, C, 2, b. A waiting period will not be required before placing the widening.

2213.03, F, 1, HMA Base Widening.

Replace the title and Article:

HMA Asphalt Base Widening.

- a. ~~Limit the compacted thickness of the top layer to no more than 2 inches. The maximum thickness of lower layers may exceed 3 inches if the Contractor demonstrates the thicker layers have compaction and riding characteristics within conformance to that expected from a 3 inch thick layer. Avoids dumping base material on the surface of the pavement. Immediately remove, by brooming, base material spilled on adjacent pavement.~~
- b. ~~Spread base material so that after compaction, the constructed width conforms to the design dimension.~~
- c **b**. Promptly and thoroughly compact each layer. Compact to the density specified in Article 2303.03, C, 5 for Class I compaction.
 - For widening in a travel lane apply Class I compaction per Article 2303.03, C, 5, b.
 - For widening in non-travel lane apply Class II compaction per Article 2303.03, C, 5, c.
- d. ~~The percent of compaction will be based on the laboratory density obtained for that day's mixture.~~
- e c. Succeeding layers of base material may be placed as soon as the previous layer has been compacted. Take density samples from the compacted material and test according to Article 2303.03, D.
- f d. When the contract for base widening does not include resurfacing:
 - Ensure the final surface of the widening is flush with, or not more than 1/8 inch below, the surface of the old pavement.
 - Limit compacted thickness of top lift to no more than 2 inches.

2213.03, I, Winter Seal.

Delete the Article:

~~I. Winter Seal.~~

1. ~~Prime HMA base which is not covered with upper base or surface in the same construction season in which it is built. The Engineer may require an application of a winter seal consisting of:

 - The bituminous material used as the primer or tack coat applied at 0.12 gallon per square yard, and
 - A sand cover applied at 10 to 15 pounds per square yard, according to Section 2307.~~
2. ~~Winter seal that the Engineer requires will be paid for as provided in Article 1109.03, B.~~
3. ~~Except where road closure is provided in the contract documents, traffic will be allowed to use the road from the time construction is stopped until work is resumed the following season. Make required repairs to the base when construction is resumed, at no additional cost to the Contracting Authority.~~

2213.04, G, Samples.

Replace the Article:

Article 2303.04, HG, applies for HMA base widening.

Section 2214

2214.03, D, 8.

Replace the first sentence:

Commence HMA or PCC overlay (HMA, PCC, Seal Coat, Slurry Seal, etc.) placement operations within 10 working days after completion of the scarification operation.

Section 2216

2216.03, A, 2, a, 1.

Delete Article c and **Renumber** Article d:

- c) ~~The roller tires shall be inflated to the pressure necessary to obtain proper surface contact pressure to satisfactorily seat pavement slabs.~~
- d c) At the Contractor's option, the roller tires may contain liquid.

2216.03, A, 2, a, 2.

Replace the Article:

Weight body suitable for ballasting to a minimum gross load of 50 30 tons. The ballast shall allow gross roller weight (mass) to be readily determined and controlled to maintain a minimum gross roller weight (mass) of 50 30 tons.

2216.03, A, 2, b.

Delete the Article:

- ~~b. Tow the roller with a rubber tired prime mover.~~

2216.03, D, 2.

Replace the Article:

Roll the cracked pavement until seated to the Engineer's satisfaction. The intent is to:

- ~~• Load the roller so that satisfactory seating can be reasonably assured by one complete coverage by the roller, and~~
- ~~• Accomplish seating with a minimum damage to aggregate interlock at the cracks.~~

Division 23. Surface Courses.

Section 2301

2301.03, A, 3, a, 6, a, 12.

Replace the second sentence:

Tilt trailing end of each vibrator downward to an ~~approximate~~ slope of ~~15~~ **10 to 30** degrees below horizontal.

2301.03, E, 1, Placing Reinforcement.

Add the Article and **renumber** following Articles:

- a. Ensure reinforcement is free from dirt, detrimental scale, rust, paint, oil, and other foreign substances.
- ~~a b.~~
- ~~b c.~~
- ~~c d.~~

2301.03, E, 1, c.

Replace the Article:

Use ~~approved~~ continuous bolsters with runners and continuous high chairs with runners, either plastic or steel, meeting requirements of Materials I.M. 451.01 to support reinforcement for bridge approach sections. Hold epoxy coated reinforcing steel in place with epoxy or plastic coated bar supports and epoxy or plastic coated tie wires. Steel reinforcement when supported and tied should not rack, shift, or deflect from its intended position.

- 1) For single reinforced sections and bottom layers of double reinforced sections, ~~P~~place supports transversely across the approach and space them ~~longitudinally~~ no greater than 4 feet apart.
- 2) For top layers of double reinforced approach sections, ~~the top layer of reinforcing may be chaired off the bottom layer of reinforcing using approved continuous high chairs with runners, provided they are positioned directly above the continuous bolsters with runners supporting the bottom layer of reinforcing. Hold epoxy coated reinforcing steel in place with epoxy or plastic coated bar supports and epoxy or plastic coated tie wires. Use continuous bolsters with runners and continuous high chairs with runners, either plastic or steel, meeting the requirements of Materials I.M. 451.01~~ place supports longitudinally on top of bottom layer and space them no greater than 4 feet apart.

2301.03, E, 2, Placing Load Transfer Devices.

Add the Article and **renumber** following Articles:

- b. Ensure load transfer devices are coated completely with a bond breaker and are free from dirt and other foreign substances.
- ~~b c.~~
- ~~c d.~~
- ~~d e.~~

2301.03, F, Placing Concrete.

Add the Article and **renumber** subsequent Articles:

3. Unless otherwise directed by the Engineer, wet subgrade or subbase just prior to placing concrete until it is uniformly moist to a depth of not less than 1 inch. Avoid excessive wetting resulting in a muddy condition of subgrade or ponding of water on subbase.

- ~~3 4.~~
- ~~4 5.~~
- ~~5 6.~~
- ~~6 7.~~
- ~~7 8.~~
- ~~8 9.~~

2301.03, K, 3, b.

Replace the first sentence:

Protect concrete pavement less than 36 hours old as shown in Table 2301.03-42.

2301.03, R, Bridge Approach Sections, Reinforced Paved Shoulders, and Full-width Reinforcement for Pavements.

Add the Article:

5. When concrete is placed by pumping, use a target value for air content of $7.5\% \pm 2.0\%$.

2301.03, U, 1.

Replace the first sentence:

The time for opening pavement for use will be based on the restrictions listed in Table 2301.03-23, with flexural strength determined from beam specimens made during the progress of the work.

2301.03, U, 3, a.

Replace the first sentence:

The time for opening pavement will be based on strength requirements only, as specified in Table 2301.03-2 3.

2301.03, U, 4.

Replace the second sentence:

Such sections of pavement may be opened to traffic in accordance with Table 2301.03-2 3.

2301.03, U, 5.

Replace the first sentence:

At the Contractor's option, when Type I/II cements are used, Class-C fly ash may be substituted for up to 10%, by weight, of the cement in Class M concrete mixtures.

2301.04, A, 2.

Replace the Article:

2. ~~The~~ ~~coring~~ Requirements for thickness do not apply to detour pavements, paved drives, and temporary pavements. The thickness of pavement constructed will be determined from ~~core depths~~ as follows:
 - a. The division of sections, lots, and ~~core~~ thickness measurement locations will be determined by the Engineer according to Materials I.M. 346.
 - ~~b. At locations determined by the Engineer, cut samples from the pavement, as directed above, by drilling with a core drill that will provide samples with a 4 inch outside diameter. Restore the surface by tamping low-slump concrete into the hole, finishing, and texturing. The Engineer will witness the core drilling, and identify and measure the cores immediately. The Engineer will measure the cores and determine the thickness index according to Materials I.M. 346. After measurement on the grade, deliver the cores to the Engineer's office or field laboratory. When cores are not measured on the grade, the Engineer will take immediate possession of the cores.~~
 - ~~c. Determine thickness for sections of the same design thickness 3500 square yards or less, by probing plastic concrete in accordance with Materials I.M. 396.~~
 - ~~d. Only sections which are cored will be included in the thickness index determination. Areas not cored or probed will be paid for at the contract unit price.~~
 - b. For Interstate and Primary projects, evaluate pavement thickness for sections of the same design thickness more than 3500 square yards using non-destructive testing according to Materials I.M. 346 Method A.
 - c. For non-Primary projects evaluate pavement thickness for sections of the same design thickness more than 3500 square yards by coring according to Materials I.M. 346 Method B. The specification will be adopted in its entirety.
 - ~~e d. Determine thickness for sections of the same design thickness 3500 square yards or less, by probing plastic concrete in accordance with Materials I.M. 396.~~
 - ~~d e. Only sections which are cored evaluated for thickness will be included in the thickness index determination. Areas not cored or probed evaluated for thickness will be paid for at the contract unit price.~~

2301.05, A, Portland Cement Concrete:

Replace Articles 2 and 3:

2. For sections greater than 3500 square yards, ~~P~~payment for the quantities of pavement in square yards will be at a percentage of the contract unit price according to Table 2301.05-1.

Table 2301.05-1: Payment Schedule for Quantities of Pavement

| Thickness Index Range | Percent Payment | Thickness Index Range | Percent Payment |
|-----------------------|-----------------|-----------------------|-----------------|
| 0.00 or more | 103 | -0.56 to -0.60 | 91 |
| -0.01 to -0.05 | 102 | -0.61 to -0.65 | 90 |
| -0.06 to -0.10 | 101 | -0.66 to -0.70 | 89 |
| -0.11 to -0.15 | 100 | -0.71 to -0.75 | 88 |
| -0.16 to -0.20 | 99 | -0.76 to -0.80 | 87 |
| -0.21 to -0.25 | 98 | -0.81 to -0.85 | 86 |
| -0.26 to -0.30 | 97 | -0.86 to -0.90 | 85 |
| -0.31 to -0.35 | 96 | -0.91 to -0.95 | 84 |
| -0.36 to -0.40 | 95 | -0.96 to -1.00 | 83 |
| -0.41 to -0.45 | 94 | -1.01 to -1.05 | 82 |
| -0.46 to -0.50 | 93 | -1.06 to -1.10 | 81 |
| -0.51 to -0.55 | 92 | -1.11 or less | 80 |

For sections 3500 square yards or less, payment for the quantities of pavement in square yards will be at a percentage of the contract unit price according to Table 2301.05-2

Table 2301.05-2: Payment Schedule for Quantities of Pavement 3500 square yards or less

| Thickness Deficiency (TD) | 8 inch or less Percent Payment | 9 inch Percent Payment | 10 in or greater Percent Payment |
|---------------------------|--------------------------------|------------------------|----------------------------------|
| -0.15 or more | 100 | 100 | 100 |
| -0.16 to -0.25 | 95 | 96 | 96 |
| -0.26 to -0.50 | 91 | 92 | 93 |
| -0.51 to -0.75 | 85 | 87 | 88 |
| -0.76 to -1.00 | 80 | 82 | 84 |
| -1.00 inch or less | 2301.05, A, 4 | 2301.05, A, 4 | 2301.05, A, 4 |

Individual probing test results greater than or equal to the design thickness minus 3/8 inch are considered complying. When an individual probing test result is greater than design thickness minus 1 inch but less than design thickness minus 3/8 inch, take corrective action. When an individual probing test result is less than design thickness minus 1 inch, the Engineer will determine core locations to determine the area of deficient pavement thickness.

- Use the following formula to determine the thickness index for the a section of pavement thickness greater than 3500 square yards

Where: $TI = (\bar{X} - S) - T$

TI = thickness index for the section.

\bar{X} = mean core length for the section.

T = design thickness.

S = core length standard deviation (of the sample) for the section.

Use the following formula to determine the thickness deficiency for a section of pavement 3500 square yards or less:

Where: $TD = (\bar{X} - T)$

TD = thickness deficiency for the section.

T = design thickness.

\bar{X} = mean probe depth for the section.

2301.05, D, 2.

Replace the ninth bullet:

Placing, finishing, texturing, ~~grooving~~, and curing.

2301.05, K, 1

Replace the first sentence:

When any of the types of additional protection described in Article 2301.03, K, 3, is necessary, additional payment will be made as extra work at the rate of \$4 2.00 per square yard of surface protected.

Section 2302**2302.03, G, 2.**

Delete the second sentence:

No overhaul will be allowed.

Section 2303**2303, Flexible Pavement.**

Replace the Section:

2303.01 DESCRIPTION.

- A. Design, produce, place, and compact flexible paving mixtures using proper quality control. Construct to the dimensions specified in the contract documents.
- B. A surface course is the top lift. An intermediate course is the next lower lift or lifts. 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.

2303.02 MATERIALS.**A. Asphalt Binder.**

Use the specified Performance Graded (PG) asphalt binder meeting the requirements of Section 4137. For shoulder mixtures refer to Section 2122. For base widening mixtures refer to Section 2213. Adjustments to the contract binder grade may be required according to Article 2303.02, C, 6.

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

- a. Use virgin mineral aggregate as specified in Section 4127.
- b. When specified, furnish friction aggregate from sources identified in Materials I.M. T203.

1) Friction Classification L-2.

Use a combined aggregate such that:

- a) At least 80% of the combined aggregate retained on the No. 4 sieve is Type 4 or better friction aggregate, and
- b) At least 25% of the combined aggregate retained on the No. 4 sieve is Type 2 or better friction aggregate, and
- c) For Interstates and all mixtures designed for ~~30,000,000 ESALS and higher~~ Very High Traffic (VT), 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.
- d) On Interstates and all mixtures designed for ~~30,000,000 ESALS and higher~~ Very High Traffic (VT), if 40% or more of the total aggregate is a limestone as defined in Materials I.M. T203, at least 30% of the combined aggregate retained on the No. 4 sieve is Type 2 or better friction aggregate and at least 25% of combined aggregate passing No. 4 sieve is Type 2 or better friction aggregate.

2) Friction Classification L-3.

Use a combined aggregate such that:

- a) At least 80% of the combined aggregate retained on the No. 4 sieve is Type 4 or better friction aggregate, and
- b) At least 45% of the combined aggregate retained on the No. 4 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 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 sieve is Type 4 or better friction aggregate.

2. Combined Aggregates.

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

C. Recycled Asphalt Materials.

1. RAM includes RAP and RAS. The designations Classified and Unclassified are exclusively for the use of RAP in HMA.
2. Identify each RAP stockpile and document Classified and Unclassified RAP stockpiles as directed in Materials I.M. 505. Do not add material to a Classified 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 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.
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. 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. RAP may be used in accordance with Materials I.M. 510 Appendix C. For surface mixtures, 70% of the total asphalt binder shall be virgin.
 - a. **Classified RAP.**
 - 1) Classified RAP is one of the following
 - RAP from a documented source.
 - RAP from an undocumented source meeting quality control sampling, testing, and reporting requirements in Materials I.M. 505. Material shall be tested at a lab designated by the Engineer according to Iowa Test Method 222 at no additional cost to the Contracting Authority.
 - 2) Classified RAP may be used in mixtures for which the RAP aggregate meets the quality requirements for the mixture design per Materials I.M. 510 Appendix A.
 - 3) When from a documented source, credit will be given for frictional aggregate and crushed particles used in the original pavement to be reclaimed as determined in the paving history (or mix design when paving history is unavailable).
 - 4) For all other Classified RAP, credit for crushed particles shall be the percent of aggregate retained on the No. 8 sieve from Engineer's extraction test. No friction credit will be given.
 - b. **Unclassified RAP.**
 - 1) Any stockpiled RAP not meeting the requirements of Classified RAP shall be designated as Unclassified RAP. 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.
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 Iowa DOT source approval will not be certified.

D. Flexible Paving Mixture.

1. The JMF is the percentage of each material, including the asphalt binder, to be used in the asphalt mixture. Ensure the JMF gradation is within the control points specified for the particular mixture designated.
2. The basic asphalt binder content is the historical, nominal mixture asphalt binder content, expressed as percent by weight (mass) of the asphalt binder in the total mixture. Apply the values in Table 2303.03-4 2303.02-1, based on mixture size and type.
3. If the asphalt binder demand for the combination of aggregates submitted for an acceptable mix design exceeds the basic asphalt binder content (see Table 2303.02-2 2303.02-1) by more than 0.75%, include an economic evaluation with the mix design. 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 2303.02-1: Basic Asphalt Binder Content (%)

| Size | Aggregate Type | 1 inch | 3/4 inch | 1/2 inch | 3/8 inch |
|--------------------------|----------------|--------|----------|----------|----------|
| 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 mixture substitutions meeting guidelines in Materials I.M. 511. When a commercial mix is specified, use 1/2 inch 300K Standard Traffic (ST) or higher surface mixture or higher, with PG 58-28S or PG 64-22S binder, for JMF approval.
5. For shoulders placed as a separate operation refer to Section 2122. When paving the shoulder with the mainline the Contractor has the option to substitute the mainline intermediate or surface mixture for a specified shoulder mixture at the Contractor's expense.
6. For base widening refer to Section 2213. When an adjoining surface is designed for 300,000 ESALs or less Standard Traffic (ST) and is paved during the same project, use a base mixture at same ESAL level traffic designation used in surface mixture.
7. WMA refers to asphalt concrete mixtures produced at temperatures approximately 50°F or more below those typically used in production of HMA but no higher than that shown in Article 2303.03, C, 3, d, 2, a. Temperature reductions may be achieved through additives or water injection systems.
8. Submit a mixture design complying with Materials I.M. 510. Propose both a production and a compaction temperature between 215°F and 280°F for WMA mixture designs.
9. 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.

E. Other Materials.

1. Tack Coat.

Tack coat may be SS-1, SS-1H, CSS-1, or CSS-1H, CQS-1, or CQS-1H. Do not mix CQS, CSS, and SS grades. RC-70 and MC-70 may also be used prior to May 1 and after October 1, at the Contractor's option. An equivalent trackless product approved on AASHTO's Product Evaluation Listing (APEL) may be used when ambient temperatures are at least 55°F.

2. Anti-strip Agent.

- a. Perform a moisture sensitivity evaluation of the proposed asphalt mixture design in accordance with Materials I.M. 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 Very High Traffic (VT), and
 - 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.

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 Appendix F and Materials I.M. 319 for bid item plan quantities of more than 1000 tons as follows:
 - 1) For mixtures satisfying Article 2303.02, E, 2, a.
 - 2) For conditions satisfied in Article 2303.02, E, 2, f.
- c. Moisture susceptibility testing will not be required for base repair, patching, temporary pavement, or paved shoulders. Moisture susceptibility testing for mixture bid items of 1000 tons 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 based on traffic designation:

| PG High Temperature, °C | SIP, Number of Passes ¹⁻² | |
|----------------------------|--------------------------------------|-------------------|
| | < 3,000,000 ESALS | ≥ 3,000,000 ESALS |
| 58 | 10,000 | 14,000 |
| 64 | 10,000 | 14,000 |
| 70 | 10,000 | 14,000 |

Table 2303.02-4 2: Minimum Stripping Inflection Point

| Traffic Designation | SIP, Number of Passes ^{1, 2} |
|---------------------|---------------------------------------|
| S | 10,000 |
| H, V | 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.

When notified of non-compliant results, the Engineer may suspend paving operations until an approved "significant mix change" is implemented.

- e. When the Contractor's mix design SIP results are below 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 SIP is achieved.
- f. The Engineer may require an evaluation of the test method in Materials I.M. 319 for plant produced mixture at any time.
- 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. Hydrated lime will not be considered part of the aggregate when determining the job mix formula.
 - 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 additive rate that produces the maximum SIP value.
 - 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 that produces the maximum SIP value. See Materials I.M. 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. WMA Technologies.

Chemical additives, organic additives, zeolites, or water injection systems 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. The Contractor is responsible for all aspects of the project.
- 2. Provide quality control management and testing, and maintain the quality characteristics specified.
 - a. Apply Article 2303.03, D to asphalt mixture bid items when the plan quantity is greater than 1000 tons.
 - b. Apply Article 2303.03, E, for asphalt mixture bid items that have a plan quantity of 1000 tons or less as well as patching, detours, and temporary pavement bid items. For items bid in square yards, apply Article 2303.03, E when the plan quantity by weight (estimated with a unit weight of 145 pounds per cubic foot unless otherwise stated on the plans) does not exceed 1000 tons.

B. Equipment.

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. 514.
 - 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. 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.
- 2) Place a tack coat to form a continuous, uniform film on the area to be covered. Tack coat may be diluted with water at a 1:1 ratio 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
 - Milled HMA/CIR Surface: 0.05 to 0.07 gallon per square yard
 - PCC/Existing HMA Surface: 0.04 to 0.06 gallon per square yard
- 3) 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. 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.
- 4) 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 days' work.
- 5) Allow tack coat to adequately cure prior to placement of HMA. 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 for excessive application rates, breakdowns, and short sections remaining at the end of a day's run.

3. Handling, Production, and Delivery.

Ensure plant operation complies with the following requirements:

a. Handling Mineral Aggregate and RAM.

Apply Materials I.M. 505 and Materials I.M. 508.

b. Handling Asphalt Binder.

Maintain asphalt binder temperature between 260°F and 330°F. Heat modified asphalt binder according to the supplier's recommendations.

c. Handling Anti-Strip Agents.

1) Hydrated Lime.

a) Added to a Drum Mixer.

- (1) Add hydrated lime at the rate of 0.75% by weight of the total aggregate (virgin and RAM) 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) 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 of the total aggregate (virgin and RAM) 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 optimization of the SIP as determined by Materials I.M. 319. 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 asphalt coating and mixture.
 - 2) 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 and 280°F until placed on the grade. Maximum production temperature for WMA is 330°F before May 1st and after October 1st.
 - b) Do not produce WMA mixtures more than 10°F 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 and 330°F until placed on the grade. Do not discharge HMA into the hopper when its temperature is less than:
 - (1) 245°F for a nominal layer thickness of 1 1/2 inches or less, or
 - (2) 225°F for a nominal layer thickness of more than 1 1/2 inches.
 - d) Flexible paving mixtures not meeting these requirements will be rejected.
 - e) Production temperature limits apply starting at point of discharge from mixer.
 - 3) Minimize segregation to the extent that it cannot be visibly observed in the compacted surface.
 - 4) Apply only approved release agents to trucks and equipment, as specified in Article 2001.01.
 - 5) Except for an unavoidable delay or breakdown, provide continuous and uniform delivery of hot HMA to any individual spreading unit.
- 4. Placement.**
 - a. Clean each lift according to Article 2212.03, B, 1. If necessary, re-tack.
 - 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, unless allowed per Article 2303.03, F.

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

| Nominal Thickness - inches | Road Surface Temperature, °F |
|----------------------------|------------------------------|
| 1-1/2 Less than 2 | 40 |
| 2 – 3 | 35 |
| Over 3 | 35 |

Table 2303.03-2: Surface Course Lifts of Asphalt Mixtures

| Nominal Thickness - inches | Road Surface Temperature, °F |
|----------------------------|------------------------------|
| 1 | HMA: 50 / WMA: 40 |

| | |
|---------------|-------------------|
| 1 1/2 | HMA: 45 / WMA: 40 |
| 2 and greater | 40 |

- d. The Engineer may further limit placement if, in the Engineer's judgment, other conditions are detrimental to quality work.
- e. Maintain a straight paving edge alignment. Correct edge alignment irregularities immediately.
- f. 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 | Minimum Lift Thickness - inches |
|--------------------------|---------------------------------|
| 3/8 | 1 |
| 1/2 | 1 1/2 |
| 3/4 | 2 |
| 1 | 3 |

- g. Complete each layer to full width before placing succeeding layers.
 - h. 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.
 - i. After spreading, carefully smooth to remove all segregated aggregate and marks.
 - j. 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.
 - k. At the close of each working day, clear all construction equipment from the roadbed.
 - l. Prior to opening a lane to traffic, place fillets, safety edge, 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.
 - 3) The quality characteristic is in-place air void content and will be based on the theoretical maximum specific gravity (G_{mm}) for that day's mixture.
 - b. **Class I Compaction.**
 - 1) **Applications.**
Use Class I compaction for all courses for the traffic lanes, ramps, and loops on all roadways.
 - 2) **Test Strip Construction for Class I Compaction.**
 - a) For the purpose of evaluating properties of the asphalt 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 other mixtures may be constructed, but are not required.
 - b) Test strips are not required when the entire production of the mixture bid item is placed in a single day.
 - c) The quantity of mixture subject to the test strip production, will be pre-established with the Engineer and limited to a half day's production
 - d) 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.
 - 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 test strip production control that meets the requirements of Article 2303.03, D, 3, b. The test strip will be an independent lot. Determine sublots in accordance with Table 2303.03-5.
 - c. **Class II Compaction.**
Intended for paved shoulders, temporary crossovers, onsite detours, base widening in a non-travel lane and other situations where Class I is not specified.
 - 1) Establish a rolling pattern to verify adequate density.
 - 2) At the Engineer's option, cores or gauge readings at the frequency designated in Materials I.M. 204 Appendix F for the first day of placement will be used. The Engineer may modify the sample size and frequency provided compaction is thorough and effective.

- 3) The Engineer will accept the rolling pattern based on the average test results. When the average field voids is less than or equal to 8.0%, the pattern is considered thorough and effective.
 - 4) When the average field voids exceeds 8.0%, modify the rolling pattern. The Engineer may require additional testing until thorough and effective compaction is achieved.
 - 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 within 3 inches of the existing longitudinal joint. Construct longitudinal joints to secure complete joint closure and avoid bridging of the roller. When the joint is completed, the hot side shall be no more than 1/4 inch higher than the cold side.
 - b. Saw transverse construction joint to a straight line at right angles to the center line to provide a full thickness vertical edge before continuing paving.
 - c. Place temporary runouts according to road standards. Remove temporary runouts before commencing paving. Runout removal is incidental to the HMA mixture.
- 7. Miscellaneous Operations.**
- a. **Leveling and Strengthening Courses.**
 - 1) Use the same mixture specified for the base or intermediate course.
 - 2) Compact leveling courses and intermediate mixtures placed as leveling/scratch courses (less than or equal to 1 inch plan thickness) using pneumatic and vibratory rollers. This is considered Class II compaction.
 - 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.
 - 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) Use Class II compaction.
 - 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) Unless otherwise approved, 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.
 - 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, remove loose material, and tack the surface adjacent to the pavement. 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 or wider may be placed as a separate operation. Pave fillets which are 8 feet 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) Same rolling pattern established for adjoining mainline or ramp driving lane, as determined by density coring.
 - 2) Shoulder area will not be included in 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.**1. General.**

Except for small quantities as defined in Article 2303.03, A, 2, 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 HMA Level II.
- d. An approved JMF will be required prior to beginning plant production.

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

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. Production Control.

- 1) After the JMF is established, the combined aggregate gradation furnished for the project, asphalt binder content, asphalt film thickness, and laboratory air voids should consistently comply with the JMF target values and design criteria in Materials I.M. 510 Appendix A. Control them within the production tolerances given in Table 2303.03-4.

Table 2303.03-4: Production Tolerances

| Measured Characteristic | Target Value (%) | Specification Tolerance (%) ^(a) |
|--|------------------|--|
| Cold feed gradation No. 4 and larger sieves | by JMF | ± 7.0 |
| Cold feed gradation No. 8 | by JMF | ± 5.0 |
| Cold feed gradation No. 30 | by JMF | ± 4.0 |
| Cold feed gradation No. 200 | by JMF | ± 2.0 |
| Field laboratory air voids absolute deviation from target ^(b) | 0.0 | ≤ 1.0 |
| Daily asphalt binder content | by JMF | ± 0.3 |
| (a) Based on single test unless noted otherwise. | | |
| (b) When lab voids acceptance is not based on PWL. | | |

- 2) The gyratory mix design gradation control points for the size mixture designated in the project plans will not apply to plant production control tolerances.
- 3) 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) The Contractor's adjustment recommendations prevail provided all specifications and established mix criteria are being met for plant production.
- 4) Calculate estimated film thickness every day of production according to Materials I.M. 501. Compliance is based on limits in Materials I.M. 510 Appendix A.
- 5) Calculate absolute deviation from target lab voids according to Materials I.M. 501. 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.

- 6) 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. The moving AAD may restart only in the event of a mandatory plant shutdown for failure to maintain the average within the production tolerance.
- 7) After the second occurrence of the moving AAD falling outside the specification tolerance limit, the Engineer may declare the lot or portions of the lot defective.

4. Sampling and Testing.

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 involved in sampling and testing on both verification and quality control shall be Iowa DOT certified for the duties performed per Materials I.M. 213.
- 3) Provide easy and safe access for Iowa DOT staff to the location in the plant where samples are taken.
- 4) 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.
- 5) Identify, store, and retain all quality control samples and field lab gyratory specimens used for acceptance until the lot is accepted.
- 6) Obtain verification samples at random times as directed and witnessed by the Engineer according to Materials I.M. 204 Appendix F. Secure all verification samples according to Materials I.M. 205 Appendix A. Store verification samples for the Contracting Authority until delivery to the Contracting Authority's lab.
- 7) Deliver the Plant Report to the Engineer and the designated district materials laboratory daily. At project completion, provide the Engineer a copy of the reports, charts, and other electronic file(s) containing project information generated during the progress of the work.

b. Asphalt Binder.

Sample and test asphalt binder to verify the quality of the binder grade. Do not sample when daily production is less than 100 tons of mixture.

c. Tack Material.

Sample and test asphalt emulsions to verify residual asphalt content.

d. Aggregate Gradation.

- 1) Use cold feed or ignition oven gradation for aggregate gradation control to assure materials are being proportioned according to the specifications.
- 2) Take a minimum of one aggregate gradation for each day's production that exceeds 100 tons of mixture. When more than one sample in a day's production is tested, use the average gradation to determine compliance of the daily lot.
- 3) Engineer will verify Contractor gradation with an ignition oven or a split cold feed sample. For ignition oven validation, split a cold feed sample with the Engineer to determine the need for a correction factor according to Materials I.M. 511. The Engineer may require additional cold feed split samples.

e. Uncompacted Asphalt Mixture.

- 1) Sample the loose mixture according to Materials I.M. 322.
- 2) Modify sampling location to include placement with mix stored from a previous day's production.
- 3) The number of daily samples is defined in Table 2303.03-5 based on the day's estimated production. See Materials I.M. 511 for determining sample locations.

Table 2303.03-5: Uncompacted Mixture Sampling

| Estimated Daily Production, Tons | Number of Samples |
|----------------------------------|-------------------|
| 101-500 | 1 |
| 501-1250 | 2 |
| 1251-2000 | 3 |
| 2001-4500 | 4 |
| Over 4500 | 5 |

- 4) Do not take samples from the first 100 tons of mix produced each day or the first 100 tons of mix following a significant mix change. When paving operations are staged so each day of placement is less than 100 tons 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.
- 5) Split samples for specimen preparation according to Materials I.M. 357.
- 6) 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.
- 7) Test the quality control sample of each production paired sample as follows:
 - a) Prepare and compact two gyratory specimens according to Materials I.M. 325G.
 - b) Determine the bulk specific gravity of compacted mixture (G_{mb}) at N_{design} for each specimen according to Materials I.M. 321. Average the results.

- c) Determine the Theoretical Maximum Specific Gravity (G_{mm}) of the uncompacted mixture according to Materials I.M. 350.
 - d) Determine laboratory air voids for each sample according to Materials I.M. 501. Use the target laboratory voids listed in Materials I.M. 510 Appendix A unless otherwise specified in the contract documents.
- f. Compacted Pavement Cores.**
- 1) 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 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.
 - 2) Take samples from the compacted mixture and test no later than the next working day following placement and compaction.
 - 3) Restore the surfaces the same day. Dry, fill with the same material, and properly compact core holes.
 - 4) Pavement core samples will be identified, taken possession of by the Engineer, and delivered to the Contractor's quality control field laboratory.
 - 5) 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.
 - 6) Prepare and test the cores according to Materials I.M. 320, 321, and 337.
 - 7) 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.
 - 8) The compacted HMA pavement will be tested in a timely manner by the Engineer's personnel. 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. Verification and Independent Assurance Testing.**
- a. 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.
 - b. 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.
 - c. 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.
 - d. Personnel and laboratory equipment performing tests used in the acceptance of material are required to have participated in the statewide Independent Assurance Program according to Materials I.M. 207.
- 6. Acceptance of Asphalt Mixtures.**
- a. Lab Voids.**
- 1) Use the following methods of acceptance for laboratory voids:
 - a) For base widening, ramps and loops, 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 2303.03-4. During a day's production, if more than 100 tons of the bid item is placed in an area not listed above, apply Article 2303.03, D, 6, b, for entire production of bid item.
 - b) Determine PWL for each lot as defined in Materials I.M. 501. The PWL limits shall be +/- 1.0% from the target air voids. Each mixture bid item will constitute a lot. Lot size is defined as follows:
 - (1) No less than eight and no more than 15 sequential tests will constitute a lot (exceptions stated below).
 - (2) After the eighth test, all subsequent samples collected will also be included in the lot up to a maximum of 15.
 - (3) Once a lot has been established with at least eight tests, a new lot will begin the day following the fifteenth sample. Lots shall not contain partial days. When the fifteenth sample is reached, include all samples taken that day in the lot.
 - (4) If the bid item's production has ended and fewer than eight 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 fifteenth sample, include all samples for that day. Do not combine partial day's results.
 - (5) If samples cannot be combined with the previous lot due to maximum lot size restrictions or if fewer than eight 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.
 - (6) Test strips will be considered a separate lot.
 - (7) When the same mix type is produced for multiple bid items in one day from a single plant and the production going to each item exceeds 500 tons, assign all box samples to each bid item's existing lot for lab voids. In addition, assign the quantity of each bid item produced to its respective lot.

- (8) When the same mix type is placed in both PWL and AAD areas in a single day on a single project, 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.
- 2) Determine the pay factor using the AAD procedure described in Materials I.M. 501 for mix in a PWL lot which is produced at 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
 - Asphalt mixture produced and placed on shoulders.
- To be considered irregular, the production rate for mixture bid items described above is not to exceed 1000 tons in a single day.
- b. **Field Voids.**
- 1) **Class I.**
- a) 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.
- b) 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 excluding areas deducted from the field voids lot,
 - When the day's operation is not more than 500 tons excluding quantities deducted from the field voids lot,
 - When the mixture is being placed in irregular areas, or
 - When placing strengthening courses.
- c) 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 from the unconfined edge of a given pass of the placing equipment, from run-outs, or from day's work joints or structures.
- d) Use the following methods of acceptance for field voids:
- (1) For mixture bid items placed in the following areas:
- Base widening placed in a travel lane,
 - 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, and
 - Irregular areas identified by the Engineer that may include areas not suitable for continuous paving,
- 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 8.0% 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 Article 2303.05, A, 3, b, 3, to areas where thorough and effective compaction is not achieved.
- (2) For all other areas of Class I compaction, determine PWL as defined in Materials I.M. 501. The PWL limits shall be between 91.5% of G_{mm} (8.5% voids) and 98.5-96.5% of G_{mm} (3.5% voids). 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.
- e) 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.
- 2) For Class II apply Article 2303.03, C, 5, c.
- c. **Asphalt Film Thickness.**
A lot is considered one day's production of one mixture. When film thickness falls outside the limits in Materials I.M. 510 Appendix A, see Article 2303.05, A, 3, c, for payment adjustment.
- d. **Thickness.**
- 1) The Engineer will measure cores, exclusive of thin surface treatments, according to Materials I.M. 337. Sampling frequency and lot definitions are as follows:
- a) **Class I Compaction.**

The Engineer will obtain and test samples for each lot according to Materials I.M. 204 Appendix F. Density cores sampled as part of a field voids lot will be combined into daily lots based on cores' intended 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. When measuring density of top lift from a full depth core, measure thickness before trimming core for density testing.

b) Class II Compaction.

The Engineer will obtain and test samples full depth once the final lift is placed. The lot shall be defined as the length of a day's production of the final lift. Take a minimum eight cores from each lot. The Engineer may approve classifying multiple days of construction as a lot.

- 2) Provided there is reasonable assurance that the pavement complies with the required thickness, the Engineer may waive sampling for thickness for the following situations:
 - a) When an alternate method is deployed by the Engineer
 - b) When the day's operation is 2500 square yards or less.
 - c) When the mixture is being placed in irregular areas.
 - d) When the mixture is being placed next to structures.
- 3) Establish the intended thickness daily with consideration given to field conditions and tie-in features.
- 3 4) When the quality index falls below 0.00, the Engineer may declare the lot or parts of the lot defective. If the final lift has not been placed, the Engineer may approve additional thickness to be placed on succeeding lifts to ensure a final grade as intended. The unit price of the defective lot will be used for payment of the additional material.

e. Smoothness.

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

- 1) Apply Section 2317 to HMA surface mixture bid items of a Primary project if any individual HMA mixture bid item is 1000 tons or greater or 5000 square yards or greater. Apply Section 2316 to all other Primary projects with a surface course and when specifically required for other projects.
- 2) When neither Section 2316 nor Section 2317 is applied to a project, the Engineer may check the riding surface for defects using one of the following criteria:
 - The surface shall not deviate from a straight line by more than 1/8 inch in 10 feet when measured longitudinally with a 10 foot straightedge.
 - The surface shall not contain any bump or dip exceeding 1/2 inch over a 25 foot length when measured with a method in Materials I.M. 341.

The Engineer may either require the defects be corrected according to Article 2316.03, B, 2, or apply a price adjustment.

E. Quality Control for Small HMA Paving Quantities.

1. General.

For small quantities, a lot will be the entire quantity of each HMA mixture bid item.

2. Mix Design.

- a. Prepare the JMF. Prior to production, obtain the Engineer's approval for the JMF. Comply with Article 2303.02 and Materials I.M. 510.
- b. For mixtures meeting the criteria in Article 2303.02, E, 2, a:
 - 1) An anti-stripping agent is required when the optimum dosage is greater than 0%.
 - 2) Use Materials I.M. 319 to optimize the design dosage rate.
 - 3) When prior-approved designs have demonstrated acceptable field SIP values, the anti-stripping agent and dosage from the JMF may be used in lieu of optimization testing.

3. Plant Production.

- a. Ensure 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 delivery tickets identify the JMF.
- c. Monitor the quality control test results and make adjustments to keep the mixture near the target JMF values.

4. Sampling and Testing.

a. Field Voids.

- 1) Take compacted mixture G_{mb} measurements, except when Class II compaction is specified, no later than the next working day following placement and compaction.
- 2) 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.
- 3) PWL for field voids will not apply to small quantities.

b. Lab Voids.

Material sampling and testing is for production quality control. Acceptance of mixture is based on Contractor certification. Sampling and testing of uncompacted mixture is only required for mechanically placed mixture. Sample and test a minimum of one uncompacted mixture sample 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 of production. No split samples for agency verification testing are required.

- c. **Binder.**
No binder sampling or testing is required.
- d. **Moisture Sensitivity.**
Moisture susceptibility testing on plant produced mixture is not required.
- e. **Gradation.**
Perform a minimum of one aggregate gradation.

5. Certification.

- a. When the production tolerances in Table 2303.03-4 are not met, payment may be adjusted according to Article 1105.04.
- b. When the production tolerances are met, 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 Plant Report.
"The 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."
- c. The Daily Plant Report may be submitted at the end of the project for all certified quantities, or submitted at intervals for portions of the certified quantity.

F. Cold Weather Paving.

- 1. When road surface temperature is below requirements shown in Tables 2303.03-1 and 2303.03-2, or when air temperature approximately 3 feet above grade, in shade, and away from artificial heat sources is less than 40°F, cold-weather paving may be considered by the Engineer.
- 2. **Cold Weather Paving Plan.**
 - a. Submit a written cold weather paving plan to the Engineer. Document material, operational, and equipment changes for paving when air temperature approximately 3 feet above grade, in shade, and away from artificial heat sources is less than 40°F.
 - b. Include the following:
 - 1) Use an approved mix design that incorporates a warm mix additive. Do not use water injection.
 - 2) Identify warm mix additive and dosage rate.
 - 3) Identify modifications to compaction process and when modifications apply.
 - c. If the National Weather Service forecast for the construction area predicts ambient air temperature less than 40°F at the projected time of paving within the next 24 hours, confirm or submit revisions to the cold weather paving plan for Engineer validation. Update plan as required to accommodate conditions anticipated for the next day's operations. Upon validation of the plan, the Engineer will allow paving for the next day. Once in effect, pave conforming to the Engineer-accepted cold weather paving plan for balance of that workday or shift regardless of the temperature at time of paving.
 - d. Engineer's written acceptance will be required for the cold weather paving plan. Engineer's acceptance of the plan does not relieve Contractor of responsibility for the quality of HMA pavement placed in cold weather.
- 3. Do not place flexible paving mixtures over frozen subgrade or base, or where roadbed is unstable.
- 4. Engineer may further limit placement if, in the Engineer's judgment, other conditions are detrimental to quality work.

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.
- 2. **Measurement by Weight.**
 - a. The quantity of the type specified, expressed in tons, will be determined from the weight of individual loads, including fillets, measured to the nearest 0.01 tons.

- b. Loads may be weighed in trucks, weigh hoppers, or from the weight from batch plants computed by count of batches in each truck and batch weight. Article 2001.07 applies. Segregate the weights 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, will be shown in the contract documents to the nearest 0.1 square yard. 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, 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 by 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 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, b.
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. 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 of HMA mixture with anti-strip agent added.

E. Tack Coat.

Will not be measured separately.

F. Hot Mix Asphalt Pavement Samples.

Will not be individually counted for payment if furnished according to Article 2303.03, D, 4, or required elsewhere in the contract documents,

G. 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.

H. Cold Weather Paving.

Will not be measured separately. The quantity will be based on tons of flexible paving mixture placed with warm mix additive.

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. Flexible Paving Mixture.

1. Payment will be the contract unit price for Asphalt Mixture of the type specified per ton or square yard.
2. Payment for test strips will be the contract unit price for the test strip mixture bid item per ton regardless of lift placement.
3. Payment will be adjusted by the following Pay Factor for field voids, laboratory voids, and film thickness determined for the lot.

Multiply the unit price for the HMA bid item by the Pay Factor rounded to three 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 maximum |

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

- 2) Payment when 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 maximum |

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.

c. Film Thickness.

When film thickness (FT) is outside the limits in Materials I.M. 510 Appendix A, apply the following pay factor:

| Placement | Pay Factor | |
|----------------|---------------------------|-------------------------|
| | (Low Film (FT < LL)) | (High Film (FT > UL)) |
| Base/Shoulders | 1 - (0.85 0.15*(LL - FT)) | 1 - (0.85 0.15*(FT-UL)) |
| Intermediate | 1 - (0.80 0.20*(LL - FT)) | 1 - (0.80 0.20*(FT-UL)) |
| Surface | 1 - (0.75 0.25*(LL - FT)) | 1 - (0.75 0.25*(FT-UL)) |

Where:

LL = Lower Limit (Materials I.M. 510, Appendix A)

UL = Upper Limit (Materials I.M. 510, Appendix A)

- When basis of payment is by area, multiply add 1.0 to the pay factor (computed above) and divide by 0.5 2.0.
- For FT < 7.0 or FT > 16.0, the Engineer may consider the lot defective. This applies to all lots (days) of production.
- No film thickness price adjustment for the test strip (first day of production, if no test strip performed) for each job mix formula.
- No film thickness price adjustment on temporary pavement.

d. Pavement Thickness

- 1) Payment will be further adjusted by the appropriate percentage in Table 2303.05-1 below according to the quality index for thickness determined for that lot:

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

Table 2303.05-1: Payment Adjustment for Thickness

| Quality Index (Thickness) 8 Samples | Percent of Payment |
|-------------------------------------|--------------------|
| Greater than 0.34 | 100 |
| 0.14 to 0.34 | 95 |
| 0.00 to 0.13 | 85 |
| Less than 0.00 | 75 maximum |

- 2) Do not apply the quality index adjustment to a layer with a designated thickness of "variable" or "nominal", or to a layer designated as scratch course or leveling course. Do not apply the quality index adjustment to pavement layers designated in the contract documents as grade correction or cross slope correction. Place grade correction or cross slope correction layers as specified in the contract documents or as directed by the Engineer.

4. 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.

B. Asphalt Binder.

1. Payment will be the contract unit price per ton for the number of tons 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 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, compensation for asphalt binder will be included in the contract unit price per square yard.

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 test results from the field produced mixture meet or exceed the minimum requirement established in Article 2303.02, E, 2, d . Payment will be made at the rate of \$2.00 per ton of asphalt mixture in which the anti-strip agent is incorporated.
2. Payment will be full compensation for designing, adding, and testing for anti-strip agent.

E. Tack Coat.

Incidental to HMA.

G. Hot Mix Asphalt Pavement Samples.

1. Payment will be the lump sum contract price.
2. Payment is full compensation for furnishing all samples for all courses or items of work, and for delivery of samples as specified in Article 2303.03, D, 4.

H. Cold Weather Paving.

1. When cold weather paving is permitted by the Engineer, incorporation of warm mix additive into the asphalt mixture will be considered as extra work ordered by the Engineer. Payment will be made at the rate of \$2.00 per ton of flexible paving mixture in which the warm mix additive is incorporated.
2. Contracting Authority will not pay for compaction additive when:
 - a. Pay factor for Field Voids is less than 1.0 for Class I compaction.
 - b. Compaction is not thorough and effective for Class II compaction.
 - c. On days when liquidated damages have been assessed.
3. If because of an excusable compensable delay, the Engineer directs Contractor to pave when temperatures meet cold weather definition, the Contracting Authority will relieve Contractor of responsibility for damage and defects the Engineer attributes to cold weather paving.

Section 2304

2304.02, A, PCC Option.

Replace the title and Add the Article:

A. PCC Portland Cement Concrete Option.

3. For detour pavement left in place, meet requirements of Section 2301 for Class C PCC Pavement. Use Class 3 durability aggregate, or better, as defined in Article 4115.04.

2304.02, B, HMA Option.

Replace the title and Article:

B. HMA Hot Mix Asphalt Option.

Design a mixture per Materials I.M. 510 for the following:

1. For detour pavement carrying less than 10,000,000 total 20-year ESALs, use HMA 1,000,000 ESAL surface or intermediate course, 1/2 inch or 3/4 inch, with PG 64-22 asphalt binder. For detour pavements or median crossovers on interstates and multi-lane primary highways, use a 10,000,000 ESAL High Traffic (HT) surface or intermediate mixture, with PG 64-22S or PG 58-28HS asphalt binder. PG 58-28S binder use requires a mixture with at least 15% binder replacement from RAM. The surface lift requires L-4 friction aggregate.
2. For detour pavement carrying more than 10,000,000 total 20-year ESALs, use HMA 10,000,000 ESAL surface or intermediate course, 3/4 inch, with PG 64-22 asphalt binder. For detour pavements on all other primary highways, use a 3,000,000 ESAL High Traffic (HT) surface or intermediate mixture with a PG 64-22S or PG- 58-28HS asphalt binder.
3. For median crossovers, use HMA 10,000,000 ESAL surface or intermediate course, 3/4 inch, with PG 64-22 asphalt binder. Apply compaction per Section 2303. The surface lift requires L-4 friction aggregate. For detour

pavements on non-primary projects use a 1,000,000 ESAL Standard Traffic (ST) surface or intermediate mixture with a PG 64-22S or PG 58-28 HS asphalt binder.

2304.03, A, 2.

Replace the Article:

Do not apply Articles 2301.03, H, ~~2, 3,~~ and 4, b, unless stated otherwise in the contract documents.

2304.03, A, 3.

Delete the Article:

~~3. — Apply Article 2316.02, A, 7.~~

2304.03, B, HMA Option.

Replace the Article:

Meet the requirements of ~~Section~~ Article 2303.03, E.

Section 2306

2306.02, Materials.

Replace the Article:

Unless the Engineer directs otherwise, use asphalt emulsion grade CQS-1, CQS-1H, CSS-1, or SS-1.

Section 2308

2308.02, Materials.

Replace the Article:

Use asphalt emulsion grade CSS-1, CSS-1h, SS-1, or SS-1h meeting the requirements of Section 4140, ~~unless directed otherwise by the Engineer.~~

Section 2310

2310.01, Description.

Replace the Article:

Overlay an existing pavement with ~~one of the following types of~~ a PCC overlay: Existing pavements may include any of the following:

- ~~A. **Bonded overlay:** a PCC overlay over an existing PCC pavement.~~
- ~~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 a PCC overlay over an existing eComposite pavement (flexible pavement over PCC).~~
- C. Pavement with a stress relief layer placed over the top.
- ~~C D. **Whitetopping:** a PCC overlay over an existing, full depth flexible pavement.~~

2310.02, A, 3.

Replace the Article:

Unless otherwise specified, use coarse aggregate for ~~bonded~~ overlays over existing PCC pavement that is the same type of aggregate as the existing pavement. ~~If existing pavement aggregate type cannot be determined or is not available, use limestone or dolomite coarse aggregate.~~

2310.02, B, Hot Mix Asphalt Stress Relief Course.

Replace the Article:

- ~~1. When required by the contract documents, Use an HMA stress relief course for unbonded overlays consisting of a nominal 1 inch course of HMA meeting the requirements of Section 2303.~~
2. Use PG 58-28S asphalt binder.
3. Use a mixture meeting the following:
 - a. 300,000 ESAL Standard Traffic (ST), 3/8 inch HMA mix requirements.

- b. Target air voids of 3.0%.
- c. No maximum film thickness restriction and no minimum filler/bitumen ratio restriction.
- d. Type B Aggregate (or better) with no percent crushed particle requirements and gradation falling below the restricted zone.
- e. Apply Article 2303.05, A, 3, a, 2 for AAD Acceptance of lab voids.

2310.02, C, Seal Coat Bond Breaker.

Rename the Article and **replace** the Article:

Seal Coat Bond Breaker.

Meet Use white pigmented liquid curing compound meeting the requirements of Article 2307.02 4105.05.

2310.03, B, 2, a.

Replace the Article:

When required for bonded overlays over existing PCC pavement, prepare the surface by shot blasting, waterblasting, or scarifying. Scarify to a nominal depth of 1/4 inch.

2310.03, B, 3, c, Seal Coat Bond Breaker.

Rename the Article and **replace** the Article:

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 liquid curing compound on all scarified PCC patches or other PCC surfaces to be overlain. Do not allow traffic on bond breaker before it has set. Apply each coat evenly on the full area at a rate of 1 gallon per 200 square feet. If drying to the touch occurs within 10 minutes or rapid absorption into the scarified PCC surface is noted, then apply a third coat at a rate of 1 gallon per 200 square feet.

2310.03, C, 2, Joints.

Replace the Article:

a. Unbonded Overlays and Whitetopping.

Place Saw joints as shown in the contract documents. **Seal** all joints unless directed otherwise.

b. Bonded Overlays.

For overlays over existing PCC pavements:

- 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.

2310.03, D, 3.

Replace the Article:

Place bonded concrete overlays over existing PCC pavements between June 1 and September 30.

Section 2316**2316.02, A, General.**

Replace the first sentence:

Evaluate pavement smoothness for all Interstate and Primary main line pavement surfaces, and all other road surfaces included on Primary projects, except when specifically excluded or modified by the contract documents.

2316.02, A, 6, b.

Replace the Article:

For through traffic lanes wider than 8.5 feet which requires matching the surface of the new pavement to the surface of an existing old pavement, the price reduction tables for Schedule A and B will be replaced by Schedule C. When the Profile Index is greater than 7.0 inches for schedule A segments or 22.0 inches per mile for Schedule B segments, calculate an Average Base Index (ABI) will be calculated for each segment as shown in Table 2316.02-1 on lanes wider than 8.5 feet. This will be the smoothness base in inches per mile for payment for the new pavement unless specified otherwise. The requirements are shown in Schedule C.

2316.02, B, 2, c.

Replace the Article:

Testing will be done at the quarter point of the traffic lanes Determine pavement profiles for each lane according to procedures for one lane, as shown in Materials I.M. 341 except for main line traffic lanes which will be tested in the wheel

paths. Round trace scallops to nearest 0.01 inch. Wheel paths are defined as 3 feet and 9 feet from center line or lane line. Average the two wheel path profile indexes for each segment. For projects with less than 0.5 miles of mainline paving, Contractor may elect to determine pavement profile in the quarter point unless another location is specified in the contract documents.

2316.05, F.**Replace the Article:**

A ~~\$900~~ \$1600 price adjustment will be assessed for each dip not corrected in each pavement lane under schedule a and b, except as stated in article 2316.03, C, 3. In addition, a ~~\$900~~ \$1600 price adjustment will be assessed for each bump not corrected under schedule a and b, except as stated in article 2316.03, C, 3. Bumps and dips not corrected will also be included in the evaluation for the segment smoothness.

Section 2318**2318.02, A, 2.****Replace the Article:**

Foamed Asphalt using PG 52-34S 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 52-34S 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 (Jnr waived), or
- Maximum $G^*\sin\delta$ of 5000 kPa for PAV aged binder (Jnr waived).

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. CIR may commence when air temperature is 55°F and rising. Do not perform recycling operations when:

- ~~The ambient daytime temperature is below 60°F,~~ Air temperature is less than 55°F,
- ~~For night work, the following day's forecasted high is below 60°F,~~ National Weather Service forecasts a temperature of 35°F or less in the next 24 hours,
- 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, A, 1.**Replace the third and fourth bullets:**

- ~~Producing the properly sized RAP or additional screening.~~
- ~~Crushing the RAP. Additional screening and/or crushing is allowed to produce properly sized RAP.~~

2318.03, H, Placement of Surface Course.**Replace the Article:**

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 2.5%, whichever is greater.~~ one of the following requirements has been met:

1. Average moisture content of the CIR layer is no more than 0.3% above the residual moisture content (according to Materials I.M. 504) or 3.5%, whichever is greater.
2. The moisture content of the CIR layer has reached a plateau of less than 5.0% and has remained constant (within +/- 0.3%) for a minimum of 3 calendar days.
3. The CIR layer has been completed for 21 calendar days.

The Engineer may adjust this drying period depending on field conditions. The completed CIR layer shall be retested until ~~the moisture content is at or below the limits stated above~~ one of the requirements listed above has been met.

Section 2320**2320.02, A, 1.****Replace the Article:**

Use a blend of emulsified quick-set polymer-modified CSS-1H or CQS-1H asphalt and latex-based polymer.

2320.02, B, Aggregate.

Replace the Article:

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:
 - 1) ~~Table 4124.03-1 with the following exceptions:~~
 - ~~Maximum abrasion loss of 30%, and~~
 - ~~Sand equivalence of not less than 60.~~
 - 2) ~~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:
 - 1) ~~Table 4124.03-1, and~~
 - 2) ~~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:
 - 1) ~~Table 4124.03-1, and~~
 - 2) ~~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 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 | Iowa DOT Materials Laboratory Test Method No. 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" | No. 4 | No. 8 | No. 16 | No. 30 | No. 50 | No. 100 | No. 200 |
| Quartzite/Granite/Slag | 100 | 90-100 | 65-90 | 45-70 | 30-50 | 18-30 | 10-24 | 5-15 |
| Limestone/Dolomite | 100 | 70-90 | 45-70 | 25-50 | 15-35 | 10-25 | 5-20 | 5-15 |

Meet the requirements of Section 4126.

2320.03, A, Equipment.

Replace the Article:

1. **Machinery.**
 - a. **Self-propelled Machine.**
 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.
 - b. **Truck-mounted Machines.**
 - 1) Use truck-mounted machines specifically designed and manufactured to perform microsurfacing work. The machine shall supply a consistent amount of material to all parts of the spreader box to ensure complete and uniform coverage.
 - 2) Operate a minimum of two truck-mounted machines. Cycle these truck-mounted units so mixture production is never delayed more than 15 minutes. Control forward speed of truck in a manner resulting in a uniform spread rate of material. If there is noncompliance with these requirements, stop production and make appropriate adjustments to the operation.

- 3) Finished surface, joints, and edges shall meet the requirements of Article 2320.03, F. If there is noncompliance with these requirements, stop production and make corrections to affected areas. The Engineer may require a second lift, to correct widespread segregation or variations in the spread rate, at no additional cost to the Contracting Authority.
2. Use a screening unit to remove objectionable oversize material that may be encountered. Screen material before loading the mixing machine and/or weighing for payment.
- 2 3. 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 4. 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 5. 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 6. 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 7. 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 8. Calibrate the mixing unit in the presence of the Engineer prior to the start of construction.
- 8 9. 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.

2320.04, A, Aggregate for Microsurfacing.

Add to the end of the Article:

When slag is used, reduce aggregate quantity for pay by 25%.

2320.04, C, Emulsified Asphalt for Microsurfacing.

Add to the end of the Article:

When slag is used, reduce emulsion quantity for pay by 25%.

Division 24. Structures.

Section 2401

2401.03, A, Notification for Complete Removal of Bridges.

Replace the Article:

1. Notify the Iowa DNR ~~by mail and the Engineer~~, with the "Asbestos Notification of Bridge Demolition and Renovation" form, no less than 10 business days prior to the start of bridge demolition. Iowa DNR form is available at <http://www.iowadnr.gov/Environmental-Protection/Air-Quality/Asbestos-Training-Fires>. Provide a copy of the submitted form to the Engineer.
2. If unable to begin work on the original intended start date, notify the Iowa DNR and the Engineer, by sending a revised "Asbestos Notification of Bridge Demolition and Renovation" form, of the new intended start date. Provide notification of the inability to commence work on the intended start date no later than 1 business day prior to the original intended start date. Failure to notify the Engineer of a change in start date 1 business day prior to the original intended start date will result in the need for a new 10 business day notification to the Iowa DNR and the Engineer.
3. The Contracting Authority has inspected the existing bridge for asbestos. Unless otherwise indicated in the contract documents, no asbestos was found, or it has been removed prior to the letting. The Contractor may use this information to complete the "Asbestos Notification of Bridge Demolition and Renovation" form.

2401.03, C, 1.

Replace the Article:

Remove substructures of existing structures within the stream to 1 foot below natural stream bottom, ~~unless otherwise provided or ordered~~. Remove those parts outside the stream to 1 foot below natural ground surface or as noted if grading limits modify the natural ground surface. Within grading limits of the project, substructure removal shall be 1 foot minimum below the grading surface. Within the limits of revetment placement, substructure removal shall be 1 foot minimum below

the bottom of the revetment. Where these portions of existing structures lie wholly or in part within limits for a new structure, remove as necessary to accommodate construction of the proposed structure.

2401.05, Basis of Payment.

Add the Article:

- C. Payment for Removal of Existing Bridge is full compensation for submittal of Asbestos Notification of Bridge Demolition form(s) and associated fees to Iowa DNR, removal of bridge according to contract documents, and transporting and disposal of materials.

Section 2402

2402.03, H, 4.

Add to the end of the Article:

When placing granular backfill material for mechanically stabilized earth (MSE) retaining walls, refer to Section 2432 for material and construction requirements.

2402.03, H, Placing Backfill Materials.

Add the Article:

- 14. Where a granular working blanket is specified, spread material meeting the requirements of Section 4118 unless another material is specified in the contract documents.

2402.03, Construction.

Add the Article and **renumber** existing Article:

J. Backfilling and Compaction of Pipe and Reinforced Box Culverts by Flooding.

1. Use floodable backfill material meeting the requirements of Section 4134. When required, use porous backfill material meeting the requirements of Section 4131.
2. When shown in the contract documents, use perforated subdrain meeting requirements of Section 4143.
3. When backfilling and compaction by flooding is required, backfill may be placed in lifts up to 2 feet thick. Place backfill simultaneously on both sides of culvert. Determine if pipe culverts need to be restrained and take appropriate actions to prevent floating of culverts during backfilling, flooding, and compaction.
4. Begin surface flooding for each lift at the inlet end of the culvert and progress to the outlet. To ensure uniform surface flooding and adequate compaction, fan-spray water in successive 6 to 8 foot increments using a 2 inch diameter hose for three minutes within each increment. Run hose fully, but with water pressure low enough to avoid eroding cohesive soil plugs.
5. After flooding, evaluate effectiveness of compaction with a vibratory pan compactor. If pan compactor produces visible compaction, repeat flooding process until pan compactor produces no visible compaction.

J K. Classification of Excavation.

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 greater than the inside width of the culvert.

2402.04, E.

Add the Article:

- 3. For granular backfill material for MSE retaining walls, refer to Section 2432.

2402.04, Method of Measurement.

Add the Articles:

I. Flooded Backfill.

Quantity of Flooded Backfill, in cubic yards, will be the quantity shown in the contract documents, including pipe culverts installed by fill installation. Quantity measured for payment will not be adjusted unless the quantity of culvert installed is adjusted.

J. Granular Working Blanket.

Cubic yards according to Article 2312.04, A.

2402.05, Basis of Payment.

Delete Article D and **renumber** following Articles:

D.—Overhaul.

1. ~~Material from classes of excavation other than Class 24 will ordinarily be deposited within 200 feet from the point of excavation as directed by the Engineer. Payment for overhaul beyond the free haul limit of 200 feet will be as provided in Article 1109.03, B.~~
2. ~~Payment for overhaul on Class 24 excavation will be as provided in Section 2108, except the free haul limit will be 500 feet.~~

E D. Unexpected Rock Excavation.

F E. Foundation Treatment Material.

G F. Granular Backfill.

H G. Compaction with Moisture Control (Structures).

I H. Flowable Mortar.

Add the Articles:

I. Flooded Backfill.

Contractor will be paid contract unit price for Flooded Backfill per cubic yard. Backfill material subdrains, restraining culverts against floating, and water required for flooding will not be measured separately for payment, but will be considered incidental to the contract unit price bid for Flooded Backfill.

J. Granular Working Blanket.

Per cubic yard.

2402.05, F, Granular Backfill.

Add to the end of the Article:

For payment of granular backfill material for MSE retaining walls, refer to Section 2432.

Section 2403

2403.02, A, 3, c.

Replace the second sentence:

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

2403.02, B, 2, a.

Replace the Article:

Place with a slump between 1 and 3 4 inches as a target range, allowing a maximum of 4 5 inches as a tolerance. ~~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 and 4 inches as a target range, allowing a maximum of 5 inches. Use Type A normal water reducer.~~

2403.02, B, 2, c.

Replace the last sentence and **delete** Table 2403.03-1:

Free moisture in the aggregate plus total mixing water shall not exceed that shown in ~~Table 2403.03-1~~ Materials I.M. 529.

Table 2403.03-1: Mixing Water and Free Moisture

| Class of Concrete | Pounds of Water per Pound of Cementitious Material |
|-------------------|--|
|-------------------|--|

| | |
|--------------------------|-------|
| C-Separated Aggregate | 0.488 |
| X-Separated Aggregate | 0.444 |
| C-with-Class-V-Aggregate | 0.444 |
| X-with-Class-V-Aggregate | 0.422 |
| D57 | 0.437 |

2403.02, B, 3, Entrained Air Content.

Add to the end of the Article:

When concrete is placed by pumping, use a target value of 7.5% +/- 2.0%.

2403.03, F, 5, e.

Replace the first sentence:

If all concrete is at least 1 foot below ground water level, it may be placed at a temperature no less than 40°F and flooded to a minimum depth of 1 foot in lieu of other methods of protection and curing provided the water temperature is 50°F or greater.

Section 2404**2404.03, E.**

Replace the Article:

Hold epoxy coated reinforcing steel in place with epoxy coated steel or plastic coated bar supports, and epoxy or plastic coated tie wires.

Section 2405**2405.03, H, 1, General.**

Add the Article:

- d. Unless otherwise specified in the contract documents, complete anchor bolt connections prior to subjecting the structural system to vehicle live load.

2405.03, H, 2, Bridge Bearings.

Add the Article:

c. Nut Tightening.

Tighten nuts to snug tight condition. Snug tight is defined as the full effort of one person on a wrench with a length equal to 14 times the bolt diameter, but not less than 18 inches. Apply full effort as close to the end of the wrench as possible. Perform tightening by leaning back and using entire body weight to pull firmly on the end of the wrench until the nut stops rotating. Perform a minimum of two separate passes of tightening. Sequence tightening in each pass so the nut on the opposite side, to the extent possible, is subsequently tightened until all nuts in that pass have been tightened.

Section 2407**2407.01, C.**

Replace the Article:

Apply the provisions of this section to production and construction of prestressed precast concrete bridge units and nonprestressed precast concrete bridge units.

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 T358~~ 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 T358~~ 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.
- c. Contact the Engineer and arrange for a trial batch. The producer certified technician shall cast 4 inch by 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 T358~~ results shall be 30 kilohm-cm or more on samples moist cured for 28 days.

- d. When ~~silica fume~~, a minimum of 20% class F fly ash, or GGBFS, or Type IS or IP cement is used in the mix, the Engineer may waive ASTM C 1202 or AASHTO ~~TP 95 T358~~ testing.

2407.03, H, 4.

Replace the Article:

Measure the initial camber due to prestress while the beam is on the bed by checking the beam profile within three hours after prestress transfer according to Materials I.M. 570.

Section 2408

2408.02, Materials Requirements, Identification, and Fabrication.

Replace the first paragraph:

Unless modified elsewhere in the contract documents, all fabrication to which this section applies shall be done in the United States and in steel fabrication shops and plants that are approved prior to the letting according to Materials I.M. 557. All main member fabrication, ~~except bearing devices~~, shall be fabricated by plants certified as ~~Category III, Major Steel Bridges~~, under the provisions of Simple, Intermediate, or Advanced Bridges according to the AISC's Quality Certification Program for Steel Bridge Fabricators. AISC categories are defined as follows:

- Simple bridges consist of unspliced rolled sections with no radius in the section.
- Intermediate bridges are typical bridges not requiring extraordinary measures. Typical examples include: (1) a rolled beam bridge with field or shop splices, either straight or with a radius over 500 feet; (2) a built up I-shaped plate girder bridge with constant web depth (except for dapped ends), with or without splices, either straight or with a radius over 500 feet; (3) a built-up I-shaped plate girder with variable web depth (e.g., haunched), either straight or with a radius over 1000 feet; (4) a truss with a length of 200 feet or less that is entirely or substantially pre-assembled at the certified facility and shipped in no more than three sub-assemblies.
- Advanced bridges require an additional standard of care in fabrication and erection, particularly with regard to geometric tolerances. Examples include tub or trapezoidal box girders, closed box girders, large or non-preassembled trusses, arches, bascule bridges, cable-supported bridges, moveable bridges, and bridges with a particularly tight curve radius.

Certification in a higher category qualifies all lower categories.

2408.02, B, 1.

Replace the eighth bullet:

- ~~Bearing stiffeners and bearing devices~~, and

2408.02, L, 1, General.

Replace Article a:

Drill, plasma cut (secondary members only), or punch all bolt holes. If utilizing plasma cutting, demonstrate ability to meet tolerance criteria prior to production. Do not punch holes in metal thicker than 3/4 inch for carbon steel and 5/8 inch for alloy steel. Instead, subdrill and ream holes, or drill holes to full size. Subpunch and ream, subdrill and ream, or drill full size holes in main stress carrying members. ~~Punch or drill full size holes for members (other than main stress carrying members) made of~~ Full size punched holes (secondary members only) are allowed for metal no thicker than 3/4 inch for carbon steel and 5/8 inch for alloy steel.

Add the Article:

- d. Ensure all bolt holes meet the following criteria:
- 1) Hole axis is square to faying surface within 1 in 20.
 - 2) No tears, cracks, fins, burrs, or other anomalies that could result in stress concentration or impede intimate contact at the faying surface
 - 3) Round within +/- 1/32 inch.
 - 4) For bolt holes in primary members, within +1/32, -0 inch. For bolt holes in secondary members or in crossframes or diaphragm connection plates, within +1/16, -0 inch.
 - 5) Maximum surface roughness of ANSI 1000 micro inches.

2408.02, Q, 1, a, 4.

Replace the first sentence:

Achieve a sharp, angular blast profile of a minimum ~~4-mil~~ 1.5 mils and maximum 3 mils on all surfaces, including thermal cut edges.

2408.03, B, Welding.

Replace the Article:

1. Current AWS standards in effect at the time of letting are applicable.
2. Comply with ~~ANSI/AWS D1.1 Structural Welding Code~~ procedures and requirements for the following items, ~~except comply with AASHTO/AWS D1.5 as modified below for filler metal and welder qualification requirements.~~ Comply with ANSI/AWS D1.5 Structural Welding Code procedures and requirements for items in Article a below. Comply with ANSI/AWS D1.1 Structural Welding Code procedures and requirements for items in Articles b through e below.
 - a. Bridge Components and Miscellaneous Items. This includes bearing assemblies, sole plates, expansion joint devices, pile and appurtenances, drainage system components, guardrail connections, metal railing, chain link enclosures and wire fence components, conduit systems, and tread plates.
 - b. Traffic Signal Components.
 - c. Sign Support Components.
 - d. Lighting Structure Components.
 - e. Pre-Engineered Pedestrian Bridges.
3. Comply with AASHTO/AWS D1.5-02, as modified by this specification, for welding and fabricating steel structures.
4. Each of the modifications in this article is referenced by the appropriate paragraph number in AASHTO/AWS D1.5-02, to which it is a modification.

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SECTION 1. General Provisions

1.3 Welding Processes

ADD the following Paragraphs after the existing 1.3.1:

1.3.1.1 Welding of main members and welding of attachments thereto shall be performed using only shielded metal arc, flux cored arc, submerged arc, and/or stud welding processes. Unless otherwise approved by the Engineer, all welding of butt splices and flange to web welds and stiffeners to web welds shall be done using the submerged arc process. Shielded metal arc welding may be used for repairs to butt splices and flange to web welds.

1.3.1.2 The WPS shall be initialed by the welder and posted at the welder's workstation at all times during welding operations.

REPLACE Paragraph 1.3.2 with the following:

Electroslag (ESW) and electrogas (EGW) welding are specifically disapproved for use.

SECTION 3. Workmanship

3.2 Preparation of Base Metal

ADD the following paragraph before the existing first Paragraph 3.2.2:

For main members, thermal cutting is limited to oxygen cutting except that plasma arc cutting of web and stiffeners may be used when approved by the Engineer.

DELETE the last sentence of Paragraph 3.2.7 which reads "Excess Camber may be corrected by heating without the engineer's approval."

3.5 Dimensional Tolerances

REPLACE all of the text and tables of Paragraph 3.5.1.3 with the following:

Camber of main members of continuous or simple span bridges with lines composed of rolled beams, beams and girders, or girders, shall be fabricated so that when the members are assembled in laydown with bearing points accurately positioned as shown on the erection diagram, points on any member shall not vary in the offset position from that indicated in the erection diagram by more than $\pm 1/2$ inch.

The erection diagram on the shop drawings shall show camber offsets at bearing points and splice points, and at midpoints of individually cambered beams or girders.

REPLACE Paragraph 3.5.1.4 with the following:

Permissible variation in specified sweep for horizontally curved welded beams or girders is

$$\frac{\pm 1/8 \text{ in.} \times \text{No. of ft. of total length}}{10} \quad (\pm 1 \text{ mm/m of the total length})$$

provided the member has sufficient lateral flexibility to permit the attachment of diaphragms, cross-frames, lateral bracing, etc., without damaging the structural member or its attachments.

REPLACE Paragraph 3.5.1.14 with the following:

Mechanically connected joints and splices of main members with surfaces intended to be parallel planes shall be nearly parallel after connection, and the surfaces to be in contact shall have an offset no greater than 1/16 inch after all filler plates have been added, if any. The accuracy of the angle of connecting stiffeners, angles, or plates shall be ± 0.5 degrees, when measured at the hole locations.

3.7 Repairs

REPLACE Paragraph 3.7.4 with the following:

Prior approval of the Engineer shall be obtained for repairs to base metal, repair of major or delayed cracks, or for a revised design to compensate for deficiencies.

ADD the following paragraph before the existing Paragraph 3.7.7:

The approval of the Engineer is required for all corrections of mislocated holes.

ADD the following Paragraph after the existing 3.7.7:

3.7.8 The maximum number of repairs to unacceptable defects in a butt splice shall be three, i.e., the times a butt splice may be opened, welded closed, and resubmitted for NDT inspection, unless otherwise approved by the Engineer.

SECTION 5. Qualifications

Part A. General Requirements

5.2 Qualification Responsibility

REPLACE ADD the following paragraph after the first paragraph of Paragraph 5.2 with the following:

To qualify welding procedures, the Contractor shall produce test weldments, perform nondestructive testing and machine specimens for mechanical testing in accordance with this code. ~~The Contracting Authority will witness the production of test weldments and conduct mechanical tests.~~

Part B. Welder, Welding Operator, and Tack Welder Qualification

5.21 General Requirements

REPLACE Paragraph 5.21.4 with the following:

Shop welder's, welding operator's, or tack welders qualification herein specified shall be considered as remaining in effect from the end of the month in which the tests were taken, for a period of 1 year. The qualification for the above may be extended annually, based on a letter from the fabricator/Contractor certifying that they have been engaged in the process(es) for which they qualified without interruption of more than 6 months during the preceding twelve months, or by requalification.

Field welder's qualification herein specified will be considered as remaining in effect from the end of the month in which the test was taken, for a period of 4 3 years. ~~For field welders who have successfully passed their qualification tests without failure for 3 consecutive years, requalification will only be required every 2 years. Requalification may be required at any time there is a specific reason to question a welder's ability to make sound welds.~~

5.21.6 Responsibility

REPLACE Paragraph 5.21.6.1 with the following:

To qualify shop welders, welding operators, and tackers, the Contractor shall ~~furnish test weldments, and perform nondestructive testing in accordance with this code. The Contracting Authority shall witness the production of test weldments and conduct mechanical tests.~~ The Contractor may, at no additional cost to the Contracting Authority, engage an outside firm or agency to witness production of test weldments and conduct mechanical tests. The acceptance of work performed by an outside firm or agency is the prerogative of the Contracting Authority. The engineer may require recertification if there is specific reason to question the welder's ability.

Field welders shall be certified by a test facility with an accredited AWS Certified Welder Program as defined in the current AWS Standard QC 4. Welders shall be certified per the current QC 7 Standard for AWS Certified Welders. The code of acceptance shall be AWS Bridge Welding Code D1.5. Certification maintenance per applicable AWS Code of Acceptance shall be the responsibility of the certification holder. A copy of the current welder's certification from the AWS test facility shall be available to the Engineer upon request. The Engineer may require recertification if there is specific reason to question the welder's ability.

5.23 Qualification Tests Required

ADD Subparagraph 5.23.1 (5) after the existing 5.23.1 (4):

Plate weld tests may also be accepted for qualification of welding pipe piling of any diameter.

REPLACE Paragraph 5.23.3 with the following:

Tack Welder Qualification. A tack welder shall be qualified by fillet-weld-break specimen made using the same criteria as listed for plate-fillet welder qualification in Table 5-6 5.8. The tack welder shall make a 1/4 inch maximum size tack weld approximately 2 inches long on the fillet-weld-break specimen, as shown in Fig. 5.28.

SECTION 6. Inspection

Part A. General Requirements

6.7 Nondestructive Testing

REPLACE last sentence of 6.7.1 with the following:

When required, testing of CJP groove welds in butt joints in compression or shear shall be done by RT.

REPLACE Subparagraph 6.7.1.2(1) with the following:

100% of each joint subject to tension or reversals of stress, except that on vertical butt weld splices in beam or girder webs, only 1/3 of the web depth beginning at the point, or points, or maximum tension need be tested. If unacceptable discontinuities are found in the first 1/3, the remainder of the weld shall be tested.

REPLACE Subparagraph 6.7.1.2(2) with the following:

50% of each joint subject to compression or shear in each main member including longitudinal butt weld splices in beam or girder webs. If unacceptable discontinuities are found in the first 50% of joint, the entire length shall be tested.

Part B. Radiographic Testing of Groove Welds in Butt Joints

6.10 Radiographic Procedure

ADD the following Paragraph after existing 6.10.5.3:

6.10.5.4 Where areas being radiographed are adjacent to the edge of the plate, edge block shall be used.

6.12 Examination, Report, and Disposition of Radiographs

REPLACE Paragraph 6.12.3 with the following:

Two sets of radiographs shall be taken for welds subject to radiographic testing, including any that show unacceptable quality prior to repair. One radiograph of each test shall, upon completion of Q.C. and Q. A. interpretation, be forwarded to the Office of Materials, Ames, Iowa. The second set of radiographs shall be retained by the Contractor as part of on-site inspection records. Upon completion of the project, this second set will become the property of the Contractor.

2408.03, Q, Assembling Steel.

Add the Article:

6. Unless otherwise specified in the contract documents, complete bolted and welded structural connections prior to subjecting the structural system to vehicle live load.

2408.03, S, 5, a, 6.

Replace Table 2408.03-2:

Table 2408.03-2: Minimum Bolt Tension

| Bolt Dia. inches | Min. Bolt Tension, lbf. ^(a) | Bolt Dia. inches | Min. Bolt Tension, lbf. ^(a) |
|---------------------|--|---------------------|--|
| 1/2 | 12,050 | 1 1/8 | 56,450 64,900 |
| 5/8 | 19,200 | 1 1/4 | 71,700 82,400 |
| 3/4 | 28,400 | 1 3/8 | 85,450 98,200 |
| 7/8 | 39,250 | 1 1/2 | 104,000 119,500 |
| 1 | 51,500 | | |

^(a) Equal to the proof load (length measurement method) given in ASTM A-325 F 3125.

Section 2412

2412.02, E.

Delete the Article and **renumber** following Article:

- ~~E. When a 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 and 4 inches as a target range, allowing a maximum of 5 inches.~~

F E.

2412.02, Materials.

Add the Article:

- F. Meet requirements of Article 2403.02, B, 3 for entrained air content. When concrete is placed by pumping or belt conveyor, use a target value of 7.95% plus or minus 2.0%.

2412.03, C, Placing Concrete.

Replace the first sentence of Article 4:

Do not place concrete if the forecast theoretical rate of evaporation for that day exceeds 0.2 lbs. pounds per square foot per hour.

Add the Articles:

5. Calculate theoretical evaporation rate, in accordance with methods described in Materials I.M. 382, at a maximum interval of every 3 hours during placement. If rate exceeds 0.2 pounds per square foot per hour, cease placement at next location acceptable to Engineer.
6. Concrete placement equipment proposed to be operated directly on bridge deck reinforcing steel shall be submitted to the Engineer with manufacturer's specifications for review/approval prior to use in concrete placement. Requests may require closer spacing of reinforcing bar supports and tying of all reinforcing bar intersections.

2412.03, E, Curing Concrete Decks.

Replace the first paragraph:

Use burlap with sufficient water that is prewetted by fully saturating, stockpiling to drain, and covering with plastic to maintain wetness prior to placement, to prevent absorption of moisture from the concrete surface. Keep the burlap wet.

2412.03, E, 2.

Replace the Article:

As soon as practical, but no later than 2 hours after placing the first layer, place a second layer of prewetted burlap on the deck.

Section 2413

2413.02, C.

Add to the end of the Article:

Unless otherwise specified, use coarse aggregate that is the same type used in the existing bridge deck concrete or limestone or dolomite coarse aggregate.

2413.02, D, 1, b.

Replace the Article:

Fly ash substitution up to 20% is not permitted for Class O PCC. The proportions for Class O mix with fly ash are in Materials I.M. 529.

2413.02, D, 2, b.

Replace Articles b through g:

- b.** Use a mid-range normal water reducing admixture listed in Materials I.M. 403, Appendix C and a retarder listed in Materials I.M. 403 Appendix G. When the expected haul time is less than 30 minutes or the maximum air temperature expected is less than 75°F, addition of a retarder is not required. The intent of the mid-range water reducer is to achieve a workable, dense, and low w/c ratio concrete. The Engineer may approve other admixtures or combinations of admixtures and dosages to achieve a workable low w/c ratio mix.
- c.** Increase moisture testing of coarse and fine aggregate to ensure batch-to-batch consistency and reduce water addition at job site. Perform moisture testing of coarse and fine aggregate prior to batching when batch weights are determined and then again half-way through the placement.
- d c.** Air content is to be the same as required for Class O PCC.
- e d.** Use Type IS or Type IP cement. If Type I/II is used, 25% replacement with GGBFS is required.
- f e.** Limit fly ash substitution to 20% replacement by weight.
- g.** For projects with deck overlay quantities greater than 1800 square yards, make a trial batch of the mix (minimum 3 cubic yards) at the anticipated concrete temperature during delivery. Initially test the slump and air content. Let the mixer run for the time anticipated, including batching, delivery to the project, estimated waiting time for discharge of the load, and the time to discharge the load. Test the slump and air content again. If the slump at the discharge time is 2 inches or less, the proposed mix is not suitable and an additional trial batch will be required. The intent is to ensure the admixture or combination of admixtures will maintain the desired slump without additional water at the discharge site. If unacceptable slump loss occurs during the project placement so that the slump is 2 inches or less, one or all of the following steps will be required:
 - 1) Change the dosage rate of admixture(s).
 - 2) Change the brand of admixture(s).
 - 3) Change the location of mixing admixture(s). For example: incorporate admixture(s) in the ready mix truck on the project site instead of at the ready mix plant.
 - 4) Reduce the concrete temperature. For example: use ice or chilled water.

2413.03, C, Preparation of Surface for Deck Repair.

Add to the end of the first paragraph:

Deck repairs on concrete beam and steel girder bridges have no removal area restrictions. Deck repairs on continuous concrete slab bridges shall not extend below top mat of deck reinforcing without review and approval of the Engineer.

2413.03, F, Curing.

Replace the Article:

Use burlap that is prewetted by fully saturating, stockpiling to drain, and covering with plastic to maintain wetness prior to placement.

1. Place 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 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.
 - c. Failure to apply prewetted burlap within the required time is cause for rejecting the affected work. Remove surface concrete in the rejected area and replace at no additional cost to the Contracting Authority.
- ~~2. Cure the concrete as follows:

 - a. ~~For Class O PCC or Class HPC-O:~~
 - 1) ~~Allow the surface to cure for at least 72 hours.~~
 - 2) ~~Keep the burlap continuously wet by means of an automatic sprinkling or wetting system.~~
 - 3) ~~Failure to apply wet burlap within the required time is cause for rejecting the affected work. Remove the surface concrete in the rejected area and replace at no additional cost to the Contracting Authority.~~
 - b. ~~Prewet the burlap with sufficient water, prior to placement, to prevent absorption of moisture from the concrete surface.~~~~
2. Apply water to the burlap covering for a period of 72 hours. Use a pressure sprinkling system that is effective in keeping burlap wet during the moist curing period. The system may be interrupted to replenish water supply, during periods of natural moisture, or during construction contiguous to the concrete being cured. The Engineer may approve interruptions for periods longer than 4 hours on the basis of the method for keeping the concrete moist.
3. Maintain continuous contact, except as noted above, between all parts of the concrete deck and the burlap during the 72 hour moist curing period.

2413.03, H, 10.

Replace the first sentence:

Do not allow traffic on a finished surface course until 72 hours after placement or ~~168 hours for Class HPC-O projects with greater than 1800 square yards.~~

2413.03, H, 12.

Replace the Article:

Do not place concrete mixture without the Engineer's written approval after October 1 and before April 1 ~~without the Engineer's written approval~~, or when temperatures are forecast by the National Weather Service to be below 40°F during the first 24 hours of the curing period and below 35°F for the next 48 hours of the curing period.

Section 2414

2414.02, B, Pipe and Structural Steel Pedestrian Hand Railings.

Add the Article:

3. Comply with Materials I.M. 557.

Section 2416

2416.03, A.

Replace Table 2416.03-1:

Table 2416.03-1: Minimum and Maximum Allowable Pipe Sizes

| Culvert Use | Minimum Pipe Size in. | Maximum Pipe Size in. |
|--------------------|------------------------------|------------------------------|
| Roadway Culvert | 18 | 108 |
| Entrance Culvert | 18* | 108 |

* 15 inch entrance pipes allowed on non-interstate and non-primary roadways.

2416.03, C.

Replace the second sentence:

Place embankment within the restrictions of Article 1105.13 1107.18.

2416.03, D, 2, a, 1, Class B Bedding.

Replace the Article:

Class B bedding consists of a 2 inch cushion of sand shaped with a template to a concave saddle in compacted or natural earth to such a depth that 15% of the height of the pipe rests on the sand cushion below the adjacent ground line. Place Class B Bedding as shown in the contract documents.

2416.03, D, 4, d.

Add as the last sentence of the Article:

If backfilling and compaction by flooding is specified, comply with Article 2402.03, J.

2416.03, D, 5, Concrete Pipe Joints.

Add the Article:

e. For connections between dissimilar pipes, provide transition section or Type C adapter.

2416.04, B.

Replace the Article:

Aprons: quantity shown in the contract documents each apron installed will be counted for each size class.

2416.05, H, 1.

Add as the second sentence:

When substitutions are made per Article 2553.02, A, 2, e, payment will be made per type and size of pipe as shown in the contract documents.

Section 2417

2417.02, Materials.

Replace the Article:

- A.** Use corrugated steel culverts that meet the meeting requirements of Section 4141.02, or Section 4146 For primary and interstate projects, corrugated steel culverts shall be coated according to Article 4141.02. When polyethylene culvert pipe is designated, meet requirements of Section 4146.
- B.** Use round culvert pipe, unless specified otherwise. When required, elongate round pipe. When specified, use arch type pipe.
- C.** ~~When placing under roadway, use corrugated steel culverts coated according to Article 4141.02.~~
- D C.** A paved invert may be required according to the contract documents.

2417.03, A, 1.

Replace Table 2417.03-1:

Table 2417.03-1: Minimum Allowable Pipe Sizes

| Culvert Use | Minimum Pipe Size in. |
|--------------------|------------------------------|
| Roadway Culvert | 18 |
| Entrance Culvert | 18* |

* 15 inch entrance pipes allowed on non-interstate and non-primary roadways.

2417.03, C, 1, Class B Bedding.**Replace** the Article:

When installing corrugated metal pipe or polyethylene pipe for roadway culverts, use Class B Bedding described in Article 2416.03, D, 2 place Class B Bedding as shown in the contract documents.

2417.04, B.**Replace** the Article:

Aprons: quantity shown in the contract documents each apron installed will be counted for each size class.

2417.04, D, 1.**Replace** the Article:

Roadway culverts: Article 2402.04, E C, applies.

Section 2418**2418.01, Description.****Replace** the second sentence:

Temporary stream diversion involves diverting flow of a perennial stream around the construction site by use of either a diversion channel, pipe, or hose.

Section 2419**2419.01, E.****Add** to the end of the Article:

Section 2436: Precast Noise Wall

Section 2523: Highway Lighting

2419.02, A, 1.**Replace** the Article:

Apply Sections 4110, 4111, 4115, and 4117, except gradation requirements of Articles 4110.02 and 4115.03 and cement requirements of Article 4117.05.

2419.03, C, 1.**Replace** the Article:

Proportion and mix concrete according to applicable requirements of Article 2403.02, D, 3 2.

2419.03, D, 1.**Replace** the first sentence:

Use a method of curing that prevents loss of moisture and maintains an internal concrete temperature of at least 40°F and not more than 155°F during the curing period.

2419.03, D, 3, d.**Replace** the second sentence:

After the 2 hour period, the temperature of the concrete may be raised to a maximum temperature of 160 155°F at a rate not to exceed 25°F per hour.

Section 2423**2423.01, Description.****Replace** the second sentence:

Design according to the contract documents and the applicable AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. specifications for highway signs, luminaires, and traffic signals.

Section 2426**2426.02, B, 2, Regular Repair.****Add** as the second sentence:

Materials I.M. 447 provides for use of packaged, dry, combined materials for Class O PC concrete.

Section 2428

2428.04, B, 1.

Replace the Article:

Correct all dips exceeding 0.5 inch in a 25 foot span, as indicated on the profilogram, only when the Engineer requires, except as stated in Article 2428.04, C. The Contractor will be assessed a price adjustment of \$900 \$1600 for each dip exceeding 0.5 inch that is not corrected, except as stated in Article 2428.04, C. When the Engineer requires correction of a dip by grinding, and grinding would result in a cover concrete thickness less than 2 inches, use the following method to correct the dip:

- Identify limits of dip area,
- Saw cut 3/4 inches deep at the perimeter,
- Remove deck concrete to 1 inch below top mat of deck reinforcing, and
- Place a deck overlay patch in accordance with Articles 2413.03, D; E, 2 & 3; F; G; and H.

2428.05, B, 3.

Replace Table 2428.05-2:

Table 2428.05-2: Price Reduction

| New Bridge Decks | | Bridge Deck Overlays | |
|---|---------------------|---|---------------------|
| Initial Profile Index Inches Per Mile (mm/km) Per Segment | Dollars Per Segment | Initial Profile Index Inches Per Mile (mm/km) Per Segment | Dollars Per Segment |
| 22.1 - 30.0 (351 - 470) | 2000 | 15.1 - 20.0 (241 - 315) | 1000 |
| 30.1 - 35.0 (471 - 550) | 4000 | 20.1 - 25.0 (316 - 390) | 2000 |
| 35.1 - 40.0 (551-630) | 6000 | 25.1 - 30.0 (391 - 470) | 3000 |
| over 40.0 (over 630) | (a) | over 30.0 (over 470) | (a) |

(a) Correction is required to an index of 15.0 inches per mile (240 mm/km) for overlays and to an index of 22.0 inches per mile (350 mm/km) for new decks.

Section 2429

2429.02, B, 3, Field Splices:

Replace the third bullet:

Field connection bolts tightened by the “turn-of-nut method” to obtain proper torque. See Articles 2408.03, S, 5, b and 2408.03, S, 5, c.

Section 2430

2430.02, B, Materials.

Replace the first sentence:

Furnish a wall manufactured by a company on the approved manufacturer’s list in Materials I.M. 445.04 and 445.05.

Retitle Article 1:

1. Concrete Units, Dry Cast.

Add the Article and renumber subsequent articles:

2. Concrete Units, Wet Cast.

- a. Minimum 28 day compressive strength of 6000 psi for any one individual unit.
- b. Minimum compressive strength of 3500 psi achieved before blocks are moved and/or transferred to a storage site.
- c. Air content in the fresh concrete of 6.5%, -1%, +1.5 %.
- d. Aggregates, cement, mineral and liquid chemical admixtures from an approved source and complying with the Standard Specifications. Minimum of Class 2 coarse aggregate durability.
- d. Overall dimensions for width, height and length do not differ by more than ± 1/8 inch from the specified minimum dimensions.
- e. All units sound and free of cracks or other defects that would:
 - Interfere with the proper placement of the units,
 - Affect physical appearance of the units, and/or

- Impair the strength or long range performance of the units.
- f. Apply Section 2419.

2430.02, B, 5, Backfill Material.

Add as the second sentence:

The Contractor has the option to substitute crushed stone meeting the requirement of Section 4131 for granular backfill.

Section 2431

2431, Segmental Retaining Wall.

Retitle Section:

Segmental Block Retaining Wall

2431.01, Description.

Replace the Article:

Furnish and install segmental block retaining wall (SRW) units, wall fill, and granular backfill material to the lines and grades shown in the contract documents. ~~Segmental retaining walls are defined as systems which usually require mesh or strips in the backfill material behind the wall facing to limit backfill material stresses by reinforcing the soil structure.~~

2431.02, B, Materials.

Replace the Article:

Furnish a wall manufactured by a company on the approved manufacturer's list in Materials I.M. 445.04 or 445.05. Ensure both the supplier of all substantial material components and the Wall Design Engineer have demonstrated experience in reinforced soil-reinforced SRWs for previous projects.

1. Concrete Units, Dry Cast.

- a. Ensure the following:
 - Concrete segmental units and cap blocks comply with the requirements of ASTM C 1372, except with a minimum 28-day compressive strength of 5500 psi for any one individual unit, and 6000 psi for the average of three units.
 - ~~The 24 hour water absorption rate does not exceed 5%.~~
 - The top surface of cap blocks ~~are~~ is sloped 10:1 from front to back or from a crown at the center.
- b. Ensure block sampling and testing comply with ASTM C 140.
- c. Ensure maximum water absorption meets the requirements of ASTM C1372, except that the 24 hour water absorption rate shall not exceed 5%.
- ~~c~~ d. Freeze-thaw durability testing will be required as described in ASTM C 1372 Sections 5.2, 5.2.1, and 8.3. Ensure testing is done according to ASTM C 1262.
- ~~d~~ e. Ensure specimens meet weight loss limits for testing in water as required in ASTM C 1372 Section 5.2.1.
- ~~e~~ f. Ensure specimens are also tested in a 3% saline solution and comply with either of the following:
 - The weight loss of each of five test specimens ~~at the conclusion of~~ after 40 cycles does not exceed 1% of its initial weight; or
 - The weight loss of four out of five specimens ~~at the conclusion of~~ after 50 cycles does not exceed 1.5% of its initial weight.
- ~~f~~ g. Ensure testing is continued until one of the following occurs:
 - The weight loss each of five test specimens exceeds 2% of its initial weight, or
 - The weight loss of one of the five test specimens exceeds 2.5% of its initial weight, or
 - The specimens have been tested for at least 100 cycles.
- ~~g~~ h. Submit complete durability test reports for water and saline conditions, including the cycle number at which failure occurred, to the Engineer.
- ~~h~~ i. Ensure all units are sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the construction.
- ~~i~~ j. Ensure SRW units dimensions do not differ by more than ~~± 1/4~~ 1/8 inch.
- ~~j~~ k. Apply Section 2419.

2. Concrete Units, Wet Cast.

- a. Minimum 28 day compressive strength of 6000 psi for any one individual unit.
- b. Minimum compressive strength of 3500 psi achieved before blocks may be moved and/or transferred to a storage site.
- c. Air content in the fresh concrete of 6.5%, -1%, +1.5 %.
- d. All aggregates, cement, mineral and liquid chemical admixtures from an approved source and complying with the Standard Specifications. Minimum of Class 2 coarse aggregate durability.
- d. Overall dimensions for width, height, and length do not differ by more than $\pm 1/8$ inch from the specified minimum dimensions.

- e. All units are sound and free of cracks or other defects that would:
 - Interfere with the proper placement of the units,
 - Affect physical appearance of the units, and/or
 - Impair the strength or long range performance of the units.
- f. Apply Section 2419.

2 3. Leveling Pad.

Use supplier/manufacturer recommended leveling pad materials. If granular material is recommended for the leveling pad, use backfill material meeting the requirements of Section 4132. If unreinforced concrete is recommended for the leveling pad, use Class C concrete meeting the requirements of the Materials I.M. 529 and Section 2403.

3 4. Unit Fill.

If fill is required by the construction drawings for in-place concrete segmental block units, place porous backfill material meeting the requirements of Section 4131.

4 5. Subdrains.

- a. Ensure the subdrains are a minimum of 4 inches in diameter and meet the requirements of Article 4143.01, B.
- b. Provide Standard Road Plan DR-305 Type A outlets and fit with rodent guards (complying with Materials I.M. 443.01).

5 6. Backfill Material.

Use granular backfill meeting the requirements of Section 4133 for fill soil material in the entire reinforced earth zone. The Contractor has the option to substitute crushed stone meeting the requirement of Section 4131 for granular backfill.

6 7. Geogrid Reinforcement.

Comply with the following:

- Type, strength, and placement location determined by the Wall Design Engineer.
- Design properties of the reinforcement determined according to the procedures outlined in NCMA Section 3.5.
- Detailed test data (including strength, creep, site damage, and pullout testing) submitted to the Engineer for approval at least 30 days prior to construction.
- Of a type recommended by the block supplier to be compatible with the facing units, with a minimum long term design strength of 1500 pounds per foot.
- Regular grid structure having an aperture geometry and rib and junction cross-sections sufficient to permit significant mechanical interlock with the granular backfill material.
- High continuity of tensile strength through all ribs and junctions of the grid structure.
- High resistance to deformation under sustained long-term design load while in service, and resistant to: 1) ultraviolet degradation; 2) damage under normal construction practices; and 3) all forms of biological or chemical degradation normally encountered in the granular backfill material.

7 8. Certifications.

- a. Submit a notarized manufacturer's certification to the Engineer at least 14 days prior to the preconstruction conference, stating that the SRW units meet the requirements of this specification.
- b. Submit a notarized manufacturer's certification signed and sealed by an officer of the manufacturer, prior to start of work, stating that the geogrid reinforcement meets the requirements of the SRW unit manufacturer and this specification.

2431.04, A, Segmental Retaining Wall.

Retitle the Article:

Segmental Block Retaining Wall.

2431.05, A, Segmental Retaining Wall.

Retitle the Article:

Segmental Block Retaining Wall.

Section 2432

2432.02, B, 4, b.

Replace the Article:

Provide a Standard Road Plan DR-305 Type A outlet fitted with a Standard Road Plan DR-304 rodent guard (complying with Materials I.M. 443.01).

2432.02, B, 6, a, 1.

Replace the first sentence:

Tie strips shall be shop-fabricated from hot-rolled steel conforming to the minimum requirements of ASTM A 570 1011, Grade 50, or equivalent.

2432.05, B, Granular Backfill Material.

Add the Article:

3. Includes testing for moisture and density control.

Section 2433**2433.02, B, 6.**

Replace the Article:

Mid-range or high-range water reducer is required according to Materials I.M. 403.

2433.03, C, Control and Disposal of Materials.

Replace the Article:

1. Dispose of excavated material, as well as slurry and/or water removed from the shaft excavation. Collect and properly dispose off site all slurry and untreated water displaced during final cleaning and concrete placement. Open pits for collection of materials will not be allowed. Control all excavated material, slurry, water, and other matter so that at no time it enters or encroaches upon the adjacent travel lanes, railroad, water ways, and so forth.
2. Water properly treated to remove sediment may be disposed on site. Take measures to prevent scour erosion at discharge point. Ensure turbidity of treated water does exceed 25 Nephelometric Turbidity Units (NTUs) greater than receiving water at the point of discharge; pH shall not be less than 6.5 nor greater than 9.0 at point of discharge; ensure pH is within 0.5 of receiving water; and discharge does not create objectionable color in receiving water. Contractor is responsible for testing prior to discharge and while discharging. If water is not able to be properly treated, dispose of off site per Article 2433.03, C, 1, at no additional cost to the Contracting Authority.

2433.03, D, 1, b.

Delete the last sentence:

~~No separate payment will be made for removing obstructions.~~

2433.03, J, Crosshole Sonic Log (CSL) Testing.

Replace Articles 2, 3, and 6.

2. The procedure in ASTM D 6760 will be followed with the exceptions listed below:
 - a. Plastic access ducts and drilled boreholes will not be allowed unless the Engineer approves.
 - b. A minimum of four access ducts are required, except for three tubes if the reinforcing cage is 2.5 feet in diameter or less
 - c. Perform CSL testing after the shaft concrete has cured at least 48 hours but no later than ~~7~~ 14 calendar days.
 - d. Grout the access ducts after the Engineer's approval of the testing results. Place grout with a pump, starting at the bottom of each access duct.
 - e. Include the waterfall diagram (which is a nesting of ultrasonic pulses in an ultrasonic profile) in the report.
3. Furnish and install one access pipe per 1 foot of shaft diameter, but no less than four per shaft ~~with external couplings for CSL testing~~, except for three tubes if the reinforcing cage is 2.5 feet in diameter or less. Furnish access pipes complying with the following:
 - 1.5 to 2 inch diameter, Schedule 40 pipe conforming to ASTM A 53, Grade A or B, Type E, F, or S.
 - Round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the unobstructed passage of 1 3/8 inch maximum diameter source and receiver probes used for the CSL tests.
 - Watertight and free from corrosion with clean internal and external faces to ensure a good bond between the concrete and the access pipes.
 - Fitted with a watertight cap on the bottom and a removable, watertight cap on the top to prevent debris from entering the pipes.
 - Watertight joints to achieve the specified length.
 - Use external couplings for CSL testing tubes.
6. Fill the access pipes with clean water prior to concrete placement. To prevent debris from entering the pipe, reseal each access pipe immediately after water placement. ~~Prior to CSL testing, flush all access pipes containing debris, refill with water of similar temperature, and reseal. Use water of similar temperature to avoid debonding of access pipes with surrounding concrete.~~ Dewater all access pipes and fill with grout after the tests are completed, and the

shaft has been accepted by the Engineer. Place grout with a pump, starting at the bottom of each access duct. Use grout meeting the requirements of Materials I.M. 388.

Add the Article and **renumber** subsequent Articles:

- 8.** Further investigation may be required of shafts with defects or poor quality concrete (as defined by Publication No. FHWA-NHI-10-016 Drilled Shaft Manual).
 - a.** If subsequent testing (CSL, tomography, coring, etc.) at a drilled shaft indicates the presence of a defect in the drilled shaft, testing costs and delay costs resulting from each of the additional testing methods and required remediation shall be borne by Contractor.
 - b.** If this additional testing indicates the drilled shaft has no defect, testing costs and delay costs resulting from the test which provided acceptable results will be paid by Contracting Authority.

~~8 9.~~

~~9 10.~~

~~10 11.~~

2433.03, K, 4.

Replace the second sentence of the Article:

The Contractor may be required to perform additional demonstration shafts at their own expense until an adequate procedure is demonstrated and approved by the Engineer.

2433.03, L, 1, b, 4.

Add to the end of the Article:

Concrete strength will be determined based on a cylinder test the day of the load cell test.

2433.03, L, 2.

Replace the Article:

If the Engineer determines the test shaft to be unacceptable, submit a plan for remedial action to the Engineer for approval. The Engineer may require another load cell test on another shaft, at no additional expense to the Contracting Authority.

2433.05, A, 2.

Replace the fifth bullet:

All CSL pipe and initial testing, Further investigation and remediation of shafts with proven defects or poor quality concrete (as defined by Publication No. FHWA-NHI-10-016 Drilled Shaft Manual) identified by CSL tests, shaft inspection is also included, and

2433.05, A, Concrete Drilled Shaft.

Add the Article:

- 3.** Removal of obstructions during excavation is considered as extra work and payment will be as provided in Article 1109.03, B.

Section 2435

2435.01, B.

Replace the Article:

Construct storm sewer intakes and linear trench drains for collection of surface water and conveyance to storm sewer system.

2435.02, Materials.

Replace the Article:

Apply Articles 4149.04 and 4149.05.

2435.03, A, 3, b.

Replace the Article:

Precast Structures: If precast structure is provided, install 8 inch thick pad of Class-I bedding material a minimum of 12 inches outside the footprint of the structure. For Non-Primary Road projects, use material meeting the requirements of Section 4118. For Interstate and Primary Road projects, use material meeting the requirements of Section 4119.

2435.03, A, 4, Installation of Manhole or Intake.

Add as the second sentence:

Form walls and construction joints for cast-in-place intakes or install precast intake boxes to ensure intake lids are set to match the longitudinal slope of the adjacent street unless otherwise specified in the contract documents.

2435.03, A, 7.

Replace the title and Article:

Invert Fillet.

- a. Construct manhole invert fillet up to one half of pipe diameter to produce a smooth half pipe shape between pipe inverts.
- ~~b. Shape invert to provide a smooth transition between pipe inverts.~~
- ~~c.~~ b. Slope invert fillet top toward pipe 1/2 inch per foot perpendicular to flow line.
- ~~d.~~ c. For sanitary sewer, keep void between pipe and structure wall free of debris and concrete.
- ~~e.~~ d. For precast inverts fillets, remove projections and repair voids to provide a hydraulically smooth channel between ends of pipes.

2435.03, A, 9, Adjustment Ring(s).

Replace the second sentence:

Bed each polyethylene or expanded polypropylene ring with the manufacturer's approved product and according to manufacturer's recommended installation procedure.

2435.03, A, 10, Casting.

Replace the Article:

1. Install the type of casting specified in the contract documents and adjust to proper grade.
2. Where a manhole or intake is to be in a paved area, adjust the casting to match the slope of the finished surface.
~~When specified in the contract documents, attach a casting frame to the structure with four anchor bolts.~~
3. **Three-piece Castings.**
 - a. Attach the frame to the structure with four anchor bolts.
 - b. Set initial position of movable portion of the casting in the center of the adjustment range.
 - c. Remove height-adjustment bolts or mechanism after the paving is completed.

2435.03, A, 11, Infiltration Barrier.

Add the Article:

c. Heat Shrink Sleeve.

- 1) Ensure surfaces are clean, dry, and free of foreign objects and sharp edges.
- 2) Warm surface to drive off any moisture.
- 3) Cut sleeve to required length per manufacturer's requirements.
- 4) Apply primer to manhole and casting surface.
- 5) Place sleeve according to manufacturer's requirements.
- 6) Apply heat to sleeve, smooth out wrinkles, and remove trapped air.
- 7) Cut sleeve at the casting gussets. Reheat to place sleeve onto the casting.
- 8) Trim off excess material.

2435.03, A, 12, Backfill and Compaction.

Replace the title:

Backfill and Compaction (Non-Primary Road projects).

2435.03, A, 13, Bedding and Backfill Under Interstate and Primary Roads.

Replace the title and Article:

Bedding and Backfill Under (Interstate and Primary Roads projects).

Place and compact the material according to Article 2552.03, E, 2.

2435.03, Construction.

Add the Article and **renumber** subsequent Articles:

D. Linear Trench Drain.

1. Install linear trench drain according to manufacturer's recommendation and contract documents.

2. Install casting certified for 40,000 pound proof load according to AASHTO M 306.
3. Use duct tape or wood block to cover drain during paving operations.

D E. Adjustment of Existing Manhole or Intake.

E F. Connection to Existing Manhole or Intake.

F G. Cleaning, Inspection, and Testing of Structures.

2435.03, E, 3, c.

Replace the Article:

Remove and replace or modify existing riser section and/or top section, ~~as appropriate~~ according to the method approved by the Engineer.

2435.03, F, 1, a.

Replace the Article:

Remove ~~invert~~ fillet as necessary to install pipe at required elevation and develop hydraulic channel.

2435.03, F, 4, Storm Sewer.

Replace the Article:

- a. ~~Cut opening to manhole or intake to 3 to 6 inches beyond the outside of the pipe.~~ **Cut and Chipped Opening.**
 - 1) Use for pipe sizes 12 inches in diameter or larger.
 - 2) Saw opening to approximate dimensions with a masonry saw. Saw to depth sufficient to sever reinforcing steel.
 - 3) Remove concrete and expand opening to a diameter at no more than 4 inches larger than the outside diameter of the new pipe.
 - 4) Leave a minimum of 6 inches of manhole or intake wall above and on the sides of the pipe.
 - 5) Cut off all reinforcing steel protruding from the structure wall.
- b. **Cored Opening.**
 - 1) Core new openings in existing manholes or intakes for all pipes less than 12 inches in diameter.
 - 2) Opening to be no greater than 2 inches larger than the outside diameter of the pipe.
 - 3) Leave a minimum of 6 inches of manhole or intake wall above and on the sides of the pipe.
- b c.** Fill opening between manhole or intake wall and outside of pipe with non-shrink grout or construct a concrete collar around the pipe according to Article 2435.03, E, 2.

2435.04, Method of Measurement.

Add the Article and **renumber** subsequent Articles:

C. Linear Trench Drain.
To the nearest foot.

C D. Drop Connection.

D E. Casting Extension Rings.

E F. Manhole or Intake Adjustment, Minor.

F G. Manhole or Intake Adjustment, Major.

G H. Connection to Existing Manhole or Intake.

H I. Cleaning, Inspection, and Testing.

2435.05, A, 2.

Replace the Article:

Payment is full compensation for excavation, furnishing and installing pipe, lining (if specified), furnishing (~~if required~~) and placing, and compacting bedding and backfill material, ~~compaction~~, base, structural concrete, reinforcing steel, precast units (if used), concrete fillets, pipe connections, infiltration barriers (sanitary sewer manholes only), 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~~ fillets, pipe connections, castings, and adjustment rings.

2435.05, Basis of Payment.

Add the Article and **renumber** subsequent Articles:

C. Linear Trench Drain.

1. Payment will be at the contract unit price per linear foot.
2. Payment is full compensation for:
 - a. Purchasing manufactured linear trench drain materials.
 - b. Concrete to construct linear trench drain.
 - c. Furnishing equipment, tools, and labor to construct linear trench drain.
3. Connection to manhole, pipe, or apron is incidental to Linear Trench Drain and will not be paid for separately.

C D. Drop Connection.**D E. Casting Extension Rings.****E F. Manhole or Intake Adjustment, Minor.****F G. Manhole or Intake Adjustment, Major.****G H. Connection to Existing Manhole or Intake.****H I. Cleaning, Inspection, and Testing.****Division 25. Miscellaneous Construction.****Section 2501****2501.03, M, 1, d.**

Replace the second sentence:

With the Engineer's approval, driving may be stopped when the rate of driving exceeds ~~460~~ 120 blows per foot.

2501.03, M, 2, b, 2.

Replace the Article:

With approval from the Engineer, driving may be stopped when the rate of driving exceeds ~~460~~ 120 blows per foot.

2501.05, E, 1.

Replace the Article:

Pile cut-offs not used ~~as extensions~~ on the same contract become the property of the Contractor. Steel pile cut-offs used ~~as extensions~~ on the same contract will not be paid for as additional plan quantity.

Section 2502**2502.02, Materials.**

Add the Article:

E. Prefabricated Pavement Edge Drain (Fin Drain).**1. Core.**

Comply with the following requirements:

- Minimum compressive strength of 40 psi according to ASTM D 1621.
- Minimum flow rate of 15 gallons per minute per foot when measured under a gradient of 0.1 at a minimum compressive stress of 10 psi according to ASTM D 4716.

2. Engineering Fabric.

Meet the requirements of Article 4196.01, B, 2.

3. Inspection and acceptance will be according to Materials I.M. 442.**2502.03, A, 8.**

Replace the second and third sentences:

Drive the posts 3 feet into the ground and install 4 foot plastic sleeves over the posts. If plastic sleeves are furnished by the Contracting Authority ~~furnishes sleeves~~, install the sleeves they furnish over posts.

2502.03, C, 2.

Replace the fourth sentence:

When specified, Cover the outlet end of each subdrains with the specific outlet covering.

2502.03, C, 10.

Replace the Article:

Use trench rollers with a minimum trench wheel weight of 6000 pounds or a vibratory compactor wheel.

2502.05, C, 2.

Replace the first bullet:

Furnishing and installing precast concrete headwall or corrugated metal pipe, double walled PE, or PVC pipe including the outlet coverings, grouted joints and special connections,

Section 2503

2503.01, Description.

Add the Article:

F. Low clearance pipe is defined as either arch or elliptical pipe. Unless specified otherwise, Contractor may supply either pipe shape when low clearance pipe is specified.

2503.03, D, 2, Reinforced Concrete Pipe, Reinforced Concrete Arch Pipe, and Reinforced Concrete Elliptical Pipe.

Replace the Article:

- ~~a. Use cold applied bituminous or rubber rope gasket jointing materials unless specified otherwise.~~
 - ~~1) Apply joint material to entire tongue, or to top half of tongue and bottom half of groove, in sufficient quantity to fill the joint. Close the joint between pipes.~~
 - ~~2) Fill remaining voids in the joint, both inside and outside of pipe, with joint material. Smooth the joint material on the inside of pipes 24 inches and larger.~~
- b. If a rubber O-ring or profile gasket is specified for RCP, coat the rubber gasket and joint with soap based lubricant immediately prior to closing the joint.
- ~~c a. Wrap non-sealed joints unless otherwise specified. If wrapped pipe joint is specified, cComply with the contract documents Standard Road Plan SW-211 for pipe joint wrapping. Wrap joints with engineering fabric meeting requirements of Article 4196.01, B, 3. Secure engineering fabric in place to prevent displacement while placing backfill material.~~
- ~~d c. Place pipe such that joint openings on the outside or inside of the pipe do not exceed 1/8 inch at the bottom and 5/8 inch at the top.~~

2503.03, Construction.

Add the Article renumber following Articles:

E. Aprons.

Install pipe aprons where specified in the contract documents. Install apron guards when specified.

E F. Tolerances.**F G. Conflicts.****G H. Storm Sewer Abandonment.****H I. Connection to Existing Manhole or Intake.****I J. Cleaning, Inspection, and Testing.****2503.04, E, 1, Plug.**

Replace the Article:

~~None.~~ Each plug installed in a pipe will be counted.

2503.04, Method of Measurement.

Add the Article:

G. Aprons.

Measured according to Article 2416.04, B and 2417.04, B.

2503.05, E, Storm Sewer Abandonment.

Replace the Article:

1. Plug.

~~Plugging sanitary sewers is incidental to other work and will not be paid for separately.~~

- a. Payment will be made at the contract unit price for each plug installed.
- b. Payment is full compensation for trench excavation (if necessary), cutting pipe (if required), furnishing and placing plug materials, and placing backfill.

2. Fill and Plug.

- a. Payment will be the contract unit price per linear foot for each size of pipe filled and plugged.
- b. Payment is full compensation for trench excavation (if necessary), cutting pipe (if required), furnishing and placing pipe fill material, furnishing and placing plug materials, and placing backfill.

2503.05, Basis of Payment.

Add the Article:

G. Aprons.

Paid according to Article 2416.05, B and 2417.05, B.

Section 2504**2504.03, D, Gravity Main Pipe Jointing.**

Renumber Article 5 and **add** the Article:

5. Polypropylene Pipe.

Coat gasket and bell with lubricant immediately prior to closing joint.

5 6. Connections between Dissimilar Pipes.

- a. Use manufactured adapters or couplings approved by the Engineer.
- b. Where adapters or couplings are not available, the Engineer may authorize use of a Type PC-2 concrete collar as shown in the contract documents.

2504.03, L, 2, Visual Inspection.

Delete the Article:

~~2. Visual Inspection.~~

- ~~a. Check each section of sanitary sewer and storm sewer by lamping.~~
- ~~b. Light should be visible through section of pipe lamped.~~
- ~~c. Visually inspect each run of pipe.~~
- ~~d. Repair or replace defective pipe or joints, or remove and relay pipe not meeting alignment tolerances, as directed by the Engineer.~~

2504.03, L, 5, a.

Replace the Article:

Perform deflection tests on all PVC flexible sanitary sewer mains, excluding ductile iron pipe. Also perform deflection tests on all HDPE storm sewer or culvert pipe 12 inches in diameter or greater.

2504.04, K, 1, Plug.

Replace the Article:

~~None.~~ Each plug installed in a pipe will be counted.

2504.05, A, 1, b.

Replace the Article:

Payment is full compensation for trench excavation, dewatering, furnishing and installing pipe; pipe lining (if specified); furnishing bedding material, placing, and compacting bedding and backfill material, wyes and other fittings, pipe joints, pipe connections, testing, and inspection.

2504.05, A, 2, b.

Add as the second bullet:

- Pipe lining (if specified),

2504.05, B, 1, b.

Add as the second bullet:

- Pipe lining (if specified),

2504.05, B, 2, b.

Add as the second bullet:

- Pipe lining (if specified),

2504.05, D, 1, b.

Replace the Article:

Payment is full compensation for furnishing and installing both sanitary sewer pipe and casing pipe, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, furnishing and installing annular space fill material, casing spacers, pipe connections, testing, and inspection.

2504.05, K, Sanitary Sewer Abandonment.

Replace the Article:

1. Plug.

~~Plugging sanitary sewers is incidental to other work and will not be paid for separately.~~

- a. Payment will be made at the contract unit price for each plug installed.
- b. Payment is full compensation for trench excavation (if necessary), cutting pipe (if required), furnishing and placing plug materials, and placing backfill.

2. Fill and Plug.

- a. Payment will be the contract unit price per linear foot for each size of pipe filled and plugged.
- b. Payment is full compensation for trench excavation (if necessary), cutting pipe (if required), furnishing and placing pipe fill material, furnishing and placing plug materials, and placing backfill.

Section 2505

2505.03, A, 3, Posts.

Replace the Article:

- a. Drive posts ~~in a manner that does not damage the post~~ using a hammer driver. Ensure posts are not damaged during installation.
- b. Posts may be set in prebored holes if site conditions are such that posts cannot be driven. Place backfill material (consisting of material removed or other suitable soil) around posts ~~required to be set in prebored holes~~. Place the backfill material in lifts not exceeding 4 inches. Thoroughly compact each lift before the next lift is placed.
- b c.** Install the posts to be firm, plumb, and at the location, spacing, and elevation designated.

Section 2506

2506, Flowable Mortar

Replace the Section and title:

Section 2506. Flowable Mortar and Foamed Cellular Concrete

2506.01 DESCRIPTION.

Place a flowable mortar fill material. ~~Uses include, but are not limited to, placement under existing bridges, around or within box culverts or culvert pipes, in open trenches, or at other locations as shown in the contract documents.~~ Foamed cellular concrete may be used at the Contractor's option.

2506.02 MATERIALS.

Meet the requirements for the respective items in Division 41 with the following exceptions:

A. Cement.

Meet the requirements of Section 4101.

B. Fly Ash.

Meet the requirements of Section 4108. Use fly ash from a source approved by the Engineer.

C. Fine Aggregate.

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

| Sieve Size | Percent Passing |
|------------|-----------------|
|------------|-----------------|

| | |
|---------------------|-------------|
| 3/8 inch No. 200 | 100 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, 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). Concrete sand may require a higher amount of fly ash (400 pounds per cubic yard) and air entrainment to produce the desired flowability.

Table 2506.02-2: Informational Gradation Limits

| Sieve Size | Percent Passing |
|------------|-----------------|
| 3/8 inch | 100 |
| No. 8 | 80-100 |
| No. 16 | 60-100 |
| No. 30 | 45-80 |
| No. 50 | 12-40 |
| No. 100 | 1.5-25 |
| No. 200 | 0-5 |

3. 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.

D. Admixtures.

1. Air entraining and water reducing admixtures may be added to increase the fluidity of flowable mortar.
2. Use preformed foam meeting the requirements of ASTM C 869 for foamed cellular concrete when tested in accordance with ASTM C 796.

E. Mix Design.

1. Flowable Mortar.

- 1 a. For non critical fluidity, use the basic proportioning for flowable mortar shown in Table 2506.02-3:

Table 2506.02-3: Quantities of Dry Materials Per Cubic Yard for Non-Critical Fluidity

| | |
|----------------|-------------|
| Cement | 100 pounds |
| Fly Ash | 300 pounds |
| Fine Aggregate | 2600 pounds |

Previous or alternate mix designs may be approved by the District Materials Engineer.

- 2 b. For critical fluidity, use the basic proportioning as shown in Table 2506.02-4.

Table 2506.02-4: Quantities of Dry Materials Per Cubic Yard for Critical Fluidity

| | |
|----------------|-------------|
| Cement | 100 pounds |
| Fly Ash | 400 pounds |
| Fine Aggregate | 2600 pounds |

- a.1) Provide Engineer with mix proportions meeting requirements in Article 2506.02, F. Do not exceed 100 pounds of cement per cubic yard and a total amount of cementitious material of 500 pounds per cubic yard.
 - b.2) 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.3) 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 c. These quantities of dry materials, with approximately 70 gallons of water (mixes utilizing foundry sand may require more water), will yield approximately 1 cubic yard 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.
 - 4 d. 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.

2. Foamed Cellular Concrete.

- a. Use foamed cellular concrete with a minimum compressive strength of 100 psi.
- b. Use high density cellular concrete with a minimum of 70 pounds per cubic foot for placement under existing bridges, applications placed below water table, or in annular pipe space that cannot be dewatered. Fine aggregate may be included.
- c. Use low density cellular concrete with a minimum of 30 pounds per cubic foot for applications above water table or if no water is present in annular pipe space.
- d. Submit mix design to the DME. Include base cement slurry mix per cubic yard, expansion factor from the foaming agent, and wet density.

3. Alternate Mix Designs.

- a. When fly ash is not available, a mix design without fly ash may be submitted to the District Materials Engineer. Approval of the design will be based on a trial batch and trial placement.
- b. Mix design may include use of flowable fill admixtures or increased dosage of air entraining admixture.
- c. Meet minimum compressive strength of 125 psi.

F. Fluidity.

1. Measure the fluidity of the flowable mortar using the method described by Materials I.M. 375. Prior to filling the flow cone with flowable mortar, pass the mixture through a 1/4 inch screen.
2. In locations where fluidity is critical, such as inside existing culverts and between the beams under existing bridges, use an efflux time of 10 seconds to 16 seconds. The Engineer will measure prior to placement and at least once every 4 working hours until work is complete.
3. 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, the Engineer will visually monitor. Provide sufficient fluidity to completely fill the space and produce a level surface without manipulation after discharge.
4. Fluidity measurement is not required for foamed cellular concrete.

G. Granular Backfill Material.

For granular backfill material used under flowable mortar, meet the requirements of Section 4133. Granular backfill is not required for foamed cellular concrete.

2506.03 CONSTRUCTION.**A. Proportioning and Mixing Equipment.**

1. Use equipment meeting the requirements of Articles 2001.20 and 2001.21. Provide mixers with sufficient mixing capacity to permit the intended placement without interruption.
2. For foamed cellular concrete, use foam generating equipment capable of producing proper volume of foam and injecting foam into truck mixer drum. Alternatively, a mobile batch plant capable of mixing and pumping foamed cellular concrete to within 10% of the design density and a minimum capacity of 1 cubic yard.

B. Flange Filler Material.

When the flowable mortar is to be placed under a bridge, cover the bridge beams with a filler material, as shown in the contract documents, to fill the flange areas in a manner that will minimize intrusion of the mortar into the flange area of the beams. Construction insulation board or any other suitable material may be used.

C. Placement of Mortar under Existing Bridges.

1. First construct the shoulder area as shown in the contract documents, with the drainage system shown. Complete this work in conjunction with pipe placement, if a pipe culvert is required.
2. If a culvert is required, place engineering fabric meeting requirements of Article 4196.01, B, 2 over all joints in the culvert, within the area where flowable mortar is to be placed as backfill material. Place the fabric from the underlying ground line around the culvert, 1 foot on each side of the joint.
3. Discharge flowable mortar from the mixer by any reasonable means into the area to be filled.
4. Bring the mortar fill up uniformly to the elevation of the first stage fill line, if specified. Cease mortar placement for a period of 72 hours.
5. If there is only one stage of flowable mortar, place granular backfill material in the lower part of the fill and around the pipe as specified. Compact the granular backfill material according to Article 2402.03, H, or thoroughly and uniformly

wet with water in a quantity of approximately 10% of the granular backfill material. Complete flooding may be required. Regardless of the method of consolidation, wait 72 hours to commence flowable mortar placement.

6. Place the flowable mortar in a sequential operation from side to side and longitudinally. Begin with fill in one shoulder area, then proceed through each hole in the deck adjacent to the shoulder until mortar is expelled from the adjacent longitudinal hole. Place the last fill on the opposite shoulder. Place mortar through holes in the deck using a suitable funnel which can create a 3 foot head during filling.
7. The locations for holes in the deck will normally be shown in the contract documents. When not shown, drill a hole approximately 5 feet from each end of the bridge in each area between bridge beams. Drill additional holes as necessary so the longitudinal spacing does not exceed 20 feet. Limit the size of the holes to that necessary to accommodate filling equipment.
8. When placement of flowable mortar is completed and set, remove the mortar in the holes in the deck and replace with a suitable PCC mixture.

D. Placement of Mortar as Culvert Backfill Material.

1. First construct the shoulder area with suitable soil as shown in the contract documents, with the drainage system shown. Complete this work in conjunction with the pipe placement, if the culvert is a pipe.
2. Place engineering fabric meeting requirements of Article 4196.01, B, 2 over all joints in the culvert, within the area where flowable mortar is to be placed as backfill material. Place the fabric from the underlying ground line around the culvert, 1 foot on each side of the joint.
3. Place granular backfill material meeting requirements of Section 4133 to approximately mid-height of the culvert. Place the backfill simultaneously on both sides of the culvert so that the two fills are kept at approximately the same elevation at all times. Granular backfill material compaction is not necessary.
4. Discharge flowable mortar from the mixer into the remaining area to be filled. Fill simultaneously on both sides of the structure so that the two fills are kept at approximately the same elevation at all times.
5. If the culvert starts to float, cease the filling operation. Apply an external load to the culvert, sufficient to hold it in place, before the filling is continued. As an alternate, the filling may be suspended until the buoyancy effect of the mortar has ceased.
6. Place the flowable mortar to the elevation shown in the contract documents. When not shown, place the mortar as follows:
 - a. If the subgrade elevation is not more than 5 feet over the top of the culvert, place mortar to 1 foot below subgrade elevation.
 - b. If the subgrade is more than 5 feet over the top of the culvert, place the mortar to an elevation 2 feet over the top of the culvert. Complete the remainder of the backfill operation using soil designated by the Engineer.

E. Annular Space Grouting

1. Flowable Mortar.

Fill all voids between the liner pipe and the host culvert with flowable mortar. Staged grouting is recommended. Ensure that all voids between the liner pipe and host pipe have been filled with flowable mortar by providing 2 feet of head when filling.

2. Foamed Cellular Concrete

- a. Construct bulkheads at each end of the pipe. Ensure bulkhead is constructed to withstand pressure of grouting operation.
- b. Use grouting pressures to ensure all voids between the liner pipe and host pipe have been filled, but do not collapse or deform the liner pipe by more than 5% of the diameter. Multiple grout lifts may be necessary in accordance with pipe manufacturer's recommendations.
- c. Contractor shall check wet density at the beginning of the placement and a minimum of once every 2 hours and results will be documented by the Engineer.
- d. If grout holes are utilized, insert cylindrical wood plugs, or other approved plugs, until the grout has set. Fill holes with concrete after plugs have been removed.

E F. Limitation of Operations.

1. Do not place ~~flowable mortar~~ on frozen ground.
2. ~~Flowable mortar~~ batching, mixing, and placing may be started when the temperature is at least 34°F and rising, if weather conditions are favorable. At time of placement, mortar shall have a temperature of at least 40°F. Cease

mixing and placing when the temperature is 38°F or less and falling.

3. Complete each filling stage in as continuous an operation as practical.
4. Do not allow flowable mortar or foamed cellular concrete into streams and waterways.

2506.04 METHOD OF MEASUREMENT.

- A. The Engineer will compute the volume of Flowable Mortar furnished and placed, from the nominal volume of each batch and a count of batches. The Engineer will estimate and deduct unused mortar; however, deduction will not be made for a partial batch remaining at the completion of the operation. Foamed cellular concrete may be substituted at the Contractor's option at no additional cost to the Contracting Authority.
- B. Granular backfill material used in the lower part of the fill area for projects utilizing flowable mortar will be based on the contract document quantity.
- C. When the flowable mortar elevation for placing backfill around culverts is shown in the contract documents, payment for Flowable Mortar will be based on the quantity shown in the contract documents.

2506.05 BASIS OF PAYMENT.

- A. Payment for Flowable Mortar will be the contract unit price per cubic yard. Foamed cellular concrete may be substituted at the Contractor's option at no additional cost to the Contracting Authority.
- B. Payment is full compensation for:
 - Placing the flowable mortar or foamed cellular concrete,
 - Flange filler material,
 - Engineering fabric as required,
 - Drilling and filling the bridge deck holes, and
 - Furnishing all materials, equipment, and labor necessary to complete the work.
- C. Payment for granular backfill material used in the lower part of the fill area will be based on the quantity shown in the contract documents, and this will normally be included in the quantity of other granular backfill material on the project per Article 2402.05, G.
- D. Excavation, placing backfill material for construction of the shoulder area, and moisture control if designated necessary for this work, will be paid for separately. These items will be included in the quantities of other similar work on the project. Furnishing and placing the drainage system in the shoulder area will be considered incidental to the payment for Flowable Mortar.

Section 2510

2510.03, A, 2, c.

Delete the last sentence:

Apply Article 1105.12, H, to use of this type of equipment.

Section 2511

2511.02, B, Hot Mix Asphalt.

Replace the Article:

1. For sidewalks and recreational trails not adjacent to pavement, use 400,000-ESAL Standard Traffic (ST), 3/8 inch HMA, according to Section 2303.
2. When the recreational trail or sidewalk is adjacent to the pavement and also functions as the pavement shoulder, use 4,000,000-ESAL Standard Traffic (ST), 1/2 inch base mixture.
3. Use PG 58-28S or PG 52-34 Performance Grade binder as specified in the plans.

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 sheets for construction of curb ramps, turning spaces, and transitions. Measure or stake as required to construct features.
 - 1) Verification of form work slopes at quadrants identified in the contract documents, by using a level or other means, is required prior to placing concrete 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 ±0.5% from design slope would exceed minimum or maximum allowable slope.
- 2) If Construction Survey is not a bid item, Engineer will verify slopes of form work. If Construction Survey is a bid item, Contractor's surveyor shall verify form work slopes. If field adjustments outside the acceptable range indicated in the contract documents are necessary, notify the Engineer prior to construction.
- ~~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 c. After concrete has been poured, verify slope compliance according to Materials I.M. 363.
- e d. 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.
- f e. Install detectable warnings according to manufacturer's recommendations. Install detectable warnings for full width of curb ramp, excluding curbs and flares.

Section 2512

2512.03, C, 3.

Replace the Article:

Place forms in a manner that ensures the top face of forms curb does not vary from a true plane by more than 1/8 inch in 10 feet. Ensure the upstanding face, including any extension, does not vary from a true plane by more than 1/4 inch in 10 feet. Remove forms that are bent, twisted, warped, broken, or battered from the work. Allow Engineer to inspect and approve repaired forms before using.

Section 2513

2513.02, Materials.

Add the Article:

G. Micro Fibers.

Use 100% virgin polypropylene, fibrillated fibers complying with Materials I.M. 491.27.

2513.03, A, 2, b.

Replace the Article:

Submit Class BR mix design to the District Materials Engineer for approval at least 7 calendar days prior to placement. Apply Section 2403, except meet the following mix design requirements:

- 1) **Water.** Do not exceed Table 2513.03-2 for total mixing water and free moisture in the aggregate. ~~Minimum slump is 1/2 inch.~~

Table 2513.03-2: Mixing Water and Free Moisture

| Class of Concrete | Pounds of Water Per Pound of Cementitious Material |
|-------------------|--|
| BR (Slip Form) | 0.450 |
| C (Cast-in-Place) | 0.488 |

- 2) **Aggregates for Class BR.** Use a well graded combination of aggregates complying with Materials I.M. 532 in Zone II-A or II-B. Meet quality requirements in Division 41 for each individual aggregate used.
- 3) **Admixtures.** Use air entrainment. Use 7% as a target value for the air content of fresh, unvibrated concrete, with a maximum variation of plus 1.5% or minus 1.0%. To improve workability and aid in air entrainment, water reducing or retarding admixtures may be used according to Article 2513.02, C. Target air may be adjusted by the Engineer based on random tests of consolidated concrete behind slip form machine. These additional random tests will be used to consider the need for a target change, and will not be used in the acceptance decision.
- 4) **Fly Ash and GGBFS.** Use the conditions and allowable rates of fly ash and GGBFS substitution in Table 2513.03-3:

Table 2513.03-3: Fly Ash and GGBFS Substitution

| Cement Type | Maximum Allowable Substitution ^(a) | Time Period |
|-------------|---|------------------------|
| Type I, II | 35% GGBFS 20% Fly Ash | March 16 to October 15 |
| Type IS, IP | 20% Fly Ash | March 16 to October 15 |
| Type I, II | 20% Fly Ash | October 16 to March 15 |

| | | |
|--|----|------------------------|
| Type IS, IP | 0% | October 16 to March 15 |
| (a) Maximum total mineral admixture substitution is 50%. | | |

- 5) **Micro Fibers.** For slip form, Contractor may use synthetic fibers at an addition rate and using batching recommendations provided by manufacturer.

2513.03, F, 1.

Replace the Article:

For permanent precast and cast-in-place concrete barrier, apply Article 2419.03, I 2403.03, P, 2, b, except do not commence the finishing operation until completion of the initial wet cure period.

Section 2517

2517.02, B, HMA Paving Projects.

Replace the title and Article:

B. HMA Hot Mix Asphalt Paving Projects.

Use an High Traffic (HT) HMA surface mixture that is one mix level above the approaching surface course. Use asphalt binder meeting or exceeding PG 64-22S asphalt binder.

Section 2518

2518, Safety Closure.

Delete the Section:

2518.01 DESCRIPTION.

This section concerns Safety Closures erected as specified in the contract documents. Two types of safety Closures will be specified: Road Closures and Hazard Closures.

2518.02 MATERIALS.

Use orange mesh safety fence meeting the requirements of Article 4188.03.

2518.03 CONSTRUCTION.

A. Erection.

1. Road Closures.

- a. Place a fence meeting the requirements of Article 2518.02 across the roadway from outside edge of shoulder to outside edge of shoulder. Securely support the fence so it is in a vertical position without sagging.
- b. Place a Type III barricade, described in Part 6 of the MUTCD, immediately in front of the fence at the approximate roadway centerline. Mount a ROAD CLOSED (R11-2) sign on the Type III barricade.
- 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. 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.
- 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.
- e. Erect road closures beginning with the start of the contract period as specified in the contract documents, or when the work commences.

2. Hazard Closure.

- a. Place a fence meeting the requirements of Article 2518.02 across the roadway from outside edge of shoulder to outside edge of shoulder. Securely support the fence so it is in a vertical position without sagging.
- b. Place a Type III barricade, described in Part 6 of the MUTCD, immediately in front of the fence at the approximate roadway centerline.
- 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.
- 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.

- e. ~~Erect hazard closures beginning with the start of the contract period as specified in the contract documents, or when the work commences.~~

B. ~~Responsibility.~~

1. ~~Maintain the location and condition of the safety closures. Any Contractor who temporarily moves the safety closure for equipment or delivery of materials, shall replace it in its original position and is responsible for the restriction of public traffic into the closed area.~~
2. ~~If a safety closure placed by the Contractor is required for an area after the Engineer's approval of completed work for that specific area, maintenance of that safety closure will become the responsibility of the Contracting Authority. The Engineer will document in writing the transfer of authority.~~
3. ~~The Engineer will notify the Contractor of the date of removal of safety closures. The safety closure remains the property of the installing Contractor. If the safety closure is not removed by the date specified in the notification, it will become the property of the Contracting Authority and the Contractor will be charged for any removal costs.~~

2518.04 METHOD OF MEASUREMENT.

The Engineer will count each Safety Closure (either road closure or hazard closure) erected.

2518.05 BASIS OF PAYMENT.

- A. ~~Payment will be the contract unit price for each Safety Closure counted.~~
- B. ~~Payment is full compensation for furnishing all material, labor, and equipment necessary to erect, maintain, and remove the Safety Closure, unless indicated otherwise in the contract documents.~~

Section 2520

2520.03, A, 1, General.

Replace Article k:

A microwave, laboratory stove, or stoves with hoods vented to an exhaust fan.

Replace Article n:

~~Wireless connectivity.~~ Provide a device to allow multiple inspectors to access the internet wirelessly, such as a mobile hotspot. Provide a minimum of 3 10 GB of data usage monthly. This device will be considered a part of the field laboratory and shall stay with the field laboratory. If the field laboratory and field office are located adjacent to each other, one device may be adequate to cover both, so long as the signal can be accessed from both trailers. The Contracting Authority will pay data charges for usage above the monthly minimum.

Section 2522

2522.03, E, Lighting Tower.

Replace the first sentence:

Ensure the structural design of the tower and its appurtenances meet the requirements of AASHTO 2013 "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.

Replace the title and Article:

Wind Velocity Speed.

Use a design wind velocity (V) of 90 mph basic wind speed (3 second gust) with a 50 year mean recurrence interval for strength design. ~~Fatigue requirements shall be Category I with 2nd second mode vortex shedding included.~~ Use HMLT Category I with yearly mean wind velocity of 11 mph for fatigue design.

2522.03, E, 4, Anchor Bolts, Washers, and Nuts.

Replace the title and Article:

Anchor Bolts, Nuts, and Washers, and Nuts.

- a. ~~Ensure galvanizing for anchor bolts, washers, and nuts meets the requirements of ASTM F 2329 with zinc temperature bath limited to 850°F; or ASTM B 695, Class 55, Type I Coating.~~
- b. ~~Furnish each anchor bolt with one leveling nut, and two one anchoring nuts, and one jam nut on the exposed end and one of the following on the embedded end: nut, nut and plate, or nut and anchor bolt assembly ring plate. Use anchor~~

bolts, nuts, and washers that: ~~meet the requirements of~~ comply with Materials I.M. 453.08. ~~Anchor bolts shall be ASTM F 1554, Grade 105.~~ Meet the following requirements:

a. Anchor Bolts.

- 1) Use full-length galvanized bolts.
- 2) Comply with ASTM F 1554, Grade 105, S4 (-20°F).
- 3) Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A tolerance.
- 4) The end of each anchor bolt intended to project from the concrete is to be color coded to identify the grade.
- 5) Do not bend or weld anchor bolts.

b. Nuts.

- 1) Comply with ASTM A 563, Grade DH or ASTM A 194, Grade 2H.
- 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.
- 5) Refer to Articles 2522.03, H, 2, b through h for tightening procedure and requirements.

c. Washers.

Comply with ASTM F 436 Type 1.

d. Galvanizing.

Galvanize entire anchor bolt assembly consisting of anchor bolts, nuts, and washers (and plates or anchor bolt assembly ring plate, if used) according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F. Galvanize entire assembly by the same zinc-coating process, with no mixed processes in a lot of fastener assemblies.

2522.03, E, 7, b.

Replace the second and third bullets:

- ~~Radiographically inspect 100% of the full penetration sections of the longitudinal seam weld at the base plate connection location~~ the full length of all full-penetration sections of longitudinal seam welds on all tower poles, and
- Use the magnetic particle method to inspect ~~a random 10% of the partial penetration section of the longitudinal seam welds.~~ the partial-penetration section of longitudinal seam welds as follows: Inspect a random 25% of all tower poles, inspecting 4 inches in every 4 feet of weld length, starting from the connection end. If there are fewer than four tower poles, at least one pole shall be randomly selected.

2522.03, G, 1, a.

Replace the Article:

Ensure the luminaire frame and head frame assembly meet the requirements of ASTM A 709 Grade 50 36. For the purpose of Charpy V-notch toughness requirements, all steel ~~required to be ASTM A 709 Grade 50~~ used for the luminaire frame and head frame assembly shall meet impact requirements specified in Article 4152.02. Miscellaneous appurtenant steel components may be constructed using ASTM A 709 Grade 36 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.

Section 2523

2523.02, B.

Replace the Article:

Use cast-in-place concrete meeting the requirements of Section 2403 or precast materials meeting Section 2419.

2523.02, Materials.

Add the Articles:

- D. Use uncoated reinforcing steel complying with Article 4151.03. All reinforcing steel shall be Grade 60.
- E. For drilled-shaft foundations, comply with Articles 2433.01, 2433.02, 2433.03, A and 2433.03, C through I.

2523.03, G, Foundations.

Replace the Article:

1. Construct cast-in-place concrete foundations for all lighting units not located on structures or barriers. Form and pour the top portion of all foundations in form work to at least 6 inches below the finished ground level. Precast foundations may be installed if allowed by the Engineer.
2. Ensure foundations conform 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 on all sides of finished foundation.

- 2 3. Ensure finished surfaces are smooth and free from stains and foreign material.
- 3 4. Construct or install an alternate foundation, as directed by the Engineer, when shale, sandstone, broken or shattered rock, solid rock, or other similar materials are encountered.
- 4 5. 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.
6. When precast foundations are used, drill the hole a minimum 1 foot larger than the diameter of the foundation. Leave bottom of hole as undisturbed as possible. If caving soil or groundwater is present, remove prior to placing foundation. Place backfill consisting of Class B concrete.

Section 2524

2524.03, A, 1, Traffic Signs.

Replace the Article:

- a. Except as modified by the contract documents, fabricate signs according to the standards established in the Standard Highway Signs, 2004 edition, and 2012 Supplement as published by the US DOT.
- b. All traffic signs, except ~~milepost markers~~ reference location signs and 6 inch by 6 inch route markers, are classified into two groups, Types A and B, as indicated in the contract documents.
 - 1) **Type A Signs.**
 - a) Comply with the following:
 - Aluminum, galvanized steel, ~~or when specifically specified,~~ plywood sheets mounted on wood posts, or ~~steel breakaway posts~~ perforated square steel tubing.
 - Sign face material fabricated from reflective sheeting.
 - Sign legends accomplished with either the direct or reverse silk screen process, ~~or with black nonreflective sheeting that is direct applied,~~ or transparent film, as approved for use by the retro reflective sheeting manufacturer.
 - b) Ensure the finished signs comply with the details specified in the contract documents.
 - 2) **Type B Signs.**
 - a) Comply with the following:
 - Extruded aluminum highway sign panels mounted on either wood posts, perforated square steel tubing, or steel breakaway posts as specified in the contract documents.
 - Sign face material fabricated from reflective sheeting.
 - Sign legends accomplished through use of reflectorized or nonreflectorized letters, numerals, symbols, and borders that are direct applied.
 - b) Ensure the finished signs comply with the details specified in the contract documents.
 - c) Prior to fabrication, submit shop drawings for each Type B sign according to Article 1105.03. Each drawing is to be a scale drawing of the sign face, showing the size, arrangement, and spacing of all letters, numerals, symbols, and borders.
- c. Digital printing shall comply with the following:
 - Sign manufacturer shall be certified for digital printing by the retro reflective sheeting manufacturer.
 - All digital printing shall be done in a workmanlike manner and as recommend by the manufacturer of the retro reflective sheeting.
 - Appropriate manufacturer's recommended overlamine films must be used in digital printing. Any noticeable deviation from the shades shall be cause for rejection of any sign.
 - Opaque or transparent inks shall be of the type and quality recommended by the manufacturer of the retro reflective sheeting.
 - A matched component system, recommended by the manufacturer shall be used in the digital printing process.

2524.03, A, 2, Milepost Markers.

Replace the title and Article:

Milepost Markers Reference Location Signs.

- a. Comply with the following:
 - Green reflectorized sheeting on flat aluminum or galvanized steel sheets as for Type A signs.
 - Reflectorized white message applied directly to the face material.
 - Dimensions as specified in the contract documents.
- b. Mount ~~milepost markers~~ reference location signs on posts of the type specified for delineators.
- c. Prior to fabrication, submit shop drawings for each reference location sign according to Article 1105.03. Each drawing is to be a scale drawing of the sign face, showing the size, arrangement, and spacing of all letters, numerals, symbols, and borders.

2524.03, A, 4, b.

Replace the Article:

Mount above ~~milepost markers~~ reference location signs on the same delineator post.

2524.03, B, Erection of Signs, Reference Location Signs, and 6 Inch by 6 Inch Route Markers.

Replace the title:

Erection of Signs, ~~Milepost Markers~~ Reference Location Signs, and 6 Inch by 6 Inch Route Markers.

2524.03, B, 2, Delineators, Milepost Markers, and 6 by 6 Inch Route Markers.

Replace the title and Article:

Delineators, ~~Milepost Markers~~ Reference Location Signs, and 6 Inch by 6 Inch Route Markers.

- a. Drive the posts for delineators, ~~milepost markers~~ reference location signs, and 6 inch by 6 inch route markers. Provide a suitable driving cap. Attach signs and delineators after driving.
- b. Erect markers and delineators so that the signs and delineator reflectors will be at elevations called for in the contract documents. Ensure they are true to line and grade and are truly vertical. Where a ~~milepost marker~~ reference location sign is designated, attach the marker in place of a delineator. Where a 6 inch by 6 inch route marker is designated, attach it above the ~~milepost marker~~ reference location sign on the same post.
- c. Ensure delineator posts for these signs are plumb and firm in the ground, spaced as shown in the contract documents, and driven to the required lines and grades. Ensure that after driving, the top of the post has substantially the same cross section dimensions as the body of the post. Battered heads will not be permitted. Remove from the site and replace (at no additional cost to the Contracting Authority) all posts which are bent or otherwise damaged to the extent that they are, in the Engineer's opinion, unfit in the finished work.

2524.04, F, Delineators, Milepost Markers, and 6 by 6 Inch Route Markers.

Replace the title:

Delineators, ~~Milepost Markers~~ Reference Location Signs, and 6 Inch by 6 Inch Route Markers.

2524.05, F, Delineators, Milepost Markers, and 6 by 6 Inch Route Markers.

Replace the title and Article:

Delineators, ~~Milepost Markers~~ Reference Location Signs, and 6 Inch by 6 Inch Route Markers.

1. **Delineators and ~~Milepost Markers~~ Reference Location Signs:**
 - a. Each for the various types.
 - b. Payment is full compensation for:
 - Furnishing, fabricating, and erecting the delineators or ~~milepost markers~~ reference location signs complete, including posts, reflector units, and frames for delineators, posts and ~~milepost marker signs~~ reference location signs,
 - Furnishing all necessary fittings and attachments, and
 - All labor necessary to complete the work.
2. **6 inch by 6 inch Route Markers:**
 - a. Each.
 - b. Payment is full payment for furnishing, fabricating, and erecting the route marker to a ~~milepost marker post~~ reference location sign previously measured for payment, including all necessary fittings and attachments and all labor necessary to complete the work.

2524.05, I, Excavation in Unexpected Rock.

Replace the first sentence:

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~~ reference location signs will be paid for as extra work in Article 1109.03, B.

Section 2525

2525, Traffic Signalization.

Replace the Section:

2525.01 DESCRIPTION.

This section was developed in conjunction with Section 8010 of the SUDAS Standard Specifications, with modifications to suit the needs of the Department.

- A.** This section includes furnishing of material and equipment necessary to complete, in place and operational, traffic control signal(s) as described in the contract documents, including:
- Underground,
 - Detection,
 - Communications,
 - Cabinet and Controller, and
 - Poles, Heads, and Signs.
- B. Submittals:** Submit applicable brochures, technical data, catalogs, cuts, diagrams, manufacturer's drawings and installation instructions, samples if required, and other descriptive data including the complete description, trade name, model number, type, size, and rating, as well as the additional requirements listed below. Submit according to Article 1105.03.
1. **Schedule of Unit Prices:** Submit a completed schedule of unit prices. Estimates of the work performed on the project will be made by the Engineer and the unit costs will be used to prepare progress payments to the Contractor.
 2. **Material and Equipment List:** Submit a completed list of materials and equipment to the Engineer for written approval before any equipment or materials are ordered.
 3. **Contractor Certification:** Submit name(s) and contact information of the IMSA Level II Certified Traffic Signal Technician(s) working on the project and a copy of their IMSA certificate.
 4. **Shop Drawings/Catalog Cuts:** Submit PDF shop drawings file for traffic signal poles and structures to be furnished on the project. Submit single PDF of catalog cuts files and list manufacturer's specifications for all items in the equipment list contract documents.
 5. **Fiber Optic Cable:** Submit a splicing schematic.
- C. Special Requirements:**
1. Comply with the MUTCD.
 2. Electrical equipment complying with current NEMA requirements.
 3. Ensure materials and work conform to current NEC and IMSA requirements.

2525.02 MATERIALS.

Apply Section 4189.

2525.03 CONSTRUCTION.

A. Underground.

1. **Handhole.**
 - a. **Locations.**
 - 1) Do not construct in ditch bottoms, low areas where ponding of water may occur, or where they will be subject to normal vehicular traffic.
 - 2) With Engineer approval, additional handholes may be placed, at no additional cost to the Contracting Authority, to facilitate the work.
 - b. **Excavation:** Excavate as necessary to accommodate the handhole and granular base.
 - c. **Granular Base:** Install 8 inch thick granular base extending a minimum of 6 inches beyond the outside walls of the handhole.
 - d. **Placement.**
 - 1) In paved areas, install the handhole at an elevation so the casting is level and flush with the pavement. In unpaved areas, install the handhole approximately 1 inch above the final grade.
 - 2) Verify ring placement. Invert rings when installed in paved areas.
 - e. **Conduit.**
 - 1) Remove knockouts as necessary to facilitate conduit entrance.
 - 2) Extend conduit into the handhole, through a knockout, approximately 2 inches beyond the inside wall. Conduit to slope down and away from the handhole.
 - 3) Place non-shrink grout (complying with Materials I.M. 491.13) in the opening of the knockout area after placement of conduit.
 - f. **Cable Hooks:**
 - 1) Install cable hooks centered between the knockouts and the top of the handhole.
 - 2) Place non-shrink grout (complying with Iowa DOT Materials I.M. 491.13) in the opening around the hook after placement of the hook.
 - g. **Backfill:** Place suitable backfill material according to Section 2552.

- h. **Casting:** Place the casting on the handhole. Ensure the final elevation meets the handhole placement requirements.

2. Conduit.

a. General.

- 1) Place conduit to a minimum depth of 30 inches and a maximum depth of 60 inches below the gutterline, unless utility conflicts require deeper placement. When conduit is placed behind the curb, place to a minimum depth of 24 inches and a maximum depth of 48 inches below top of curb.
- 2) Change direction at handholes or by bending, such that the conduit will not be damaged or its internal diameter changed. Ensure bends are uniform in curvature and the inside radius of curvature of any bend is no less than six times the internal diameter of the conduit.
- 3) On the exposed ends of conduit, place bell-end fittings on PVC or HDPE conduit and bushings on steel conduit prior to installing cable. Extend all conduits a minimum of 2 inches and a maximum of 4 inches above the finished surface of any footing or structural base.
- 4) When it is necessary to cut and thread steel conduit, do not allow exposed threads. Ensure conduits and fittings are free from burrs and rough places. Clean, swab, and ream conduit runs before cables are installed. Use nipples to eliminate cutting and threading where short lengths of conduit are required. Coat damaged galvanized finish on conduit with zinc rich paint. Use only galvanized steel fittings with steel conduit.
- 5) Install duct plugs in conduit ends or Ppack conduit ends with a conduit sealing compound.
- 6) Install pull tape in each conduit segment, including empty conduits, and secure to duct plugs at each end.

b. Trenched Installation.

- 1) Place backfill in layers not to exceed 12 inches in depth with each layer thoroughly compacted before the next layer is placed. Ensure backfill material is free of cinders, broken concrete, or other hard or abrasive materials.
- 2) Remove all surplus material from the public right-of-way as soon as possible.

c. Trenchless Installation.

- 1) When placing conduit under pavements, use the trenchless installation methods described in Section 2553.
- 2) If trenchless methods that compact soils in the bore path are used, provide sufficient cover to prevent heaving of overlying paved surfaces.
- 3) Do not allow pits for boring to be closer than 2 feet to the back of curb, unless otherwise specified in the contract documents.

3. Wiring and Cable.

- a. Where practical, follow color codes so that the red insulated conductor connects to the red indication terminal, yellow to yellow, and green to green. Ensure cables are properly labeled at the controller by durable labels, or other appropriate methods, attached to the cables. Label home runs for cables as follows: northwest corner is red, southeast corner is blue, northeast corner is green, and southwest corner is orange.
- b. Install continuous runs of vehicle and pedestrian signal cables from the vehicle or pedestrian signal head to the handhole compartment of the signal pole base. Install continuous runs of vehicle and pedestrian signal cables from the handhole compartment of the signal pole base to the terminal compartment in the controller cabinet. Do not splice signal cables in underground handholes.
- c. Install continuous runs for video detection and emergency vehicle preemption cables from the unit to the controller cabinet.
- d. Install continuous runs of power lead-in cables from the service point to the meter socket and from the meter socket to the controller cabinet.
- e. Install continuous detector cable from each detector loop to the first handhole adjacent to the loop. Ensure cables are properly labeled at the controller by durable labels, or other appropriate methods, attached to the cables. Install continuous homerun cable from the splice made in the first handhole to the terminal compartment in the controller cabinet. Attach the drain wire of the shielded cable to the ground in the controller cabinet.
- f. Provide a minimum of 4 feet of additional cable at each handhole and loosely coil the extra cable on the handhole cable hooks. Provide a minimum of 2 feet of additional cable at each signal pole (measured from the handhole compartment in the pole to the end of the cable). Provide a minimum of 10 feet of additional cable at each controller base. For fiber optic cable, coil the specified length in a wheel shape and hang vertically.
- g. Pull cables through conduit using a cable grip designed to provide a firm hold upon the exterior covering of the cable or cables, and minimize dragging on the ground or pavement.
- h. Install a tracer wire in all conduits with the exception of conduits between detector loops and handholes. Use a silicon-filled wire nut to splice the tracer wire in each handhole and at the controller to form a continuous run.
- i. **Fiber Optic Cable and Accessories.**
 - 1) Use a suitable cable feeder guide between the cable reel and the face of the conduit to protect the cable and guide the cable directly into the conduit off the reel. During the installation, carefully inspect cable jacket for defects. If defects are found, notify the Engineer prior to any additional cable being installed. Take care when pulling the cable to ensure the cable does not become kinked, crushed, twisted, snapped, etc.
 - 2) Attach a pulling eye to the cable and use to pull the cable through the conduit. Use a pulling swivel to preclude twisting of the cable. Lubricate cable prior to entering the conduit with a lubricant recommended by the manufacturer. Use dynamometer or break away pulling swing to ensure the pulling tension does not exceed the specified force of 600 pounds or the cable manufacturer's recommendations, whichever is less.

- Do not allow the cable to twist, stretch, become crushed, or forced around sharp turns that exceed the bend radius or scar or damage the jacket. Manually assist the pulling of the cable at each pull point.
- 3) Do not pull cable through any intermediate junction box, handhole, pull box, pole base, or any other opening in the conduit unless specified in the contract documents. Install cable by pulling from handhole or controller cabinet to the immediate next downstream handhole or cabinet. Carefully store the remaining length of cable to be installed in the next conduit run(s) in a manner that is not hazardous to pedestrian or vehicular traffic, yet ensures that no damage to the cable occurs. Storage methods are subject to Engineer approval.
 - 4) At each handhole, visibly mark or tag cable, "CITY (or COUNTY) FIBER OPTIC"
 - 5) Secure cables inside controller cabinet so that no load is applied to exposed fiber strands.
 - 6) Ensure the radius of the bend for static storage is no less than ten times the outside diameter of the cable, or as recommended by the manufacturer. Ensure the radius of the bend during installation is no less than 15 times the outside diameter of the cable, or as recommended by the manufacturer.
 - 7) Provide cable slack in each handhole, junction box, and cabinet as specified in the contract documents. Where handholes or junction boxes lack sufficient area for cable storage or bend radius requirements, provide equivalent slack in adjacent facilities. Coil and bind slack cable at three points around the cable perimeter and support in its static storage position.
 - 8) Install fiber optic accessories according to the manufacturer's recommendations and as specified in the contract documents.
- j. **Fiber Optic Cable Field Testing:** Provide for each fiber strand both on-reel testing prior to installation and final testing after installation using a high-resolution optical time domain reflectometer (OTDR). Conduct measurements for single-mode fibers at 1310 \pm 30 nanometer and 1550 nanometer wavelengths. Conduct measurements for multimode fibers at 850 \pm 30 nanometer wavelength. Record the identification, location, length, and attenuation measurements of each fiber, and furnish test reports to the Engineer. Replace any cable that fails testing, at no additional cost to the Contracting Authority.
- 1) **On-reel Testing:** Perform testing for attenuation and continuity using OTDR and a pigtail splice. Complete testing in one direction only. Acceptable test results will be within \pm 3% of factory-supplied attenuation measurements. Except for access to and test preparation of one end of the newly furnished cable, preserve the cable in its originally-shipped condition. Furnish test reports to the Engineer prior to installation.
 - 2) **Cable Segment Testing:** Perform an end-to-end attenuation test of each terminated fiber of each fiber optic cable. Perform testing using hand-held optical test sets. Include test results in documentation package provided to the Engineer at the conclusion of the project. Acceptable test results will not exceed the cumulative specified losses of the components. For example, at 850 nanometers, a one-kilometer multimode fiber link with two splices and a connector on each end will not exceed 5.6 dB:

| | |
|----------------------------|--------|
| 1.0 km x 3.5 dB/km: | 3.5 dB |
| 0.3 dB per splice x 2: | 0.6 dB |
| 0.75 dB per connector x 2: | 1.5 dB |
| Maximum allowable loss: | 5.6 dB |

- Repair or replace any cable segment that fails testing. Retest any repaired or replaced cable. Submit complete documentation of test results to the Engineer (hard copy or electronically).
- 3) **Final System Testing:** After complete fiber optic system is installed and terminated, but prior to capping unused fibers, perform OTDR readings on all cables to ensure that each section is in compliance with the specifications. Provide copies of OTDR trace signatures for all fibers for all cable sections to the Engineer. Also provide test results for attenuation test for the installed fibers using the insertion loss procedure and the transmitter/receiver power level test and the continuity test.
 - 2) Post installation, test 100% of the new cables' fiber count bi-directionally with an OTDR at 1310 nm and 1550 nm; in addition, use an optical loss test set (OLTS) to test all fibers at both wavelengths. Also test existing fibers that are spliced to or re-spliced as part of this contract in both directions and at both wavelengths. Provide the Engineer with up to five copies of any software required for viewing electronic files of the OLTS and OTDR traces. Use test equipment equal to EXFO FTB-500 OTDR meter, and Fluke DTX-CLT OLTS meter.
 - 3) Ensure all test equipment has been factory certified within the last year. Provide copies of the certification 10 days prior to testing.
 - 4) Record test results through the meter manufacturer's software with data compiled in a PDF. Additional alteration using software beyond the meter manufacturer's software will not be allowed. Submit test results in a format approved by the Engineer. Provide completed test forms on each fiber to the Engineer. Also provide native test (electronic version) with no alterations and meter software for viewing of fiber traces. At a minimum, ensure test results show the following:
 - Cable and fiber identification (as approved by the Engineer)
 - Operator name
 - Date and time
 - Setup and test parameters including wavelength, pulse width, range, scale, and ambient temperature.
 - Test results for OTDR test in both directions for total fiber trace, splice loss/gain (dB), connector loss (dB), all events greater than 0.05 dB, measured length from cable markings, and total length from OTDR.

- Test results for attenuation test including measured cable length (cable marking), total length (from OTDR test), number of splices (from as-built) and total link end-to-end attenuation in each direction, and the bidirectional average.
- 5) Ensure OTDR testing uses launch and receiving cables minimum 3300 feet or greater than the dead zone for the OTDR used for this test.
 - 6) Ensure all fiber connectors are cleaned and checked for dirt, scratches, or chips before installed in adapters and testing. Install all dust covers after testing is complete.
 - Ensure the fiber optic cable has a maximum attenuation of 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm when measured with an OLTS.
 - Ensure each connector has an averaged loss value of 0.25 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm.
 - Ensure each splice has an averaged loss value of 0.08 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm.
4. **Footings and Foundations.**
- a. **Excavation:** Excavate to the size, shape, and depth specified in the contract documents. Ensure the bottom of all foundations rest securely on firm undisturbed soil. Minimize over-excavation to ensure support and stability of the foundation. Notify the Engineer immediately if high water and/or poor soils are encountered during excavation. Provide circular forms if needed at no additional cost to the Contracting Authority.
 - b. **Footing Foundation:** Provide a means for holding all of the following elements rigidly in place while the concrete is being placed.
 - 1) **Forms.**
 - a) Set the forms level or sloped to meet the adjacent paved areas.
 - b) When adjacent to paved areas, shape the top 11 inches of the footing to be square and flush with the surrounding paved area. Provide preformed expansion material between the footing and paved areas.
 - c) When installed in an unpaved area, set the top of the footing 2 inches above the surface of the ground.
 - 2) **Reinforcing Steel:** Install reinforcing steel.
 - 3) **Conduit:** Install conduit.
 - 4) **Anchor Bolts.**
 - a) Set anchor bolts using a template constructed to accommodate the specified elevation, orientation, and spacing according to the pole and controller manufacturer's requirements.
 - b) Center the pole anchor bolts within the concrete footing.
 - c) Protect the anchor bolts until poles are erected.
 - d) Orient controller footing with the back of the cabinet toward the intersection such that the signal heads can be viewed while facing the controller, unless otherwise directed by the Engineer.
 - 5) **Concrete.**
 - a) Place concrete to form a monolithic foundation. Consolidate concrete by vibration methods.
 - b) Finish the top of the base level and round the top edges with an edging tool having a radius of 1/2 inch. Provide a rubbed surface finish on the exposed surface of the footing.
 - c) Allow the footings to cure a minimum of 4 days prior to erecting the poles and 7 days prior to installing the mast arms. Times may be shortened if supported by strength test results.
 - c. **Backfill:** Place suitable backfill material according to Section 2552.
5. **Bonding and Grounding.**
- a. Ensure the traffic signal installation is grounded as required by the National Electric Safety Code.
 - b. Install a ground rod at each signal pole and controller footing.
 - c. Use PVC conduit within the footing to accommodate the connection between the top of the footing and the ground rod.
 - d. Bond poles to ground rods with copper wire. Connect ground wires to ground rods with approved mechanical connectors.
 - e. Bond rigid steel conduit ends in handholes with copper wire and approved fittings.

B. Detection.

1. Detector Loop Cable Installation.

- a. Coordinate the location of the detector loop with the Engineer. Obtain the Engineer's approval prior to cutting the pavement.
- b. Saw to ensure proper depth and alignment of the slot. Make a 2 inch deep clean, straight, well-defined 3/8 inch wide saw cut without damage to adjacent areas. Overlap the saw cuts where the detector loop changes direction to provide full depth at all corners. Do not use right angle or corners less than 90 degrees. Minimize crossing the number of pavement joints where possible. Route the sawcut from the loop to the edge of pavement perpendicular to the flow of traffic, maintaining at least 1 foot of clearance from parallel joints.
- c. Before installing the detector loop cable, check the saw cuts for the presence of jagged edges or protrusions and remove if present. Clean and dry the saw cuts to remove cutting dust, grit, oil, moisture, or other contaminants. Clean by flushing with a stream of water under pressure. Use oil-free compressed air to dry the saw cuts.
- d. Install detector loop cable without damage. Place three turns of the detector loop cable into the saw cut. Seal the ends of the tubing at the time of placement to prevent entrance of moisture.

- e. Ensure the detector loop cables are in the bottom of the saw cut. Place detector loop sealant within the saw cut area. Comply with the manufacturer's instructions for mixing and using the detector loop sealant.
- f. Install preformed loop detector according to the manufacturer's recommendations.
- g. Identify each detector loop cable in the handhole by phase and location. Wind loops that are physically adjacent in an individual lane or adjacent lanes with opposite rotation (i.e. No. 1 clockwise, No. 2 counter-clockwise, No. 3 clockwise, etc.). Rotation reversal can be accomplished by reversing leads at the handhole.
- h. Twist, with at least five turns per foot, all lengths of loop wires and tubing that are not embedded in the pavement.
- i. Identify all detector loop lead-in cables with appropriate detector numbers.
- j. Use a detector loop cable splice kit for the electrical splice between the detector loop cable and the detector loop lead-in cable to the controller.
 - 1) Ensure splice kit provides a watertight protective covering for the spliced wire, the shielding on the detector loop lead-in cable, and the end of the tubing containing the detector loop cable.
 - 2) Use a manufactured electrical splice kit approved by the Engineer.
- k. Test all loops and document by using the following procedures:
 - 1) Determine the insulation resistance of the loop wire using a "megger" with 500V applied to either loop wire to earth ground. The resistance is to be greater than 100 megohms.
 - 2) Determine the inductance of the loop using a loop inductance meter.

2. Pedestrian Push Button Detectors.

- a. Install according to the manufacturer's recommendations.
- b. Seal the wire entrance into the pedestrian push button assembly.

3. Video Detection Camera System: Install according to the manufacturer's recommendations and as specified in the contract documents.

4. Wireless Magnetic Sensors (Pod/Puck): Install according to the manufacturer's recommendations.

C. Communications.

1. **Traffic Monitoring System:** Install according to the manufacturer's recommendations and as specified in the contract documents, as well as the following:
 - a. Position camera dome on the pole as directed by the Engineer.
 - b. Test installed system under the supervision of the Engineer, and certify as fully-functional.
2. **Fiber Optic Hub Cabinet:** Install according to the manufacturer's recommendations and as specified in the contract documents.

D. Cabinet and Controller.

1. **Controller, Cabinet, and Auxiliary Equipment.**
 - a. Install according to the manufacturer's recommendations and as specified in the contract documents.
 - b. Install on pre-placed caulking material on the concrete base. After the cabinet is installed in place, place caulking material around the base of the cabinet.
2. **Controller and Auxiliary Equipment:** Install according to the manufacturer's recommendations and as specified in the contract documents.
3. **UPS Battery Backup System:** Install according to the manufacturer's recommendations and as specified in the contract documents. Provide service outlet that is not connected to the battery backup system.
4. **Emergency Vehicle Preemption System:** Install according to the manufacturer's recommendations and as specified in the contract documents.

E. Poles, Heads, and Signs.

1. **Vehicle and Pedestrian Traffic Signal Heads.**
 - a. Inspect each signal head assembly while still on the ground for the following:
 - Physical defects
 - Visor type
 - LED wattage
 - Lens orientation
 - Wiring connections
 - b. Attach signal head mounting hardware according to the manufacturer's recommendations. Apply anti-seize compound to all mechanical fasteners.
 - c. Adjust each signal head both vertically and horizontally to approximate a uniform grade of all like signal heads.

- d. During the course of construction and until the signals are placed in operation, cover signal faces or turn away from approaching traffic. ~~When ready for operation, plumb and aim the heads. Confirm placement of signal heads with the Engineer.~~

2. **Traffic Signal and Pedestal Poles and Pedestrian Push Button Posts.**

- a. Erect all poles ~~and posts~~ vertically under normal load.
- b. Securely bolt the bases to the cast-in-place concrete foundations using the procedures in Articles 2522.03, H, 2, a through h.
- ~~1) Mast Arm Poles: Provide footing type (A through F) as specified in the contract documents. Level by using two nuts on each anchor bolt or according to the manufacturer's recommendations.~~
 - ~~2) Pedestal Poles: Level by using metal shims and one nut on each anchor bolt or according to the manufacturer's recommendations.~~
 - ~~3) Pedestrian Push Button Posts: Weld the post to the base plate using a minimum 3/16 inch weld. Level by using two nuts on each bolt.~~
- c. Use a torque wrench to verify that a torque at least equal to the computed verification torque, T_v , is required to additionally tighten the top nuts. An inability to achieve this torque shall be interpreted to indicate the threads have stripped and shall be reported to the Engineer.

$$T_v = 0.12d_b F_i$$

Where:

T_v = verification torque (inch-kips)

d_b = nominal body diameter of the anchor rod (inches)

F_i = installation pretension (kips) equal to 50% of the specified minimum tensile strength of ASTM F 1554, Grade 36 rods, and 60% for the rest of threaded fasteners.

- ~~c~~ d. After leveling the poles, use non-shrink grout or a rodent guard between the pole base and the foundation. When non-shrink grout is used, neatly finish exposed edges of grout to present a pleasing appearance, and place a weep hole in the grout.
- ~~d~~ e. Apply anti-seize compound to all mechanical fasteners on pole access doors.
- e f. Install pedestrian push button post caps with tamper-proof set screws per manufacturer's direction or by driving the cap a minimum of 1/2 inch onto the post.

3. **Traffic Signs:** Install signs using universally adjustable sign brackets banded to the pole. Apply anti-seize compound to all mechanical fasteners.

F. **Temporary Traffic Signal.**

Construct according to Article 2528.03, H and to the configuration specified in the contract documents.

G. **Surface Restoration.**

1. Replace or reconstruct features removed as a part of the work, such as sidewalks, driveways, curbs, roadway pavement, unpaved areas, or any other items.
2. Complete restoration according the applicable sections of the Standard Specifications.

H. **Signal Turn On.**

Six days in advance of the scheduled signal turn on, place static signs or portable dynamic message signs (PDMS) on at least each of the major street approaches indicating day of week when the traffic signals will be active. If required, special Traffic Signal Ahead signs or PDMS with "Signal Active" message may be left in place for up to 7 days following activation.

H I. **Testing.**

1. Notify the Engineer ~~48 hours~~ **2 working days** in advance of the time and date the signal or signal system will be ready for turn on. Do not turn on the signal or signal system without authorization of the Engineer.
2. Ensure a representative from the manufacturer and/or supplier of signal controller or other authorized person is at the project site when the signal controllers are ready to be turned on to provide technical assistance including, as a minimum, programming of all necessary input data.
3. All required signal timing data will be provided by the Engineer.
4. A test period of 30 calendar days will start upon confirmation from the Engineer that the signal or signal system is operating consistent with the project requirements. Any failure or malfunction of the equipment furnished by the Contractor, occurring during the test period will be corrected by the Contractor at no additional cost to the Contracting Authority. Upon confirmation by the Engineer that any failure or malfunction has been corrected, a new test period of

30 calendar days will start, exclusive of minor malfunctions such as lamp burnouts. Repeat this procedure until the signal equipment has operated satisfactorily for 30 consecutive calendar days.

5. After signal turn on and prior to completion of the 30 calendar day test period, respond, within 24 hours, to perform maintenance or repair of any failure or malfunction reported.

I J. Documentation.

1. Provide file documentation packages with each signal system, consisting of the following:
 - a. Complete cabinet wiring diagram.
 - b. Complete physical description of the equipment.
 - c. Controller printout or equal documentation of initial controller settings installed in the field or in the office.
 - d. Product manuals for all cabinet equipment.
 - e. Standard industry warranties on equipment supplied.
 - f. Documentation of field cable labeling scheme.
 - g. Diagram of phasing and detector locations.
 - h. One set of as-built construction plans indicating changes from the original contract documents.
2. Supply two complete sets of documentation. One set to be placed in the controller cabinet and the other set (less construction plan) to be delivered to the Engineer. Electronic (PDF) submittal of the documentation is acceptable, if allowed by the Engineer.

K. Traffic Signal Removal.

1. Remove and salvage traffic signal and pedestrian poles and posts, including mast arms, signal heads, wiring, mounting hardware, and associated equipment.
2. Remove and salvage controller cabinet and controller, including associated equipment.
3. Remove and dispose of handholes and abandoned conduit as specified in the contract documents.
4. Remove concrete pads and foundations, including reinforcing steel to a depth of 4 feet below established grade. Furnish, place, and compact backfill according to Section 2552.
5. Restore disturbed surfaces to match adjacent areas.
6. Deliver salvaged materials to the location specified in the contract documents.

2525.04 METHOD OF MEASUREMENT.

A. Traffic Signalization.

Lump sum item; no measurement will be made.

B. Removal of Traffic Signalization.

Lump sum item; no measurement will be made.

2525.05 BASIS OF PAYMENT.

A. Traffic Signalization.

Payment will be at the lump sum price for Traffic Signalization. Partial payment will be made according to the approved schedule of unit prices for those materials installed.

B. Removal of Traffic Signalization.

Payment will be at the lump sum price for Removal of Traffic Signalization. Lump sum price includes: removal of poles, concrete pads, foundations, wiring, traffic signal cabinet and equipment, pedestrian signal equipment, and handholes; delivery of removed materials to the location specified in the contract documents (if specified); furnishing, placing, and compacting backfill in all excavations; and restoring disturbed surfaces.

Section 2526

2526, Construction Survey.

Replace the Section:

2526.01 DESCRIPTION.

Perform survey for construction projects.

2526.02 MATERIALS.

None.

2526.03 SURVEY.

- A.** Furnish all survey necessary for construction of the project before work begins in the area. Comply with Iowa Code requirements, including monument preservation, under the direct supervision of an Iowa licensed land surveyor. Do not apply the provisions of Article 1105.15 to this work, except to preserve the original stakes set by the Engineer. Refer to Article 1105.16 for requirements when AMG is utilized. If, in the opinion of the Engineer, the Contractor has destroyed or disturbed any of the original survey stakes or benchmarks, the cost of replacing will be charged to the Contractor. Bring design errors discovered to the Engineer's attention for review prior to staking. Construction survey includes qualified personnel, equipment, and supplies required for, but not limited to, the following items:
- 1. Monument Preservation**
Preserve existing monuments as required by Iowa Code.
 - 4 2. Project Control.**
 - a. Primary Control Monuments.**
A primary control monument is a survey point the Contracting Authority establishes prior to project commencement. ~~These are shown in the contract documents.~~ The point will be established by placing a monument in the ground.
 - b. Secondary Control Monuments.**
A secondary control monument is a survey point the Contractor establishes on grading or other projects specified in the plans, and preserves on all other projects.
 - 1) The Engineer will provide monuments, similar to those the Department uses for GPS control.
 - 2) Place secondary permanent horizontal control monuments, under the Engineer's direction, at locations likely to survive project construction and at intervals not to exceed 2640 feet. Place the monuments in the ground along the project corridor. Place at higher elevations along the corridor to provide a view of the immediate project topography and to provide for visible clear line of sight to the nearest secondary permanent control monument in either direction. Primary project monuments may be substituted if appropriate.
 - 3) Plant secondary control monuments 1 to 4 inches below existing ground. Drive a metal fence post within 1 foot to mark their location.
 - 4) Carefully determine project coordinates relative to the nearest primary project control monument using project coordinate values the Engineer has provided. Ensure the resulting error radius of the secondary monument does not exceed 0.10 feet \pm 2 ppm relative to the primary control. ~~Provide the Engineer with all the field data of the survey. The data may be either unedited printed or electronic formatted field data, or both. Provide the Engineer with an ASCII comma delineated file of the coordinates formatted as (Point Number, Northing, Easting, Elevation, Point Description, Feature).~~
 - 5) Perform an independent traverse check between the secondary control monuments by observing distance and angular measurements or by use of GPS. ~~Provide the Engineer with all the field data for the traverse check. The data may be either unedited printed or electronic file, or both. Provide the Engineer with a diagram indicating horizontal ground distances to nearest 0.01 foot and angles to at least the nearest 10 seconds between each secondary control monument. Ensure inverses between the coordinate pairs as determined in the previous paragraph do not exceed 0.10 feet of the direct measurements.~~
 - 6) Replace secondary control monuments disturbed during construction activities using procedures outlined above, at no additional cost to the Contracting Authority.
 - ~~**c. Durable Physical Objects.**~~
 - 1) ~~Using measurements to the nearest 0.10 foot, reference each control monument to a minimum of three durable physical objects located 20 to 100 feet away from the monument. Durable physical objects could include trees, poles, fence posts, station marks in new roadway pavement, or metal fence posts.~~
 - 2) ~~Provide the Engineer with either a printed or electronic reference image (for example JPEG, TIFF, etc), or both, including each reference and project coordinate.~~
 - d c. Benchmarks.**
 - 1) Establish permanent vertical control benchmarks at all bridges and reinforced concrete box culverts within the project. Use an Iowa DOT brass plug on bridge barrier rail or headwall of reinforced concrete box culvert to indicate the benchmark. If the Engineer approves, a sawn "X" on bridge barrier rail or headwall of reinforced concrete box culvert may be used.
 - 2) Transfer all benchmark elevations from construction plan benchmarks to the permanent benchmarks using the three-wire method or by trigonometric leveling. Use temporary benchmarks of reasonable stability to preserve the plan benchmarks.
 - 3) ~~Provide the Engineer with all field benchmark elevation data. The data may be either unedited printed or electronic formatted, or both. Provide the Engineer with the project x and y coordinates of all benchmarks along with an ASCII comma delineated file of the coordinates formatted as (Point Number, Northing, Easting, Elevation, Point Description, Feature).~~
 - 4 3) Ensure benchmark level loops do not exceed an error of 0.05 feet times the square root of the loop's length in miles. Distribute the error equally along the loop on all intermediate traverse/benchmark points.

2 3. Grading.**a. General.**

- 1) Survey right-of-way line between permanent right-of-way corners at 100 foot 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.
- 2) Take original and final elevations of all borrows. Provide original and final graphical cross-sections at 100 foot intervals, or less if needed digital terrain model (DTM) in LandXML-format, suitable for use by the Engineer to calculate excavation quantities.
- 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.
- 4) When Class 12 excavation is an item, ~~take cross section elevations at 100 foot intervals, or less if needed, and plot cross sections~~ provide original and final DTM in LandXML format for use by the Engineer to calculate the excavation quantities.
- 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 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 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 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 intervals on mainline and at least two cross sections on side roads and ramps. Establish these hubs, using means other than the machine guidance surface (such as 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.

3 4. Bridges.

- a. Mark locations and elevations with metal pin or tack in a wood hub, flat, and lath. Clearly mark flat with the pier/abutment station location, design number, and offset distance from centerline of the approach roadway.
- b. Establish a minimum of three temporary benchmarks.
- c. Mark location of test pile with a wood hub.
- d. 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.
- e. Submit elevations of all completed substructure beam seats to the Engineer for review prior to installation of bearings and superstructure elements.
- f. Take elevations of beams as erected. Develop proposed final deck grades for review by the Engineer on an Excel spreadsheet format. Provide proposed final deck grades to the Engineer for determination of required deck grade adjustments and approval of final deck grades for deck construction. Locations for determining beam elevations are to be according to the plans.
- g. Provide the Engineer with a copy of the staking diagram prior to commencing work.
- h. For bridges on Primary and Interstate routes, submit required information from Articles 2526.03, A, 4, e and f to the Engineer on the provided bridge e-File spreadsheet.

4 5. Reinforced Concrete Box Culverts.

- a. Mark locations and elevations with metal pin or tack in a wood hub, flat, and lath. Clearly mark the flat with the station location, design number, cut/fill elevation, and offset distance from the centerline of the culvert and back of parapet.
- b. Perform an independent check of the above stakes.
- c. Provide the Engineer with a copy of the staking diagram prior to commencing work.
- d. Report to the Engineer questionable flow lines and alignments that do not match existing drainage.

5 6. Pipe Culverts.

- a. Mark locations and elevations with metal pin or a wood hub, flat, and lath. Clearly mark the flat with the station location, cut/fill elevation, and offset distance to both ends or centerline of pipe.
- b. Report to the Engineer questionable flow lines and alignments that do not match existing drainage.

6 7. Sanitary and Storm Sewers.

Mark locations and elevations with metal pin or tack in a wood hub, flat, and lath. Clearly mark the flat with the station location, pipe number, cut/fill elevation, and offset distance to centerline of pipe.

7 8. Water Mains.

Mark locations and elevations with metal pin or tack in a wood hub, flat, and lath. Clearly mark the flat with the station location, pipe number, cut/fill elevation, and offset distance to centerline of pipe.

8 9. Intakes and Utility Accesses.

Mark locations and elevations with metal pin or tack in a wood hub, flat, and lath. Clearly mark the flat with the station location, intake or utility access number, cut/fill elevation (including bottom of well and form grade), and offset distance to the Station Location.

9 10. Pavements (PCC & HMA) and Overlays (PCC).**a. General.**

- 1) 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 intervals for a minimum of 100 feet. 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 before paving begins.
- 2) For PCC and HMA pavements, when a new profile grade is not included in the contract documents:
 - a) Obtain elevations of the existing pavement and bridges at 100 foot intervals on straight and level sections and 50 foot intervals on horizontal and vertical curves.
 - 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 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 before paving begins.
- 3) For PCC overlays, when a new profile grade is not included in the contract documents:
 - a) 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.
 - b) 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.
 - c) Obtain elevations at maximum 50 foot intervals on straight and level sections and at maximum 25 foot intervals on horizontal and vertical curves.
 - d) 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 before paving begins.

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 intervals on straight and level sections and 25 foot 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 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.

10. HMA Overlays

- ~~a. Reference and preserve existing control points located at each Point of Intersection (P.I.).~~
- ~~b. Obtain the Engineer's approval for the method used to reference points.~~
- ~~c. Reset Control Points after the work is complete.~~

11. PCC Overlays**a. General.**

- ~~1) 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 intervals for a minimum of 100 feet. 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 before paving begins.

- 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.~~
 - 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.~~
 - 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.~~
 - d) ~~Obtain elevations at maximum 50-foot intervals on straight and level sections and at maximum 25-foot intervals on horizontal and vertical curves.~~
 - e) ~~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 before paving begins.~~~~
- 3) ~~Reference and preserve existing control points located at each Point of Intersection (P.I.).~~
- 4) ~~Obtain Engineer's approval for method used to reference points.~~
- 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 intervals on straight and level sections and 25-foot 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 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.~~

12 11. Structural Walls.

a. Survey requirements for structural walls includes the following work types:

- 1) Mechanically Stabilized Earth (MSE) Walls.
- 2) Cast in Place (CIP) Retaining Walls.
- 3) Soil Nail Walls.
- 4) Tie Back Walls.
- 5) Noise Walls.
- 6) Modular Block Retaining Walls.
- 7) Segmental Retaining Walls.

b. Mark locations and elevations with a metal pin or a wood hub, flat, and lath. Clearly mark the flat with the station location, cut/fill elevation, and offset distance to face of wall.

- B.** ~~Submit the method used to preserve project control to the Engineer for approval. Format the survey work documentation in a manner acceptable to the Engineer. Ensure monument preservation work is completed by a Professional Land Surveyor licensed in the State of Iowa in responsible charge, according to the provisions of Iowa Code 542B. Ensure all other survey work is completed by a Professional Engineer licensed in the State of Iowa in responsible charge or a Professional Land Surveyor licensed in the State of Iowa in responsible charge, according to the provisions of Iowa Code 542B. Submit a resume to the Engineer identifying the field survey personnel and their capabilities to perform the intended requirements.~~
- C.** Obtain the Engineer's approval for the method of determining alignments and elevations and the method of preserving control points. This approval does not act to relieve the Contractor of the responsibility for the correctness of the survey work. Do not use plan cross-sections for vertical or horizontal control.
- D.** ~~The Engineer will provide bench mark elevations, right-of-way corners, and reference control points on the original survey as shown in the contract documents. A GeoPak alignment will be provided if available.~~
- E D.** Check tie-ins with existing roadways for correctness of alignment prior to construction staking.
- F.** ~~When survey work is done under traffic, detail sheets in the contract documents will establish the required signing.~~
- G E.** Establish benchmarks in the adjacent area before installing settlement plates in accordance with Article 2526.03, A, 4 2, d c.
 1. ~~Obtain Engineer's approval for method of determining alignments and elevations and the method of preserving control points. This approval does not relieve Contractor of the responsibility for correctness of survey work.~~

~~2. Do not use plan cross-sections for vertical or horizontal control. The Engineer will locate and determine elevations of settlement plates.~~

~~H. Replace land corners and permanent reference markers unless stated otherwise in the contract documents.~~

I F. All survey work documentation becomes the property of the Contracting Authority. Assemble required documentation into a single electronic package upon completion of the project and furnish to the Engineer. The work of this specification will be considered finished complete when the following documentation is furnished to and accepted by the Engineer.:

1. ASCII comma delineated file of the coordinates formatted as (Point Number, Northing, Easting, Elevation, Point Description, Feature). Identify coordinate system used.
2. Monument preservation certificates.
3. Secondary control monument coordinates including traverse check.
4. Reference monument drawings.
5. Benchmark coordinates.
6. Required DTMs.
7. Bridge and box culvert staking diagrams.
8. Final profile grades.

J G. For the purpose of subcontracting, this item will be considered a specialty item.

2526.04 METHOD OF MEASUREMENT.

None. Lump sum item.

2526.05 BASIS OF PAYMENT.

- A.** Payment for Construction Survey will be paid for at the lump sum contract price.
- B.** Payment is full compensation for the survey work required for the project as let, including any interpolations that may be necessary between cross-section and field staking.
- C.** Payment for revisions after the letting will be paid for according to Article 1109.03, B.
- D.** Verifying form work slopes according to Article 2511.03, B, 1, b, shall be incidental to Construction Survey and will not be paid for separately.

Section 2527

2527.02, D, 2, c, 4.

Add to the end of the Article:

The Engineer will use the procedure in Materials I.M. 386 to determine retroreflectivity.

2527.03, F, Markings Obliterated During Construction.

Add the Article:

- 6.** Pavement markings disturbed by milled rumble strip operations shall be replaced within 5 working days from the day markings are disturbed.

Section 2528

2528, Traffic Control.

Replace the Section:

2528.01 DESCRIPTION.

- A. General.**

1. This section describes various materials, equipment, and procedures involved in traffic control during construction. The Contractor and the Contracting Authority have certain responsibilities, whether public traffic is allowed or is prohibited during construction. Apply Article 1107.09.
2. The contract may include an item for traffic control. In this case furnish, erect, operate, maintain, move, and remove all traffic control devices required by the contract documents.
3. The contract may indicate that traffic control is incidental. In this case the Contracting Authority will furnish all signs and traffic control devices, except pilot car and flaggers' signs, and all Type III barricades, and associated mounting devices. Furnish all other traffic control devices required. Erect, operate, maintain, move, and remove all traffic control devices. Signs and barricades to be furnished by the Contracting Authority will be made available at a nearby maintenance site. Return the signs and barricades when no longer needed. Contracting Authority signs and barricades damaged during construction activities by Contractor's activities shall be replaced at no charge to the Contracting Authority.
4. The contract documents may specify orange mesh safety fence be used in conjunction with other traffic control devices as part of the project traffic control requirements. Use orange mesh safety fence meeting the requirements of Article 4188.03. Securely support the fence so it is in a vertical position without any sagging. Locate and place the safety fence supports so they are not a safety hazard.
5. Ensure all traffic control complies with the current edition of the MUTCD, Part 6 as adopted by the Department, unless modified by the contract documents.
- ~~6. On Interstate and Primary Road projects, use crashworthy Category I and Category II traffic control signs and devices that meet NCHRP Report 350; or MASH 2016 (Manual for Assessing Safety Hardware).~~
- ~~7. Upon request provide the following to the Engineer for the purpose of documenting the crashworthiness of Category I and Category II signs and traffic control devices:

 - a. The vendor's self-certification for Category I traffic control devices.
 - b. FHWA NCHRP Report 350 or MASH approval memos for Category II signs and traffic control devices.~~
- ~~8. A list of approved Category II traffic control devices is found on the World Wide Web at the following URL: https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/.~~
- ~~9. Gender specific signs, such as FLAGMAN and MEN WORKING, will not be allowed. Use neutral gender signs, for example FLAGGER, or equivalent symbol signs.~~
- ~~10~~ 6. Provide 10 calendar days advance notification of a pedestrian path closure to the following:
 - National Federation of the Blind of Iowa: Affiliate President, <https://nfb.org/resources-iowa>.
 - Engineer.

B. Monitoring with Incident Response.

1. Provide 24 hour per day continuous monitoring of traffic control devices and incident response for emergency situations on projects during complex traffic situations as defined in the contract documents. ~~The contract documents will identify projects requiring monitoring with incident response.~~ Ensure a vehicle and operator traverses the project throughout the entire traffic control zone at all times, except for refueling and short rest breaks no greater than 15 minutes in duration.
2. Furnish this work according to the contract documents any time that signs, barriers, barricades, or other traffic control devices are in place during complex traffic situations.
3. Provide a vehicle and operator for this work as follows:
 - a. **Equipment.**
 - 1) Meet the following requirements:
 - a) 3/4 ton pickup truck or another similar vehicle.
 - b) Contractor's insignia on the doors of the vehicle.
 - c) Adequate weight and power and suitably equipped to move stalled automobiles, sport utility vehicles, or pickup trucks.
 - d) Equipped with an amber revolving light or amber strobe or yellow high intensity rotating, flashing, or oscillating warning light visible in all directions and a cellular telephone or similar type of mobile phone.
 - e) Capable of carrying traffic signs, tools, traffic control devices, and other necessary equipment.
 - 2) When used on projects where more than one lane in one direction is maintained at all times, ensure this vehicle is also be equipped with a Type C arrow panel as described in ~~Article 2528.03, G~~ Article 2528.03, F, mounted to be visible to traffic approaching from behind.

b. Operation.

- 1) Furnish an operator for the vehicle. Ensure the operator re-erects, repairs, or replaces defective devices immediately upon discovery.
- 2) Have the operator:
 - a) Be available to assist persons with vehicle problems and move automobiles, sport utility vehicles, pickup trucks and other obstructions so as to keep travel lanes and shoulders available for public traffic.
 - b) Continue assistance to motorists and involvement with obstructions until they are no longer an impediment to traffic and further assistance can be provided safely by others.
 - c) Assist motorists or remove obstructions promptly and safely when a vehicle or anything else is obstructing a travel lane or shoulder intended to be clear.
 - d) Summon further assistance if needed.
 - e) Keep a report of any events that restrict the normal traffic flow during complex operations, including responses to emergency situations, on forms provided by the Engineer. Provide the Engineer with a copy of this report daily.
- 3) During anticipated peak traffic times, the Engineer may direct the Contractor to provide additional monitoring personnel. Payment will be made as extra work according to Article 1109.03, B.

C. Traffic Quality Control.

1. Maintain a Traffic Control Technician on staff, even though the traffic control portion of the contract may be subcontracted. The Traffic Control Technician is required to have attended and passed the exam in an ATSSA Traffic Control Technician, IMSA Work Zone Traffic Control, Iowa AGC Traffic Control Technician class, Minnesota DOT Traffic Control Supervisor training class, or Texas Engineering Extension Service Work Zone Traffic Control training class. This Traffic Control Technician is responsible for overall management of the Contractor's quality control program for traffic control. Starting April 2018, the Traffic Control Technician shall retake and pass the exam in one of the approved classes every 5 years.
2. Daily as the project is constructed, perform the following quality control work associated with monitoring and documenting traffic control conditions:
 - a. Review all traffic control operations for compliance with contract documents and maintain a project traffic control daily diary in a format provided by the Contracting Authority. Submit this diary to the Engineer. It will become a part of the Contracting Authority's permanent project records. The Engineer may require submission of completed portions of the daily diary at routine intervals during construction of the project. In the diary include:
 - Listing and station location of traffic control used each day referenced to the appropriate Standard Road Plan, project plan sheet, etc.,
 - All reviews of traffic control devices and operations, whether satisfactory or unsatisfactory, and corrections made,
 - Approved changes to the contract document's traffic control,
 - Incidentals affecting the efficiency and safety of traffic, and
 - A daily list of trained flaggers used, including hours worked.
 - b. Monitor traffic operations and submit proposed Traffic Control Plan changes to the Engineer for approval.
 - c. Coordinate all changes to the Traffic Control Plan.
 - d. Coordinate all traffic control operations, including those of subcontractors and suppliers.
3. Employees who install and remove temporary traffic control signs and devices located within the traveled way or median shall be supervised by a trained Traffic Control Technician trained per Article 2528.01, C, 1. When traffic control is installed or removed, the Traffic Control Technician who supervised the installation or removal of temporary traffic control devices and signs shall be on site and document in the daily traffic control diary what was installed or removed.

2528.02 MATERIALS.

Use materials meeting the requirements of Part 6 of the MUTCD and Division 41 for the respective traffic control signs and devices.

2528.03 SIGNS AND DEVICES CONSTRUCTION.**A. Signs.**

1. Furnish signs that are of the size and type shown in the contract documents and use retroreflective sheeting meeting the requirements of Article 4186.03.
2. For Interstate and Primary projects, furnish diamond shaped warning signs that are 48 inches by 48 inches unless specified otherwise in the contract documents.
3. For traffic control zones in duration for 4 calendar days or more, mount signs on fixed posts.

4. Signs for traffic control zones in duration for less than 4 calendar days may be mounted on moveable skids or fixed posts.
5. Meet the following requirements for fixed post mounted signs:
 - a. Sign sheeting applied to rigid wood or metal.
 - b. Mounted at a height of at least 7 feet, measured from the bottom of the sign to the near edge of the pavement. A secondary sign on the same post may be mounted 1 foot lower than specified above.
 - c. A clear distance 2 feet behind a curb or beyond the edge of the shoulder.
6. Meet the following requirements for moveable skid mounted signs:
 - a. Flexible roll-up sheeting or other skid mounted sign systems that meet NCHRP 350 or MASH requirements.
 - b. Mounted at a height of at least 1 foot above the roadway.
7. Ensure mounting devices are not so substantial as to be a hazard to vehicles. Meet the following requirements for posts mounted in existing soil:
 - a. Wood sign supports meeting the materials requirements of Article 4164.04.
 - b. 3.0 pounds per foot U-shaped rail steel posts.
 - c. 2 1/4 or 2 1/2 inch square 12 gage perforated steel tubing.
8. Dual-post and triple-post configurations using these sign supports are acceptable provided that no more than two posts occupy any 8 foot wide path. Bracing of these posts will not be permitted. Posts exceeding these requirements shall have breakaway features approved by the Engineer.
9. Ensure signs are in a condition so they are effective for the intended purposes when viewed from a vehicle. For nighttime installations, ensure the reflectance is adequate so that the message is clearly readable. Ensure signs are maintained in a near vertical position.
10. When indicated in the contract documents, use supplemental sign flags in conjunction with work zone signing. Use sign flags 16 inches square and sheeted with red Type IV-XI retroreflective sheeting meeting requirements of Article 4186.03.
11. On projects where two new lanes are being constructed adjacent to an existing two lane highway, place TWO WAY TRAFFIC (W6-3) signs. Place them off the right shoulder of mainline: 1) after each public side road for each direction of travel for traffic that may enter from all intersecting side roads; or 2) at 1/2 mile intervals, whichever is less. Install these signs when grading activities start and leave in place until the entire four lane divided highway is opened to traffic. If the pavement is constructed under a separate contract, leave these signs in place after the grading contract is completed. They become the property of the Contracting Authority. The paving contractor then takes over these signs and removes them when the four lane divided highway is opened to traffic. Payment will be according to Article 2528.05, A.
12. When directed by the Engineer, cover or remove permanent signing that conveys a message contrary to the message of the temporary signing and not applicable to the working conditions. When the work is completed uncover or replace permanent signing. Permanent signs damaged by the Contractor's activities shall be replaced at no charge to the Contracting Authority.
13. The END ROAD WORK (G20-2) sign may be eliminated for mobile or short duration (less than 1 hour) temporary traffic control zones.
14. When milled or scarified surfaces exist, sign approaches to scarified areas using ROUGH ROAD (W8-8) signs. Place signs at least 250 feet 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 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.

B. Portable Dynamic Message Signs

Furnish, place, operate (when specified), and maintain Portable Dynamic Message Sign (PDMS) meeting requirements of Article 4188.07 at locations shown on the plans. The Contractor maintains possession of PDMS upon completion of the project.

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 1 week before PDMS is deployed to a project, a testing and configuration meeting with the Engineer shall be held.
 - 2) The Contractor shall 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.

3. Direct Operation.

- a. On Secondary road projects, PDMS will be operated directly by either the Contractor or the Engineer.
- b. Engineer may request the Contractor to operate PDMS for advance traffic notification and warning. Authority to operate PDMS will be under the direction of the Engineer. The Contractor may only operate the 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.

4. Maintenance.

- a. Provide preventive maintenance necessary to achieve uninterrupted service. Provide monitoring of health of each PDMS to accomplish proactive preventive maintenance and provide uninterrupted service. This includes, but is not limited to, performing remote diagnostic tests of equipment's operational status, monitoring status of system performance such as communication, battery status, etc.
- b. Engineer may perform remote diagnostic tests of sign's operational status and notify Contractor when a problem is detected.
- c. Respond to service phone calls immediately and to the service request emails within 2 hours. Conduct remote or on-site troubleshooting and respond back to the Engineer with notification of action (i.e. device repaired remotely, sending field technician, etc.) within 2 hours of responding.
- 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 2 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. Repairs shall be completed within 12 hours of initial notification or the Engineer may 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.

C. Channelizing Devices.

1. Use Channelizing Devices that are of the type shown in the contract documents. Ensure all channelizing devices meet the current requirements of the MUTCD and Section 4188. Use reflective sheeting meeting the requirements of Article 4186.03.
 - a. **Barricades.**
 - 1) ~~A 2 foot minimum length barricade may be used when Type I or Type II Barricades are furnished as one of the options for channelizing devices in lieu of vertical panels, 42 inch channelizers, cones, or drums.~~
 - 2) 1) Ensure Type III barricades have a minimum length of rail of 6 feet. When traffic is permitted in each direction around a Type III Barricade, ensure the Type III Barricade used has fully reflectorized faces on both sides of the rails.
 - 3) 2) Erect barricades in essentially a ~~horizontal~~ vertical position perpendicular to the direction of approaching traffic. Ballast them so as not to cover any striped rail.
 - b. **Cones, Vertical Panels, 42 Inch Channelizers, Drums, and Tubular Markers.**
 - 1) Ensure cones, ~~vertical panels, 42 inch channelizers, drums, and tubular markers,~~ and other traffic control devices meet the current requirements of the MUTCD, and Section 4188.
 - 2) ~~When used to separate two-way traffic, separate temporary no-passing lines approximately 16 inches, with the marker to be installed between these lines.~~
 - 3) 2) Ensure tubular markers meet the following:
 - a) A nominal 36 inch height.
 - b) Diameter facing traffic at least 2 inches in width.
 - c) Completely faced with reflectorized white and orange sheeting that is in two bands 4 inches wide with 6 inches between bands, with the top band no more than 2 inches from the top of the tubular marker.
 - 4) 3) Cones may be used as channelizing devices in tapers and along lane lines during daylight hours only.
 - 5) 4) 42 inch channelizers may be used in place of drums in work areas remaining in place for up to three days. Spacing of channelizers shall be half the spacing required for drums or double the number of drums required.
 - c. **Temporary Lane Separator System.**
 - 1) **Installation.**

Install according to the manufacturer's recommendations.

2) Maintenance.

Repair or replace all damaged curb units or posts no later than 24 hours after the damage is reported to the Contractor.

3) Removal.

a) Upon completion of the project, the temporary lane separator system will remain the property of the Contractor for systems used in temporary traffic control zones. When placed as part of a permanent installation, the system will become the property of the Contracting Authority.

b) Repair all holes left in the pavement or bridge deck when the temporary lane separator system is removed. Holes shall be filled with a non shrink grout meeting the requirements of Materials I.M. 491.13.

2. Channelizing devices may be placed up to 2 feet beyond centerline or lane line at specific locations where actual work activity is taking place. Return channelizing devices to the original position when the work activity has passed.
3. Individual channelizing devices may be omitted during working hours in areas where placement interferes with the work. Channelizing devices on tapers are required at all times.
4. Do not intermix channelizing devices of different types.
5. For pedestrian path closures, use Type III Barricades to block the full width of the pedestrian path. Mount a SIDEWALK CLOSED (R9-9) sign to at least one of the Type III barricades at each closure.

D. Pilot Cars.

1. ~~Pickup trucks or automobiles displaying the Contractor's company insignia, equipped with G20-4 signs reading: PILOT CAR FOLLOW ME. Ensure two signs are mounted on the vehicle so as to be clearly visible from both directions of traffic. Mount the signs so the bottoms are at least 1 foot above the top of the vehicle's roof.~~
2. ~~Operate pilot cars such that they maintain a uniform speed through the work area, no greater than 40 miles per hour.~~

E D. Temporary Barrier Rail.

Use temporary barrier rail as shown in the contract documents. Unless shown otherwise, use precast concrete units. Tie the units together as specified or as approved by the Engineer.

F E. Modular Glare Screens.

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 rails attached to the top of concrete barrier rail with blades evenly spaced and securely mounted to the base rails. Ensure the following:
 - Modular base rails and glare screen blades are compatible so the base unit and blades can be securely attached to each other.
 - Base rails and blades supplied are manufactured by the same manufacturer.
 - The length of individual modular base rails is no longer than the nominal length of individual temporary concrete barrier rail sections.
 - The width of the modular base 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 and width is from 6 inches to 9 inches.
 - 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 rails, blades, and associated assembly over the edges of the top of the concrete barrier rail is kept to a minimum.
 - The modular base 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.
3. Install glare screen blades so the combination of blade width and spacing provide for a minimum 22 degree sight cut-off angle.
3. 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 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.~~

G F. Lighting Devices Arrow Boards.

Furnish, place, operate, and maintain arrow boards at locations shown on the contract documents. Ensure arrow boards meet current requirements of MUTCD and Article 4188.10.

1. ~~Furnish lighting devices as required by the contract documents. Type A barricade warning lights will normally be required for nighttime installations. Type B warning lights will normally be required for 24 hour operation.~~
 2. ~~Use barricade warning lights that comply with the ITE Standard for Flashing and Steady Burn Barricade Warning Lights and are identified as such. In addition, use Type A barricade warning lights that:

 - ~~Operate on a 12 volt battery system, unless the ITE identification specifically indicates that the rating is based on a different system, and~~
 - ~~Are visible to both directions of traffic.~~~~
 3. ~~When arrow displays are used, furnish Type C arrow displays described in the current edition of the MUTCD, Part 6, and operate them in a sequential chevron mode when indicating a lane change.~~
1. **Operation.**
 - a. When indicating a right or left lane closure, operate in a sequential chevron mode.
 - b. When indicating a traffic split, operate in a flashing double arrow mode.
 - c. When indicating caution, operate in an alternating diamond mode.
 2. **Remote Communications.**
When using an Arrow Board for stationary work zones on the Interstate System or Primary roadways, remote communication capabilities meeting requirements of Article 4188.10, F are required.
 3. **Type and Size.**
Type C Arrow Boards as defined in Part 6 of the MUTCD are required for all applications.
 4. **Testing and Configuration.**
On Interstate projects or Primary roadways, at least 1 week before Arrow Board is deployed to a project, a testing and configuration process shall be performed with the Engineer.

H G. Temporary Traffic Signals.

1. **General.**
 - a. Set up and operate temporary traffic signals as shown in the contract documents. Ensure the temporary traffic signal system meets the physical display and operational requirements of conventional traffic signals as specified in Part 4 of the MUTCD. Unless stated otherwise in the contract documents, either a span wire or trailer mounted temporary traffic signal system may be provided.
 - b. In the event any part of the temporary traffic signal system malfunctions or a continuous red flash mode is encountered, furnish flaggers on a 24 hour/7 day a week basis until repairs are made and the signals are fully functional. For temporary traffic signals at intersections, install stop signs on all approaches until the signals are fully operational, at no additional cost to the Contracting Authority.
 - c. Notify the Engineer at least 48 hours prior to the use of the signals for timing approval and verification.
2. **Equipment.**
 - a. **Trailer, or Span Wire Mounted, or Flagger Station Systems.**
 - 1) Furnish actuated signal controllers complying with NEMA and ITE standards. Ensure the temporary traffic signal system complies with the following:
 - a) Includes a solid state digital traffic signal controller capable of operating the signals according to MUTCD requirements and NEMA Standard TS1 TS-5. A copy of the manufacturer's certificate of compliance is to be posted in the control cabinet (in a weatherproof folder) and made available to the Engineer upon request.
 - b) Has conflict monitoring complying with NEMA Standard TS1 and the following:

- Detects the presence of conflicting signal indications, absence of proper voltages, and proper operation of the controller.
 - Upon detection of a conflict or loss of communication, all signals enter into flashing red mode.
- 2) Apply Article 2525.03, E, 4, with the following exceptions †For one lane two way traffic control:
- a) **Green Revert.**
If during an All Red clearance interval a call occurs on the phase losing the right-of-way prior to a call on any other traffic phase, the right-of-way reverts to the previous traffic phase, initiating the initial green interval. The transfer is to be immediate without completing the All Red clearance interval.
 - b) **Rest in Absence of Actuation.**
In the absence of detector actuation of assertion or recall switch(es), the right-of-way indication dwells in All Red.
- 3) Comply with the following:
- a) Clearance for overhead wiring is a minimum of 18 feet.
 - b) A detection area is located near the stop line with the downstream edge positioned 6 feet from the stop line. A second detection area is located 100 to 150 feet in advance of the stop line. The size of detection areas is 6 feet by 10 feet. A single above-ground detector may be used to provide detection for both areas.
 - c) Signal heads have 12 inch lenses and comply with ITE Specification "Vehicle Traffic Control Signal Heads". All signal heads are equipped with visors and back plates. The backplate provides a minimum of 5 inches black field around the signal assembly and has a dull black finish.
 - d) A minimum of two traffic signal heads per approach. All signal heads mounted over the road surface are mounted a minimum of 15 feet from the bottom of the signal head to the top of the road surface. One signal head mounted over the center of the travel lane. All far right signal heads mounted a minimum of 8 feet from the bottom of the signal head to the top of the ground surface. Required signal heads for through traffic on any one approach located no less than 8 feet apart measured horizontally perpendicular to the approach between the centers of the signal faces.
- b. **Trailer Mounted Systems.**
Provide a system consisting of two or more self-contained trailer mounted units each containing two signal heads.
- c. **Span-Wire Mounted Systems.**
Ensure posts meet the requirements of Article 2528.03, A.
- d. **Flagger Station Systems.**
Provide a traffic signal system, for one-lane/two-way operation in conjunction with a flagger and/or pilot car operation in order to provide greater advance visibility to the flagging operations.
- Two or more self-contained trailer mounted units each consisting of one or two signal heads.
 - Single-signal head systems shall have a signal head mounted on each side of the roadway
 - Two-signal head systems shall have one signal head mounted on a mast arm capable of extending over the center of the travel lane and the other signal head mounted on the same trailer.
3. **Operational Requirements.**
- a. Locate signals, stop bars, and signs exactly as identified in the contract documents. Secure and level temporary traffic signal installations in a manner approved by the Engineer.
 - b. Program all temporary traffic signals for red flash upon startup, conflict, or power failure. Program the temporary traffic signal system to dwell in All Red.
 - c. For one lane two way traffic control operations, when an additional phase is used for a side road movement, only one long all red interval is to be used between active phases on each side of the work area.
 - d. Set signal timing as identified in the contract documents.
4. **Equipment Crossings.**
- a. For equipment crossings, use a signal operator to control the signal system. Position this operator with good sight distance for both the mainline and haul road.
 - b. Program the signal system with fixed yellow and all red time periods so the operator can only activate the beginning of the yellow interval for mainline traffic.
 - c. When the equipment crossing is not in use, set the signal to yellow flash mode. If hauling operations are suspended for more than one week, cover the signal heads, or if portable trailer units are used, remove the trailers.

† H. Temporary Floodlighting.

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 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. Auxiliary poles used to furnish power to floodlighting offset 30 feet 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 or MASH Category IV crash testing.
- 2) Ensure mounting height of LED luminaires is no less than 17 feet 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.

J.I. Temporary Crash Cushions.

Apply Section 2551.

K.J. Flaggers.

1. Prior to flagging operations, ensure flaggers are trained in safe flagging operations that comply with Iowa DOT Flagger's Handbook, Part 6 of the MUTCD, and the Standard Specifications. Ensure training of flaggers includes the following:
 - a. Issuing and reviewing the current Iowa DOT Flagger's Handbook,
 - b. Presentation of the current Iowa Professional Flagging Video,
 - c. Issuing flagger training cards including the information below. ~~Ensure the flaggers carry their flagger training card at all times and show it upon request.~~
 - 1) Employee name,
 - 2) Date of training,
 - 3) Name of Instructor, and
 - 4) Expiration date of December 31 of the year following the training date.
2. Maintain a list of the flaggers trained and the date of the training.
3. Training is not required for short time, emergency, or relief assignment of employees to flagging operations. Payment will not be made in accordance with Article 2528.05, I.
4. Ensure flagger operations, equipment, and apparel comply with the current Iowa DOT Flagger's Handbook.
5. When nighttime flagging is required, provide auxiliary lighting to illuminate the flagging stations according to the MUTCD, Part 6 and current Iowa DOT Flagger's Handbook. Set up this lighting in such a manner to minimize glare to motorists. The cost of furnishing nighttime flagging stations lighting is included in the lump sum price bid for Traffic Control.
6. Ensure flaggers always carry their flagger training card and show it upon request.

K. Pilot Cars.

1. Pickup trucks or automobiles displaying Contractor's company insignia on doors of the vehicle, equipped with G20-4 signs reading: PILOT CAR - FOLLOW ME. Ensure two signs are mounted on vehicle so as to be clearly visible from both directions of traffic. Mount signs so bottoms are at least 1 foot above top of vehicle's roof.
2. Operate pilot cars so they maintain a uniform speed through work area, no greater than 40 miles per hour.

L. Temporary Portable Rumble Strips

Use temporary portable rumble strips of the type shown in the contract documents and meeting requirements of Article 4188.08.

1. Placement.

- a. A temporary portable rumble strip panel consists of three individual temporary portable rumble strips placed on roadway surface.
- b. Place centerline end of temporary portable rumble strip 6 inches from centerline of roadway perpendicularly extending its full length transversely across pavement surface.
- c. Place each individual temporary portable rumble strip 15 to 20 feet apart within the temporary portable rumble strip panel.

2. Maintenance.

Ensure temporary portable rumble strips maintain alignment within 6 inches perpendicular to centerline of roadway when measured from one end to the other end of the individual temporary portable rumble strip.

3. Removal.

When temporary traffic control requiring temporary portable rumble strips is no longer in operation, remove temporary portable rumble strips from roadway.

M. Speed Feedback Signs.

Furnish, place, operate, and maintain speed feedback signs at locations shown on the contract documents. Ensure all speed feedback signs meet the current requirements of the MUTCD and Section 4188.

1. Definitions.**a. Speed Feedback Trailer.**

Speed feedback trailers are mobile devices using speed feedback signs to capture vehicle speed for oncoming traffic.

b. Display.

The display is a device connecting to the speed feedback trailer capable of broadcasting the speed of oncoming traffic captured by the speed feedback sign. This device allows for vehicle speed feedback to the vehicle operator, allowing for speed adjustment throughout the remainder of the work zone.

2. Testing and Configuration.

- a. At least 1 week before speed feedback trailer is deployed to a project, a testing and configuration meeting with the Engineer shall be held.
- b. The Contractor, in conjunction with the Engineer, will perform necessary configuration adjustments to the speed feedback trailer.

3. Maintenance.

- a. Provide preventive maintenance necessary to achieve uninterrupted service.
- b. Verify operational status each day as part of the daily diary and notify Engineer when a problem is detected.
- c. 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 speed feedback trailer for 3 continuous days or 7 intermittent days over a 2 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 the speed.
- d. 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.

4. ~~Remove speed feedback trailers when no longer needed.~~**N. Safety Closure.**

Two types of safety closures will be specified: road closures and hazard closures.

1. Road Closure.

- a. Place fence meeting requirements of Article 2528.02 across roadway from outside edge of shoulder to outside edge of shoulder. Securely support fence so it is in a vertical position without sagging.
- b. Place Type III barricade, described in Part 6 of the MUTCD, immediately in front of fence at the approximate roadway centerline. Mount ROAD CLOSED (R11-2) sign on the Type III barricade.
- c. In lieu of Articles 2528.03, N, 1, a and b above, place a series of Type 3 barricades across roadway from outside edge of shoulder to outside edge of shoulder. Ensure gaps between Type 3 barricades are no greater than 6 inches. Mount ROAD CLOSED (R11-2) sign over the top two rails of on the Type 3 barricade located closest to the approximate roadway centerline.
- d. Erect road closures as specified in the contract documents. Erect them on the mainline of roadway where public traffic is diverted onto an on-site detour and where public traffic is prohibited from entering work area.
- e. Erect road closures beginning with the start of the contract period as specified in the contract documents, or when work commences.

2. Hazard Closure.

- a. Place fence meeting requirements of Article 2528.02 across roadway from outside edge of shoulder to outside edge of shoulder. Securely support fence so it is in a vertical position without sagging.
- b. Place Type III barricade, described in Part 6 of the MUTCD, immediately in front of fence at the approximate roadway centerline.
- c. In lieu of Articles 2518.03, N, 2, a and b above, place a series of Type 3 barricades across roadway from outside edge of shoulder to outside edge of shoulder. Ensure gaps between Type 3 barricades are no greater than 6 inches.
- d. Erect hazard closures as specified in the contract documents. Erect them at locations within 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.
- e. Erect hazard closures beginning with the start of the contract period as specified in the contract documents, or when work commences.

3. Responsibility.

- a. Maintain location and condition of safety closures. Any Contractor who temporarily moves the safety closure for equipment or delivery of materials, shall replace it in its original position and is responsible for the restriction of public traffic into the closed area.
- b. If a safety closure placed by the Contractor is required for an area after the Engineer's approval of completed work for that specific area, maintenance of that safety closure will become the responsibility of the Contracting Authority. The Engineer will document in writing the transfer of authority.
- c. The Engineer will notify Contractor of the date of removal of safety closures. Safety closure remains property of the installing Contractor. If safety closure is not removed by the date specified in the notification, it will become property of the Contracting Authority and the Contractor will be charged for removal costs.

N O. Limitations.

1. Use sandbags or other crashworthy methods to anchor all traffic control devices subject to movement by wind.
- ~~2. When a two way road is open to public traffic during contract work, do not control one way traffic through the work area by means of a carry through flag or other token, except during equipment failure or emergency. Use other means when voice or signal communication between flaggers at control points is difficult or not effective because of distance, sight, or noise. Other means may be two way radio, pilot cars, or traffic signals.~~
- ~~3. Use pilot cars when the normal work area exceeds 1/4 mile on Primary projects. Where necessary for short durations, the distance may be extended to 1/2 mile for better sight distance or to clear intersections or other safety considerations with approval of the Engineer, provided a two way radio is used for communication between flaggers.~~
- 4.2. During non-working hours, remove, cover, or turn down traffic control devices intended for working hours only, unless a drop-off or physical obstruction remains within 15 feet of a lane open to traffic. Signs or barricades are not required for work beyond 15 feet of a lane open to traffic. Remove traffic control devices when no longer needed.
- 5.3. Personnel in the highway right-of-way shall wear only orange or strong yellow green ANSI 107 Type R Class 2 apparel when exposed to traffic or construction equipment. Orange or strong yellow green colored or a combination of these colors, 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 bands of retroreflective material spaced at least 6 inches apart. Background material shall extend at least 2 inches 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.
- 6.4. The Engineer may require signs and traffic control devices to be recleaned by washing. Use a brush and water, and detergent or solvent as necessary. Include the entire target area or sign face, supplemental or auxiliary signs, if any, all reflectors, and faces of warning lights which are part of that device.
- 7.5. Ensure entry to and exit from work areas is in the direction of public traffic and does not cross open traffic lanes at other than designated locations.
- 8.6. During hours of darkness, operate equipment in the traffic control zone facing in the direction of traffic flow unless specified otherwise in the Traffic Control Plan. Darkness will include the period from sunset to sunrise and other times when conditions such as fog, snow, sleet or rain provide insufficient lighting to clearly identify persons and vehicles on the highway at a distance of 500 feet ahead.
- 9.7. Unless stated otherwise in the ~~traffic control plan~~ Traffic Control Plan, provide for a minimum of 2 miles between traffic control zones on rural roadways. The Engineer will determine minimum distances between traffic control zones on urban roadways.

- 10 8.** Submit Traffic Control Plan modifications to the Engineer for review and approval prior to any changes being made. The Engineer may modify sign spacing to meet existing field conditions or to prevent obstruction of the motorist's view of permanent signing.
- 14 9.** Ensure vehicles (except ready mix trucks) hauling soil, aggregate, and paving material, and other construction material to or from work area display a minimum 16 inch by 48 inch sign with the legend "DO NOT FOLLOW - INTO WORK AREA", as shown in the contract documents. Comply with the following requirements for the sign:
- Orange with black lettering using Type VII (Iowa) sheeting.
 - Keep clean to maintain its visibility.
- 12 10.** For lanes closed to traffic, place two drums meeting the requirements of Article 2528.03, C, every 1000 feet. For full depth excavations in a closed lane, place two drums in front of each location. Additional drums need not be placed for full depth excavations spaced closer than 150 feet.
- 13.** ~~When milled or scarified surfaces exist, sign approaches to scarified areas using ROUGH ROAD (W8-8) signs. Place signs at least 250 feet 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 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.~~
- 14 11.** ~~Active~~ Contractor vehicles and self-propelled equipment (except hand operated equipment) operating or parked within 15 feet of an open traffic lane (unless shielded by temporary or permanent barrier) and contractor, delivery, and service and private vehicles entering or exiting work area shall display cab roof mounted amber or yellow high intensity rotating, flashing, or oscillating warning lights. Repair or replace vehicle warning lights not functional or missing within 24 hours.
- 12.** Parking of private vehicles on Interstate right-of-way will be allowed if private vehicles are parked at least 15 feet away from an open traffic lane when Contractor is working. Parking of private vehicles on Interstate right-of-way is not permitted during non-working hours. Request approval from Engineer of location for parking of private vehicles.
- 13.** Conduct operations within the same lane from the start of work area to end of work area and do not shift traffic from one lane to another lane unless allowed in the contract documents. If the contract includes work in adjacent lanes, space individual lane closures for each lane per requirements in Article 2528.03, O, 9.

2528.04 METHOD OF MEASUREMENT.

Measurement will be as follows:

A. Traffic Control.

Lump sum.

B. Portable Dynamic Message Signs.

The Engineer will count the number of days each Portable Dynamic Message Sign is required to be in 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.

C. Temporary Barrier Rail.

The Engineer will ~~calculate~~ measure the length of temporary barrier rail used ~~based on count and the nominal length of each unit~~ in linear feet. The length of temporary barrier rail measured will be the length required per setup. Measurement will also be made for temporary barrier rail moved within, or added to, an existing setup when required by the contract documents. Measurement of temporary barrier rail, after its initial placement, will not be made unless it is required by the contract documents to be moved.

D. Temporary Lane Separator System.

The Engineer will measure the length of the Temporary Lane Separator System installed in linear feet.

E. Modular Glare Screen.

Measurement for Modular Glare Screen System will be in linear feet.

F. Temporary Crash Cushions.

Article 2551.04 applies.

G. Temporary Traffic Signals.

By count for each group installation of temporary traffic signals operated by a common control unit. A group installation is normally four signal heads at the same traffic conflict area.

H. Temporary Floodlighting Luminaire.

By count.

I. Pilot Cars.

1. By count for the number of pilot cars used during each work shift. A shift is a scheduled period of work for the Contractor's operations.
2. For a pilot car to be counted:
 - a. Use of the pilot car is necessary and it is used as part of preplanned work that is started that shift and is intended to proceed for a major part of the shift. If used less than 4 hours during a shift, one half pilot car will be counted.
 - b. Use of other pilot cars is necessary and they are used for at least 1 hour during the shift, perhaps intermittently, and this shall be the primary duty of the employee. If used less than 4 hours in a shift, one-half pilot car will be counted. If used at least 4 hours, but less than 12 hours, a total of one pilot car will be counted. If used 12 hours or more, an additional one-half pilot car will be counted for a total of 1.5 pilot cars for the shift.

J. Flaggers.

1. By count for the number of flaggers used during each work shift. A shift is a scheduled period of work for the Contractor's operations.
2. For flaggers to be counted:
 - a. Use of the flaggers is necessary and they are used as part of preplanned work that is started that shift and is intended to proceed for a major part of the shift. If used less than 4 hours during a shift, one-half flagger will be counted. If used at least 4 hours, but less than 12 hours, a total of one flagger will be counted. If used 12 hours or more, an additional one-half flagger will be counted for a total of 1.5 flaggers for the shift.
 - b. Use of other flaggers is necessary and they are used for at least 1 hour during the shift, perhaps intermittently, and this shall be the primary duty of the employee. If used less than 4 hours in a shift, one-half flagger will be counted.

K. Monitoring with Incident Response.

Calendar days based on the contract quantity. Additional personnel required by the Engineer to provide additional traffic monitoring of CMS PDMS operation will be measured in calendar days per person needed.

L. Safety Closures.

By count for number of Safety Closures placed.

2528.05 BASIS OF PAYMENT.

Payment will be at the contract unit price as described below. When the Engineer requires recleaning of reflectorized surfaces of signs and traffic control devices, payment will be made as extra work according to Article 1109.03, B. All signs and traffic control devices furnished by the Contractor remain the Contractor's property at the completion of the work and are to be removed from the site when no longer needed.

A. Traffic Control.

1. Lump sum when there is a contract item for Traffic Control.
2. Payment is full compensation for:
 - Erecting, maintaining, moving, and removing all traffic control devices required by the contract documents, including warning lights,
 - Furnishing all materials, labor, and equipment, and
 - Traffic quality control.

B. Portable Dynamic Message Signs.

1. Payment will be at the contract unit price per calendar day for each Portable Dynamic Message Sign measured as provided in Article 2528.04, B.
2. Payment is full compensation for furnishing, placing, operation (when specified), and maintenance of PDMS. Payment includes the cost of preventative and unscheduled maintenance, cellular communication (when specified), on-board software, hardware, and power supply.

C. Temporary Barrier Rail.

1. Linear feet of Temporary Barrier Rail measured.
2. Maintenance of temporary barrier rail is incidental to Temporary Barrier Rail.

3. Payment for repair or replacement of temporary barrier rail damaged by public traffic will be paid according to Article 1109.03, B.

D. Temporary Lane Separator System.

1. Linear feet of Temporary Lane Separator System measured
2. Payment includes installation, maintenance, repair, removal of the temporary lane separator system (if installed in a temporary traffic control zone), and all required pavement or bridge deck repair.

E. Modular Glare Screen.

1. ~~Per foot~~ Linear feet of Modular Glare Screen System measured.
2. Payment is full compensation for:
 - Material, equipment, and labor to furnish and install the system on top of temporary concrete barrier rail,
 - ~~Furnishing and applying retroreflective strips,~~
 - Maintenance of the system,
 - Repairing or replacing damaged parts of the system,
 - Removing and reinstalling the system if necessary when moving the concrete barrier rail, and
 - Final removal of the system from the top of the concrete barrier rail.

F. Temporary Crash Cushions.

Article 2551.05, A, applies.

G. Temporary Traffic Signals.

1. Each, for individual group installations operated by a common control unit, normally four signal heads at the same traffic control area.
2. Payment is full compensation for furnishing, installing, maintaining and servicing the controller, signal heads, traffic detection system, signal operator, costs for electrical energy, and the cost of removing temporary traffic signal materials from the construction site. The Contractor shall supply their own breaker box and power meter and shall not connect to existing Contracting Authority owned circuits to supply power for temporary traffic signals.

H. Temporary Floodlighting Luminaire.

1. Each.
2. Payment is full compensation for: furnishing, installing, maintaining and servicing temporary floodlighting units, costs for electrical energy, cost of removing lighting materials from construction site, and Contractor shall supply their own breaker box and power meter and shall not connect to existing Contracting Authority owned circuits to supply power for temporary floodlighting.
 - ~~Furnishing, installing, maintaining and servicing the temporary floodlighting units,~~
 - ~~All costs for electrical energy,~~
 - ~~The cost of removing all lighting materials from the construction site, and~~
 - ~~The Contractor shall supply their own breaker box and power meter and shall not connect to existing Contracting Authority owned circuits to supply power for temporary floodlighting.~~

I. Pilot Cars.

Predetermined contract unit price per each for number of shifts each pilot car was operated.

J. Flaggers.

1. Predetermined contract unit price per each for number of shifts each flagger was used.
2. Payment is full compensation for providing trained flaggers according to ~~Article 2528.03, K~~ Article 2528.03, J.

K. Monitoring with Incident Response.

1. Per calendar day for number of calendar days used.
2. This payment is full compensation for:
 - Furnishing the necessary vehicle (including operation, maintenance, and supplies),
 - Furnishing the operator,
 - Documentation of events that restrict normal flow of traffic including responses to an emergency situation,

- Re-erecting, repairing, or replacing traffic control devices,
 - Providing assistance to persons with vehicle problems,
 - Moving stalled vehicles, and
 - Summoning further assistance when needed.
3. Payment for number of calendar days that additional personnel, such as for CMS PDMS operation required by the Engineer, will be the contract unit price per calendar day. Payment is full compensation for furnishing required personnel and necessary support vehicles.

L. Safety Closures.

Payment is full compensation for furnishing material, labor, and equipment necessary to erect, maintain, and remove Safety Closure, unless indicated otherwise in the contract documents.

Section 2529

2529.01, A.

Replace the first sentence.

Remove pavement in areas designated by the Engineer to be patched.

2529.02, A, Hot Mix Asphalt Mixture.

Replace the Article:

Unless stated elsewhere in the contract documents, use HMA meeting or exceeding Section 2303 requirements for a 300,000 ESAL Standard Traffic (ST) surface mixture. ~~with Use an asphalt binder meeting or exceeding PG 64-22S or PG 58-28HS Performance Graded asphalt binder.~~ Use an asphalt binder meeting or exceeding PG 64-22S or PG 58-28HS Performance Graded asphalt binder.

2529.02, B, 4, Cement.

Replace Table 2529.02-1:

Table 2529.02-1: Cement Types and Maximum Allowable Substitution Rates

| Patch Type | Cement Type | Maximum Allowable Substitution | Minimum Mix Temperature |
|---|-----------------------------|--------------------------------|-------------------------|
| 5 Hour | Type I, Type II Type IS | 0% Fly Ash 0% Fly Ash | 75°F 80°F* |
| 10 Hour | Type I, Type II Type IS | 10% Fly Ash 0% Fly Ash | 65°F 70°F* |
| 24 Hour | Type I, Type II, Type IS | 0% Fly Ash | 50°F |
| * When a Type A Mid Range Water reducing admixture is used, limit the minimum mix temperature to that required when Type I/II cement is used. | | | |

2529.02, B, 9, Concrete Mixers.

Replace the Article:

For PCC patches, use Class M mixtures with calcium chloride. ~~The Engineer may waive the use of calcium chloride on patches cured longer than 10 hours.~~ Use Class M without calcium chloride for patches cured for 24 hours.

2529.03, G, 3.

Replace the fourth sentence:

Cover the blanket-type cover completely with insulation board having the following properties: cellulosic fiber sheathing with a minimum nominal 3/4 inch thickness.

2529.03, G, 4.

Replace the Article:

Cure PCC patches placed on multi-lane sections for a minimum of 10 hours before opening to traffic. Cure PCC patches placed on two-lane sections a minimum of 5 hours before opening to traffic. When allowed by the contract documents or Engineer, cure PCC patches without calcium chloride on multi-lane sections a minimum of 24 hours. These restrictions may be modified in the plans or by the Engineer for specific sections.

2529.03, H, 1.**Replace** the Article:

Profilometer Smoothness testing and evaluation is required for each patch with a length of 50 feet or more. For full lane width patches, perform testing near the center of the traffic lane after the patch is placed. For partial lane width patches, perform testing in the patched wheel path.

2529.03, H, 2, d.**Replace** the Article:

Compare the new index with the ABI. Perform surface correction according to Article 2316.03 to a profile index less than the ABI when:

- 1) New profile index exceeds 12.0 inches per mile and exceeds ABI by more than 2.0 inches per mile.
- 2) New profile index exceeds 30.0 inches per mile and exceeds ABI.
- ~~1) If the new profilometer index does not exceed the ABI, the work is acceptable and no correction is required.~~
- ~~2) Corrective action is also not required if the new profilometer index is equal to or less than 12 inches per mile, regardless of the ABI.~~
- ~~3) If the new profilometer index is greater than 12 inches per mile and less than 30 inches per mile and is also within 2 inches per mile of the ABI, corrective action is not required.~~
- ~~4) If the new profilometer index is greater than 30 inches per mile, corrective action is required to reduce the new index at least to the ABI.~~

Section 2530**2530, Partial Depth Finish Patches.****Replace** the Section:**2530.01 DESCRIPTION.**

- A. Remove pavement in areas designated in the contract documents or by the Engineer to be patches. This includes furnishing and placing patching material to provide a new traffic surface, and restoring the adjacent shoulder as shown in the contract documents. This work is in areas where the size, shape, and depth of patch depends on the extent of pavement deterioration and shall be determined during the removal operation.
- B. Partial depth finish patches may be identified and constructed as one of the following types:
 1. **Partial Depth PCC Finish Patches.**
These patches are square or rectangular in shape. ~~Saw the edges.~~ They will be less than 6 feet in length when placed on a longitudinal or transverse joint or random crack. Removal may be by milling or other equipment. This type of patch will be identified by tabulation in the contract documents. The size and location for each lane will be shown.
 2. **Partial Depth PCC Joint and Crack Repair Patches.**
Joint and crack repairs are square or rectangular in shape. They will be placed at a longitudinal or transverse joint or random crack. They will be a minimum of 6 feet in length, and will be identified by tabulation in the contract documents. Size and location will be shown. Repair size and location may be adjusted to fit field conditions.
 3. **Overdepth Patches.**
Overdepth patches are irregular in shape. They are placed to the full depth of existing pavement in areas of unsound concrete as designated by the Engineer. Repair size and location will be determined at time of construction.
 - ~~2~~ **4. Partial Depth Regular HMA Finish Patches.**
These patches are in the shape of a square or rectangle. They have square corners and straight edges to allow almost all of the removal by a milling machine. An air hammer or saw may be necessary to complete removal along edges and at corners. This type of patch will be identified by tabulation in the contract documents. The size and location in each lane will be shown.
 - ~~3~~ **5. Partial Depth Irregular HMA Finish Patches.**
These patches are not square or rectangular in shape. They have at least one side that is not straight or one corner that is not square which will prohibit complete removal by a milling machine. Other equipment such as an air hammer or saw may be necessary to accomplish the removal. This type of patch will be identified by tabulation in the contract documents. This tabulation will be an estimate of the number of patches per lane mile, and the estimated total area of patch.

2530.02 MATERIALS.

Meet the requirements for the type of material specified.

A. Hot Mix Asphalt Patching Material.

Unless stated elsewhere in the contract documents, use HMA meeting or exceeding Section 2303 requirements for a Standard Traffic (ST) 3/8 or 1/2 inch surface mixture. Use an asphalt binder that meets or exceeds PG 64-22S or PG 58-28HS. For partial depth patches on HMA overlay projects, the binder grade specified for mainline intermediate or surface course may be substituted.

B. Portland Cement Concrete Patching Material.

Meet one of the requirements below. When patching encroaches on an adjacent lane which is open to traffic or when there is patching on two lane pavements or other locations where overnight closures are not permitted, use Class A or Class B patching material. On pavements with three or more lanes and where overnight closure is permitted, use Class C patching material.

1. Class A Patching Material.

- a. Use a modified Portland cement type manufactured to provide rapid set and high early strength. Meet the requirements of Materials I.M. 491.20.
- b. When a mortar is furnished, add the manufacturer’s recommended quantity of coarse aggregate.

2. Class B Patching Material.

- a. Use high early strength rapid set (5 hour) PCC meeting the requirements of Materials I.M. 529 and the following requirements:
 - Use Class M mixture patching material with calcium chloride. Class M mixtures with calcium chloride are not to contain fly ash.
 - When calcium chloride is used in a mixture, place the concrete within 30 minutes after the introduction of the calcium chloride.
 - For coarse aggregate, ~~meet the requirements of Section 4115 and Gradation No. 5, Aggregate Gradation Table, Appendix~~ use crushed carbonate stone chips or pea gravel, minimum Class 2 durability, meeting requirements of Section 4112.
- b. When Class B patching material is furnished for partial depth patches, it may also be furnished for full depth patches.

3. Class C Patching Material.

- a. Use a PCC mixture with an early set that will allow time of opening to traffic in 24 hours to 36 hours as directed by the Engineer. For coarse aggregate, meet the requirements for Class B patching material. Use Class M mixture meeting the requirements of the current Materials I.M. 529 without the addition of calcium chloride.
- b. When Class C patching material is furnished for partial depth patches, it may also be furnished for full depth patches.

4. Modifications to Mixtures for Class B and Class C Patching Material.

Apply the following modifications to the PCC mixtures for Class B and Class C patching material:

- a. **Slump.**
 - 1) Slump, measured according to Materials I.M. 317 prior to addition of calcium chloride solution, is to be between 1 inch and 2 1/2 inches as a target range, allowing a maximum of 3 inches. If calcium chloride solution is not to be added, the slump is to be between 1 inch and 3 inches as a target range, allowing a maximum of 4 inches.
 - 2) When a Type A Mid Range water reducing admixture is used, the slump, tested prior to the addition of calcium chloride, is to be between 1 inch and 4 inches as a target range, allowing a maximum of 5 inches.
- b. **Air Entrainment.**
The entrained air content of the unconsolidated concrete will be determined according to Materials I.M. 318, prior to addition of calcium chloride if it is to be added. When calcium chloride is to be added, air entrainment is to be 5.0%, with a tolerance of ± 2.0%. When no calcium chloride is to be added, air entrainment is to be 6.5%, with a tolerance of ± 1.5%.
- c. **Temperature.**
The temperature of Class B patching material, as delivered to the job site, is to be as required in Article 2530.02, B, 4, d below. Ensure the temperature of Class C patching material, as delivered to the job site, is greater than 65°F. Heating the water, aggregate, or both, may be necessary to meet this requirement. The cost of heating is incidental to patching.
- d. **Cement.**
 - 1) For Class M concrete mixtures, meet the requirements of Section 4101.
 - 2) Refer to Table 2530.02-1 for cement types and maximum allowable substitution rates. The maximum substitution for Type IS is not to exceed 25%.

Table 2530.02-1: Cement Types and Maximum Allowable Substitution Rates

| Patch Class | Cement Type | Maximum Allowable Substitution | Minimum Mix Temperature |
|-------------|----------------------------|--------------------------------|-------------------------|
| B | Type I, Type II Type IS | 0% Fly Ash 0% Fly Ash | 75°F 80°F* |

| | | | |
|---|----------------------------|---------------------------|---------------|
| C | Type I, Type II Type IS | 10% Fly Ash 0% Fly Ash | 65°F 70°F* |
| * When a Type A Mid Range water reducing admixture is used, limit the minimum mix temperature to that required when Type I/II cement is used. | | | |

e. Calcium Chloride.

- 1) Where calcium chloride is required, furnish it in water solution form and add it to the mix at the job site. Use a commercial 32% calcium chloride solution, or equivalent, prepared according to Table 2530.02-2:

Table 2530.02-2: Proportions for 32% Calcium Chloride Solutions

| Type of Solid Calcium Chloride | Pounds of Solid per Gallon of Water | Solution Produced per Gallon of Water |
|---|-------------------------------------|---------------------------------------|
| Type 1 – Regular Flake (77% material) | 6 | 1.3 |
| Type 2 – Concrete Flake or Pellets (94% material) | 4.5 | 1.2 |

- 2) The Engineer will check the solution concentration using a hydrometer according to Materials I.M. 373. Add the solution at the rate of 3.0 gallons per cubic yard of concrete. Calcium chloride solutions of different concentrations may be approved by the Engineer, provided appropriate adjustments in the total concrete composition are made.
- 3) Agitate the mixture until the calcium chloride is completely in solution, and continue agitation, as necessary, to maintain uniformity.
- 4) Except when using continuous mixing equipment described in Article 2001.20, E, ensure the calcium chloride solution is present in the mix for at least 2 minutes of mixing.

f. Water Reducer.

A Type A Mid Range water reducing admixture may be used. Use one listed in Materials I.M. 403, at the manufacturer's recommended dosage.

g. Aggregate Durability.

Unless specified otherwise, use coarse aggregate of the proper class of durability, as defined in Article 4115.04.

h. Transit Mix Concrete.

Use a mix from a plant from which the concrete can be delivered and placed within 60 minutes from the start of mixing. The time may be extended to 90 minutes when a retarding admixture, used according to Materials I.M. 403 including temperature dosage guidelines (and at no additional cost to the Contracting Authority), is added at the plant. Continuous mixing equipment using volumetric proportioning may be used according to Article 2001.20, E.

i. Prepackaged Mixture.

A prepackaged mixture, proportioned as specified above for Class B or Class C matching material, may be furnished as a Class B or Class C patching material with the Engineer's approval. The coarse aggregate for prepackaged mixtures is limited to that meeting the requirements of Article 4115.05. Mix prepackaged mixtures in an on-site paddle type mixer or proportion and mix with continuous mixing equipment using volumetric proportioning according to Article 2001.20, E.

C. Joint Boards.

Comply with the following:

1. Joint boards for recreating joints and cracks: use a resilient filler, cellulosic fiber, paraffin coated cardboard, or other compressible material of the proper shape to recreate the joint during placement of the patch material.
2. Boards for recreating transverse joints: one piece, ~~so as to have no horizontal joints~~. One piece boards will not be required in lengths exceeding 6 feet.
3. Boards for recreating longitudinal joints: one piece. One piece boards will not be required in lengths exceeding 4 6 feet.
4. Joints and open transverse cracks: use a board with a nominal width of 1/4 inch. Metal strips may be used for narrow cracks.
5. Extend boards and metal strips into the pavement to the bottom of the patch.
6. Use of a bond breaker on board surfaces is encouraged.

D. Joint Sealer.

Use joint sealer and backer rod meeting the requirements of Section 4136. Unless specified otherwise, use only hot

poured joint sealer.

E. Tack Coat Bitumen.

For HMA patches, use tack coat bitumen as specified in Article 2303.02, E.

2530.03 CONSTRUCTION.

A. Equipment.

1. Remove existing surface material using a milling machine, jack hammers, or similar equipment. Hand equipment may be necessary to achieve a vertical edge and the designated shape.
- ~~2. Sawing equipment is required at edges from a milling operation.~~
- ~~3~~ 2. The following additional equipment is required for PCC patches:
 - a. Sandblasting equipment for cleaning of the prepared patch area on PCC pavements.
 - b. 15 pound (or less) air chisel to complete patch area preparation. A 30 pound air chisel may be used if its use does not result in significant damage to the patch area and edges.
 - c. Air compressor that emits oil and moisture free air for cleaning the prepared area.
 - d. On-site paddle type concrete mixer for mixing Class A patching material or other prepackaged mixtures.

B. Partial Depth Finish Patch Construction.

1. General.

- a. The tabulations for partial depth finish patches shown in the contract documents are for estimating purposes only. The Engineer will designate the location and limits of these patches.
- b. The shape and depth may be irregular so that hand operated equipment may be necessary for all or some of the removal.
- c. Remove the existing pavement material within the designated area to sound concrete as determined by the Engineer. All material removed not designated for salvage becomes the property of the Contractor and shall be removed according to Article 1104.08.

2. Hot Mix Asphalt Patches.

Construct partial depth HMA finish patches as follows:

a. Preparation of Patch Area.

- 1) Remove material to a minimum depth of 3 inches. Where this depth is adequate, make the prepared surface relatively even. The maximum depth is 75% of the pavement thickness, but no more than 9 inches.
- 2) Remove material so that the edges of all patch areas are vertical to a depth of 1 1/2 inches. Minor rounding of the bottom edge is permissible. Cut and remove exposed reinforcing steel. Clean the patch area.
- 3) Where removal to the depth described above leaves unsound concrete within the limits of the patch area, the Engineer may designate a part of the patch area as a full depth patch. Remove the concrete for the full depth, but removal to a depth greater than 12 inches will not be required. Consolidate the subgrade or subbase material with a mechanical tamper or other compaction equipment as directed by the Engineer.

b. Placing HMA Patch Material.

- 1) After removal of the old pavement, lightly tack the edges and bottom of the patch area. Deposit and compact the HMA patch mixture in layers as follows:
 - a) Deposit the upper 5 inches in at least two layers, with the top layer not exceeding 2 inches in thickness, when compacted. Lifts should be at least 3 times the mixture size.
 - b) Thoroughly compact each layer, while hot, using appropriate compaction equipment. Succeeding layers may be placed as soon as the preceding layer has been properly compacted.
 - c) Smooth the final layer with a steel tired finish roller meeting requirements of Article 2001.05, B or F. A roller meeting requirement of Article 2001.05, F, may be a small roller suitable for this type of operation.
 - d) Ensure the final compacted surface is level with, or not more than approximately 1/4 inch above, the surrounding pavement.
- 2) Open the patch to traffic after the mixture has cooled to provide stability; however, on two lane roadways, do not leave barricades in place overnight. If the patch becomes distorted beyond the smoothness requirements for any reason, smooth the surface within 1 working day by blading, scraping, filling, or by other approved means.
- 3) Prior to final acceptance, a finish patch shall be level with, or not more than 1/8 inch above, the adjacent pavement, and have a smooth riding surface.

c. Sealing Joints and Cracks.

- 1) Seal all edges of HMA patches to a width of 3 inches centered on the edge. Use CRS-2 bitumen applied with a "V" shaped squeegee tool. Blot excess bitumen material with sand.
- 2) When joint and crack sealing work is part of the contract, saw joints and cracks that cross areas of HMA finish patches to a width of 1/8 inch to 1/4 inch. Saw to the depth of the patch with a maximum depth of 3 inches. Perform this work within 3 working days after placement.

3. Portland Cement Concrete Patches.

Construct partial depth PCC finish patches as follows:

a. Preparation of Patch Area.

- 1) Remove concrete in designated repair area to a minimum width of 12 inches using either of the following methods:
 - a) Mill transversely or longitudinally matching general alignment of patch. Use a mill that produces patch edges with a 30 to 60 degree angle or chip back patch edges to a 30 to 60 degree angle. Chip out secondary spalling resulting from milling at no additional cost to the Contracting Authority.
 - b) Place 2 inch saw cuts along perimeter of patch area and chip back patch edges to a 30 to 60 degree angle.
- 2) If a joint or crack is within a patch area, construct the bottom edge of that patch to be at least 6 3 inches beyond the joint or crack.
- 3) Form or saw patch edges to prevent them from protruding beyond edge of existing pavement by more than 3/8 inch.
- 2 4) Each patch will have a generally rectangular area. Remove the PCC concrete in that area to a minimum depth of 3 2 inches. Many areas will require removal of unsound PCC concrete to a greater depth to reach sound concrete. The maximum depth is 75% one half of the pavement thickness but not more than 9 inches.
- 3) ~~Milling will be allowed, but the depth within the designated patch area is to be at least 3 inches. Remove concrete from feathered runouts to a depth of 3 inches if within the designated patch area, or to a depth of 2 inches if outside the designated patch area. Saw these edges vertically. Ensure the prepared area has reasonably straight and vertical edges, not to exceed 1 inch in saw cut depth. Sawing will be required around the remainder of the patch perimeter, unless the Contractor demonstrates that an edge can be produced that is true and vertical, without sawing.~~
- 5) Do not damage steel reinforcement during removal process. Damaged steel will be the responsibility of the Contractor. If the end of a dowel bar is exposed, cut or remove dowel. Place duct tape, form oil, grease, or other method approved by the Engineer as a bond breaker on exposed dowels not removed.
- 4 6) When removal to the maximum depth leaves unsound concrete within the patch area, the Engineer may designate a part of the patch area as an full depth overdepth patch. Remove the concrete for the full depth of the existing pavement, but no more than 12 inches. Consolidate the subgrade or subbase material using a mechanical tamper or other compaction equipment as directed by the Engineer. Furnish and install No. 4 tie bars at mid-depth of existing pavement using an approved non-shrink grout. Place bar to provide a minimum 2 inch concrete cover.
- 5 7) When it is necessary to go below reinforcing steel to reach sound concrete, cut the reinforcing steel flush with the perimeter edges of the patch and remove.
- 6 8) Clean the patch area by sandblasting, followed by cleaning with compressed air. The completed surfaces are to appear surface dry to visual examination.
- 7 9) Recreate a joint or crack in the patch area with a joint board of the proper size and shape. Extend the board to the bottom of the area to be patched, so as to separate completely all patching material on both sides. Use a board of a width approximately equal to the joint or crack. For wide openings, several thicknesses may be used. For patches 6 feet or greater in length:
 - a) Longitudinal joints for patches 6 feet or greater in length may be reestablished by sawing to a depth of 1/3 the pavement thickness.
 - b) ~~With approval of the Engineer, transverse joints may be reestablished by sawing the full depth of the patch when use of a form board will not allow complete separation of patch material on both sides of joint.~~

b. Placing PCC Patch Material.

- 1) Scrub a cement-sand-water grout of creamy consistency onto the patch surfaces, including the edges. Grout shall consist of two parts of Type I or Type I/II Portland cement and one part sand mixed with water. Mix grout by mechanical means. Place the patch material before the grout dries. If grout dries before placement of patch material, clean patch area again by sandblasting and air blasting, then reapply grout.
- 2) Mix Class A patching material with water and coarse aggregate, if required. Place the properly mixed material in the patch area, consolidate and worked into place in a manner that will provide good bonding. Level it with the adjacent pavement to provide a smooth riding surface not varying from existing pavement surface by more than 1/8 inch when measured with a 10 foot straightedge placed over patch. Replace or grind patch to correct deficiencies. ~~Texture patches longer than 1 foot in the manner of the adjacent pavement surface.~~ Apply broom finish to patch surface and then apply a heavy application of grout around perimeter of patch. Position grout so 1 inch is over surrounding pavement and 3 inches is over the patch.
- 3) For Class A patching materials, perform this work according to the patching manufacturer's recommendations and limitations, subject to approval of the Engineer. Furnish these recommendations to the Engineer. After 1 hour, remove the joint board in a manner that does not damage the patch. The area may then be returned to public traffic.
- 4) ~~Mix Class B and Class C patching material and place in the patch area. Consolidate it by vibration in a manner that will provide good bonding. Level the patch to provide a smooth riding surface. Texture patches longer than 1 foot in the manner of the adjacent pavement surface.~~

c. Protecting and Curing.

- 1) Class A patching material.

Cure according to the manufacturer's recommendations. If manufacturer's strength data at anticipated curing temperatures is not available, use only when mix and substrate temperature are 50°F or greater and cure for a minimum of 4 hours.

2) Class B patching material.

- a) Cure as specified in Article 2529.03, G.
- b) Cure these patches for the minimum time specified in Article 2529.02 for the mixture used.

3) Class C patching material.

- a) ~~Cure according to Article 2529.03, G. Patches may be covered immediately with white pigmented curing compound. In this case, the specified cure may be delayed as much as 2 hours.~~ Cure patches with an approved white pigmented curing compound meeting the requirements of Section 4105. Apply curing compound within 30 minutes after placement of patching material.
- b) Cure patches with Class M concrete a minimum of 36 hours or as directed by the Engineer.
- c) ~~After the required curing period, the insulation blanket and the joint forming board may be removed in a manner that does not damage the patch, or removal may be delayed until the sealing is to be done provided no damage results from the delay.~~ Cure according to Article 2529.03, H, when overnight low temperatures are forecast to be below 35°F.

d. Surface Finish.

~~Prior to final acceptance, level finish partial depth finish patches with the adjacent pavement. Trowel toward edge of the repair when finishing. Ensure they have a smooth riding surface.~~

e. Joint and Crack Sealing.

Where joints and cracks cross areas of partial depth PCC patches, saw, seal, and clean the patch according to Article 2301.03, P. Complete sealing within 5 working days after the patch is placed. When joint and crack sealing is included in the contract, perform sealing as part of that work.

f. Failure Repair.

Repair failed patches that appear within 30 calendar days of original construction or subsequent repair at no cost to Contracting Authority. Failures may include, but are not limited to, loss of bond between patch and underlying pavement or random cracking.

C. Limitations of Operations.

1. Unless the road is closed, maintain traffic during construction operations. Conduct all operations with minimum inconvenience to traffic. On two-lane roads, limit operations to one traffic lane at a time, except for minor encroachment in the adjacent lane for sawing and installing forms when traffic is maintained. For multiple lane roadways, the work area may include one lane in each direction.
2. An adjacent lane shall be opened to traffic prior to the old pavement being removed from a patch area.
3. When approved by the Engineer, patch areas may extend up to 2 feet into an adjacent lane as allowed by the contract documents.
4. Adjust the work schedule so all work for each patch, including removal of barricades and equipment (except the cure period for PCC Class C concrete), will be completed on the same day it is started between the hours of 30 minutes after sunrise to 30 minutes before sunset. If unforeseen conditions result in excavated areas being left overnight, assign a sufficient number of flaggers to warn and direct traffic until the patches are placed. Extra payment will not be made for the necessary flaggers.
5. Place PCC patching material only when the ambient air and pavement temperatures are 45°F or above.
6. The Engineer may limit advance sawing.
7. If an emergency makes a DW joint necessary, temporarily fill the excavated area following the joint with a suitable hot or cold paving mixture or stable granular material, as directed by the Engineer. The Engineer may direct that the lane remain closed to traffic overnight. Provide traffic control.
8. When PCC patches without calcium chloride are constructed, place two drums meeting the requirements of Article 2528.03, C, in front of each patch location where there is a possibility of turning into or returning to the closed lane. Additional drums need not be placed for patches spaced closer than 150 feet.
9. Apply Articles 1107.08, 1107.09, and 1108.03.

D. Area Restoration.

When the patch is completed, remove forms if they have been used. Fill all excavated space along the outside pavement edge with material similar to that in the existing shoulder, satisfactory to the Engineer. Thoroughly compact the material before the section is opened to traffic.

2530.04 METHOD OF MEASUREMENT.

The Engineer will determine the quantities involved in satisfactory construction of partial depth finish patches for the areas specified as follows:

A. Partial Depth PCC Finish Patches.

1. The Engineer will calculate the area of each patch in square feet from surface measurements. The area of each patch less than 1 square foot will be counted as 1 square foot for payment purposes. If the patch area is increased by the Contractor to accommodate milling equipment, only the area designated by the Engineer will be measured for payment.
2. ~~The Engineer will also calculate the area of patches in square feet which have been directed to be constructed full depth.~~ Removal and repair of areas up to one half existing pavement thickness will be included in this payment.

B. Partial Depth PCC Joint and Crack Repair Patches.

1. Measurement for Partial Depth PCC Joint and Crack Repair Patches will be to the nearest 0.1 linear foot on the basis of 12 inch width of repair. Areas designated for repair outside the 12 inch repair width will be measured as Partial Depth PCC Finish Patches per Article 2530.04, A, 1.
2. Removal and repair of areas up to one half existing pavement thickness will be included in this payment.

C. Overdepth Patches.

Engineer will calculate area of each Overdepth Patch in square feet at the mid-depth of the pavement. Area of each patch less than 1 square foot will be counted as 1 square foot for payment purposes.

B D. Partial Depth HMA Finish Patches.

1. The Engineer will measure the area for each patch and the weight of HMA placed in partial depth patches according to Article 2303.04. Regular patches and irregular patches will be calculated and totaled separately. If the patch area is increased to accommodate milling equipment, only the quantities for the area designated by the Engineer will be measured for payment.
2. Asphalt binder and tack coat will not be measured separately for payment.
3. The Engineer will also calculate the area and weight of patch material placed in HMA patches which have been directed to be constructed full depth. The Engineer will deduct quantities not used.

2530.05 BASIS OF PAYMENT.

Payment for construction of the various types of partial depth finish patches, satisfactorily constructed, at the areas specified, will be the contract unit price as follows:

A. Partial Depth PCC Finish Patches.

1. Per square foot.
2. Payment is full compensation for removal of all pavement, preparing the patch area, furnishing and placing all material, construction of joints, sawing, finishing, curing, and restoration of the area.
3. ~~When parts of PCC partial depth finish patches are constructed to full depth at the direction of the Engineer, payment will be for the areas of those parts at two times the contract price per square foot for partial depth PCC patches.~~

B. Partial Depth PCC Joint and Crack Repair Patches.

1. Per linear foot.
2. Payment is full compensation for repairs up to one half existing pavement thickness and includes removal of pavement, preparing the patch area, furnishing and placing material, construction of joints, sawing, finishing, curing, and restoration of area.

C. Overdepth Patches.

1. Per square foot. Payment for Overdepth Patches will be in addition to Partial Depth PCC Finish Patch or Partial Depth PCC Joint and Crack Repair Patch quantities for the same area.
2. Payment is full compensation for repairs designated in lower half of existing pavement and includes removal of pavement, preparing the patch area, and furnishing and placing material.

B D. Partial Depth HMA Finish Patches.

1. Payment will be for both the patch area and the quantity of HMA placed in the patch.
 - a. **Regular Partial Depth HMA Finish Patches, by Area.**
Per square yard.
 - b. **Irregular Partial Depth HMA Finish Patches, by Area.**
Per square yard.
 - c. **Hot Mix Asphalt Mixture.**
Per ton. Includes mixture designated for full depth patches.
2. When parts of regular or irregular partial depth HMA finish patches are constructed to full depth at the direction of the Engineer, payment will be for the areas of those parts at two times the contract price per square yard for regular or irregular partial depth HMA finish patches.
3. Payments are full compensation for:
 - Removal of the old pavement,
 - Preparing the patch area,
 - Furnishing and placing the HMA patching material, including asphalt binder in the mixture and necessary tack coat bitumen,
 - Sawing and sealing,
 - Sealing the patch edges, and
 - Restoration of the area.

4 E. When joint and crack sealing is included in the contract, it will be paid for as a part of that work.

Section 2532**2532.03, B, 3, a.**

Add as the second sentence:

No areas greater than 2 feet in length shall be left without texture. Total depth of concrete surface ground shall not exceed 1/4 inch.

Section 2535**2535.03, A, 2.**

Replace the last sentence of the Article:

When not included in contracts for grading, all excavation in connection with this construction is Class 23 Excavation according to Article 2402.03, J K.

Section 2540**2540.02, Materials.**

Replace the Article:

A. Use the following materials for filling the longitudinal joint in the PCC base:

1. For a 0 to 3/4 inch opening, fill the existing joint with either PG 58-xxS or CRS-2 emulsion.
2. For an opening greater than 3/4 inch, fill the existing joint with a 3/8 inch to 1/2 inch commercial HMA mixture with PG 58-xxS or other suitable hot or cold bituminous mixture approved by the Engineer.

B. For completing the joint repair (filling the milled trench above the PCC base), use a ~~300,000 ESAL~~ Standard Traffic (ST) HMA or similar mixture approved by the Engineer.

Section 2543**2543.02, A.**

Replace the Article:

Unless stated elsewhere in the contract documents, use HMA meeting or exceeding Section 2303 requirements for a ~~300,000 ESAL~~ Standard Traffic (ST) surface mixture.

Section 2548

2548.02, B, 1.**Replace** the Article:

Use asphalt emulsion Grade CSS-1, or CSS-1h, SS-1, or SS-1h meeting requirements of Section 4140.

2548.03, Construction.**Add** to the end of the first paragraph:

Allow PCC to cure for a minimum of 14 days prior to placing milled rumble strips.

Section 2549**2549, Pipe and Manhole Rehabilitation****Replace** the Section:**2549.01 DESCRIPTION.**

This section was developed in conjunction with Sections 4050 and 6020 of the SUDAS Standard Specifications, with modifications to suit the needs of the Department.

A. Cured-in-place Pipe (CIPP) Lining:

1. ~~Resin impregnated, cured-in-place~~ Mainline.
2. ~~Deformed/reformed polyethylene~~ Service (Lateral) Repair.
3. ~~Folded/formed polyvinyl chloride~~ Point Repair.
4. ~~Sliplining.~~

B. Pressure Testing and Grouting of Sewer Joints.**B C.** Pipe spot repairs.

- D. Pre-rehabilitation cleaning and inspection is light sewer cleaning including an unlimited number of passes with a hydraulic flusher. Does not include root cutting or removal of deposits or protruding service connections.
- E. Additional sewer cleaning is heavy sewer cleaning including an unlimited number of passes with high velocity hydro cleaning equipment / hydraulic spinner nozzle, cutting roots, removing deposits of attached encrustation (DAE), and removing deposits of attached grease (DAGS). Does not include lateral cuts.
- C F.** Rehabilitate existing manholes to waterproof and to prevent inflow and infiltration, to prevent corrosion, or to reestablish the structural integrity of the manhole. Includes construction of structural liners, protective liners, and infiltration barriers.

2549.02 MATERIALS.**A. Pipe Rehabilitation.**

1. Apply Article 4147.01.
2. **Submittals.**
 - a. **CIPP Rehabilitation.**
 - 1) **Thickness Design:** Submit design calculations for CIPP wall thickness based upon ASTM F 1216, prepared and signed by a licensed Professional Engineer in the State of Iowa.
 - 2) **Resin:** Certificate of compliance with ASTM F 1216 or D 5813.
 - 3) **Tube:** Certificate of compliance with ASTM F 1216 or F 2019. If glass fiber reinforcement is used, CIPP strain corrosion testing according to ASTM D 3681.
 - 4) **Wet Out and Curing:** Complete description of the manufacturer's recommended wet out procedure and curing method for the type of lining proposed.
 - 5) **Safety Procedures:** ~~When required in the contract documents,~~ Submit documentation of National Institute of Occupational Safety and Health (NIOSH) testing, health hazard evaluation, and recommended safety procedures for CIPP workers and public. The safety plan is to include emission stacks a minimum of 6 feet tall and a method to establish a safe perimeter around manholes/emission stacks a minimum of 15 feet in diameter. Based on active air monitoring, workers must wear suitable Personal Protection Equipment (PPE) when initially opening and entering the transport truck or storage unit holding the liner.
 - b. **Grouting Sewer Joints and Service Connections.**
 - 1) **Grout:** Description of chemical grout materials to be used.

- 2) **Additives:** Description of additives to be used including strengthening agents, shrinkage reducers, dye, viscosity modifiers, gel time modifier, freeze/thaw inhibitor, or others.
 - 3) **Root Inhibitor:** Description of chemical root deterrent.
 - 4) **Procedures:** Manufacturer's published recommendations for storing, mixing, testing, and handling chemical grouts.
- c. **Installer Information:** When requested by the Contracting Authority, submit the following prior to the preconstruction meeting.
- 1) Installer name.
 - 2) Completed project list for last 5 years including for each project and year completed, client name/address/contact person/phone number, footages installed by pipe diameter, and number of lateral reinstatements.
 - 3) Detailed installation procedures, including estimated times for each task, lateral reinstatement methods, number of required excavations, and other items unique to each product.
 - 4) Video of installation process, if available.
 - 5) Evidence of properly trained personnel.
 - 6) Related ASTM standards or any nationally recognized standards for product installation.
 - 7) Available equipment list.
 - 8) Detailed procedures for repairing the product in the event of future damage or failure and for tapping future service connections, including and required specialized equipment or training.
 - 9) Videos of two rehabilitated sewer sections showing before and after conditions.
- d. Additional information may be required. The submittal of prequalification information in no way implies that the product, manufacturer, or installer will be deemed to be qualified. The Contracting Authority, in its sole discretion, will determine whether a product, manufacturer, or installer does or does not qualify as an approved equal.

2 3. The Engineer may allow substitutions. Provide as a minimum the following information for evaluation:

- a. **Product Information.**
 - 1) Product name.
 - 2) Year product first available in the United States.
 - 3) Total footage or number of line segments installed in the United States.
 - 4) Results of all available product testing, including but not limited to leakage, physical properties, pipe stiffness, chemical resistance, strain-corrosion, external loading, flow characteristics, infiltration/inflow reductions, structural capacity, and external hydrostatic loading capacity.
 - 5) Samples of before and after product.
 - 6) Design method.
 - 7) Typical lining thickness for pipe sizes included in the project.
- b. **Manufacturer Information.**
 - 1) Manufacturer name.
 - 2) Years of experience manufacturing the product.
 - 3) Country of manufacture of all product components.
 - 4) Quality control procedures for product manufacture, including inspection requirements, testing procedures, and allowable tolerance levels.
 - 5) Related ASTM standards, or other nationally recognized standards for product manufacturing.
- c. ~~**Installer Information.**~~
 - 1) ~~Installer name.~~
 - 2) ~~Completed project list for last five years including for each project and year completed, client name/address/contact person/phone number, footages installed by pipe diameter, and number of lateral reinstatements.~~
 - 3) ~~Detailed installation procedures, including estimated times for each task, lateral reinstatement methods, number of required excavations, and other items unique to each product.~~
 - 4) ~~Video of installation process, if available.~~
 - 5) ~~Evidence of properly trained personnel.~~
 - 6) ~~Related ASTM standards or any nationally recognized standards for product installation.~~
 - 7) ~~Available equipment list.~~
 - 8) ~~Detailed procedures for repairing the product in the event of future damage or failure and for tapping future service connections, including required specialized equipment or training.~~
 - 9) ~~Videos of two rehabilitated sewer sections showing before and after conditions.~~
 - 10) ~~Additional information may be required. The submittal of prequalification information in no way implies that the product, manufacturer, or installer will be deemed to be qualified. The Contracting Authority, in its sole discretion, will determine whether a product, manufacturer, or installer does or does not qualify as an approved equal.~~

B. Manhole Rehabilitation.

Apply Article 4147.02

2549.03 CONSTRUCTION.

A. Pipe Rehabilitation.**1. Public Relations Program.**

Establish a Public Information and Notification Program for contacting each home or business connected to the affected sanitary sewer, informing them of the work to be done and when the sewer will be off line. The following specific steps are part of the Public Information and Notification Program:

- a. Provide written notice to be delivered to each affected home or business describing work, schedule, how the work affects them, and a local telephone number of the Contractor they can call to discuss the project or their problems.
- b. Personally contact each home or business on the day lateral verifications using closed circuit video inspection are to be performed. The homeowner or business will be asked to run water down their drain to verify each lateral. If the homeowner is unavailable, attempt other arrangements (cleanouts) to drain water through the lateral to verify each connection.
- c. Provide written notice and personally contact the home or business the day prior to beginning inversion of the section of sewer to which they are connected.
- d. Personally contact all homes or businesses that cannot be reconnected within the time stated in the written notice.
- e. Furnish and service portable toilets for use by the home or business occupants if so required by any affected served business or homeowner.

2. Special Requirements.

- a. Prior to start of work, notify all affected parties 24 hours in advance as to the length of time their service will be blocked.
- b. ~~Notify the Engineer's Water Works Department to use meter and pay for water, if required.~~
- c. Unless specified otherwise, the Contracting Authority will provide water at no cost for cleaning and installation of cured-in-place pipe from a nearby hydrant through a separate valve mounted on the hydrant. Utilize an approved double check backflow assembly or open gap.

3. ~~Examination.~~**a. ~~Cleaning.~~**

- 1) ~~Clean and remove soil, grit, debris, and obstructions prior to video inspection or insertion of lining pipe, or both.~~
- 2) ~~Do not flush debris to downstream sections.~~
- 3) ~~Deposit removed material at an approved site.~~

b. ~~Video Inspection.~~

- 1) ~~Furnish the Engineer with a recording of sewers: 1) before the lining process and while the flow is being bypassed; and 2) after lining process and service reconnections have been completed.~~
- 2) ~~Provide an on-screen numerical display of camera location, indexed from the starting manhole, in feet (meters).~~

c. ~~Service and Obstruction Location.~~

- 1) ~~Coordinate and cooperate with the Engineer for service and obstruction location.~~
- 2) ~~Locate the active sewer services by one of following:~~
 - a) ~~Use video inspection to observe service locations, breaks, obstructions, and structural failures.~~
 - b) ~~Insert a sounding device through the service, noting its location on the ground surface.~~
 - c) ~~Dye testing.~~

4. ~~Bypassing Sewage.~~

- a. ~~Submit a bypassing plan to the Engineer for review.~~
- b. ~~Plug the line at a point upstream of pipe to be rehabilitated if bypassing is required.~~
- c. ~~Pump flow to a downstream point or adjacent system as directed by the Engineer.~~
 - 1) ~~Provide pump and bypass lines of adequate capacity to handle all flows.~~
 - 2) ~~Provide adequate reserve pumps on site for emergency use and for storm flows.~~

5. ~~Obstructions.~~

- a. ~~Remove all obstructions.~~
- b. ~~If an obstruction is encountered that cannot be removed by equipment operating within the pipe, excavate and remove the obstruction upon approval of the Engineer.~~
- c. ~~Place backfill material, compact, and restore the surface according to the contract documents.~~

6. ~~Temporary Sewer Service.~~

~~If full normal sewer service is not re-established within the times stated, provide temporary facilities or hotel accommodations for affected residents and businesses.~~

7. ~~Sliplining.~~**a. ~~Excavation.~~**

- 1) ~~For sliplining insertions, excavate at or near one structure and work from the existing manhole at the other end of the section to be pulled.~~

- 2) **Insertion Pit.**
 - a) For sliplining with segmented pipe (one pipe section at a time), construct the insertion pit as required to accommodate the length of individual pipe sections.
 - b) For sliplining with pipe that is to be welded together above ground and pulled into sewer, dig a pit length 12 times the inside pipe diameter and slope the pit end back to the ground surface at 2.5 (horizontal) to 1.0 (vertical).
 - b. **Test Head.**
 - 1) Pull the pulling head with one short section of sliplining pipe through the sewer before inserting the liner to test for taps or obstructions protruding too far into the sewer.
 - 2) Attach cables to both ends of the test head to allow for removal if an obstruction is encountered.
 - c. **Installation.**
Push segmented pipe into the host pipe according to the manufacturer's recommendations, or pull in a continuously welded pipe according to ASTM F 585.
 - d. **Service Reconnection.**
 - 1) Allow the sliplining pipe to recover according to the manufacturer's recommendations.
 - 2) Do not leave the sanitary service unconnected for more than 24 hours.
 - 3) Complete reconnections involving excavation of service lines according to the local plumbing codes.
 - 4) Reconnect excavated service connections according to the local plumbing code, except that the annular space between the host pipe and the sliplining pipe is to be filled with grout.
 - e. **Grouting.**
 - 1) Before trimming the ends of the pipe and sealing, allow for the pipe to recover its original length according to the manufacturer's recommendations. Recovery time is at least equal to the time required to pull the pipe into place.
 - 2) Fill the space between the sliplining pipe and the host pipe with CLSM complying with Article 2552.02, E, 3, or other material approved by the Engineer. Pump filler in from the lower end of the sliplining pipe.
8. **Resin Impregnated Cured-In-Place Pipe Lining.**
- a. Install according to the manufacturer's recommendations for this lining process and ASTM F 1216 unless noted otherwise.
 - b. Use a resin impregnated tube, hydraulically inverted in place with an approved lubricant, and cured in place according to ASTM F 1216, Section 7.
 - c. Make the tube continuous between manholes. The tube may span several manhole reaches as allowed by the equipment, properties of the CIPP, and the size and condition of the sewer.
 - d. Ensure the tube is free of uncured spots, lifts (spots cured away from the sewer), and delaminations. Remove and replace deficient sections.
 - e. **Service Reconnections.**
 - 1) Do not leave sanitary service unconnected for more than 24 hours.
 - 2) Complete reconnections involving excavation of service lines according to the local plumbing code.
9. **Deformed/Reformed High Density Polyethylene Pipe or Folded/Formed Polyvinyl Chloride Pipe Lining Installation.**
Install according to the manufacturer's recommendations for particular lining material and process, unless specified otherwise.
- a. **Lining Installation.**
 - 1) Designate location where insertion is to begin, subject to the Engineer's approval.
 - 2) Transport lining to the site in one continuous length on spools compatible with manufacturer's designated process.
 - 3) Heat lining material at the job site as necessary for insertion. Pull lining into the sewer with appropriate pulling heads, cables, and heat distribution equipment.
 - 4) Ensure lining is continuous between manholes as allowed by the tensile properties of lining and the size and condition of the sewer.
 - 5) Connect fully inserted lining to the heat source distribution equipment.
 - 6) Round and expand by uniformly distributed heat, steam, and pressure and by mechanical devices.
 - 7) After lining has been expanded to a tight fit, cool gradually under pressure until the process is complete.
 - 8) Provide a continuous pipe lining, without joints, over the entire length of pipe.
 - 9) Ensure the lining is free of all material defects, pits, pinholes, cracks, crazing, folds, or unrounded sections.
 - 10) Repair all defects at no additional cost to the Contracting Authority.
 - b. **Service Reconnections.**
 - 1) Do not leave sanitary service unconnected for more than 24 hours.
 - 2) Complete reconnections involving excavation of service lines according to the local plumbing code.
3. **Sewer Cleaning and Inspection for Rehabilitation.**
- a. **General.**
 - 1) Provide equipment specifically designed and constructed for sewer cleaning and inspection.
 - 2) Use sewer cleaning equipment manufacturer's recommended size tools for various pipe sizes.
 - 3) Utilize equipment recommended by the manufacturer to protect the manhole and pipe during cleaning and inspection operations.

- 4) Perform all cleaning and removal operations under CCTV observation to monitor the progress of the work and to monitor the sewer line for damage. Continue until the condition of the host pipe meets the requirements of the liner manufacturer.
 - 5) Flush all debris to downstream manhole. Screen, collect, and remove debris from sewer.
 - 6) Dispose of all sanitary sewer debris and material at a location directed by the Contracting Authority. If specified in the contract documents, pay for all disposal fees.
- b. Pre-Cleaning Inspection.**
- 1) Complete CCTV inspection of sewer prior to initiating cleaning.
 - 2) Inspect each pipe segment between manholes or access points in a single, continuous run where possible.
 - 3) If line is impassable due to debris or obstructions, reverse setup and inspect from opposite manhole or access point.
- c. Pre-Rehabilitation Sewer Pipe Cleaning.**
- 1) Perform light cleaning with hydraulic flusher or high velocity cleaning equipment to remove loose debris.
 - 2) Complete up to three passes in an attempt to remove all debris from line.
 - 3) If the pre-rehabilitation light cleaning fails to leave the sewer line in a condition ready for lining, contact Engineer for authorization to proceed with additional sewer cleaning.
- d. Additional Sewer Cleaning.**
- 1) Notifying Engineer prior to performing heavy cleaning as required to remove obstructions, grease, rock, sticks, deposits settled (DS), deposits attached grease (DAGS), deposits attached encrustation (DAE), and roots, so the sewer is ready for lining. This item does not include cutting/grinding protruding service lines.
 - 2) Utilize rotating nozzles, saws or cutters, or high velocity hydro-cleaning equipment.
 - 3) Notify Engineer prior to use of mechanical/hydraulic spinner nozzle, chain flail, or other devices that may damage pipe or service connections.
 - 4) If deposits and obstructions cannot be removed by tools normally used in the sewer cleaning industry, notify Engineer immediately.
 - 5) Maintain a log of time spent performing additional pipe cleaning on each line segment.
- e. Remove Protruding Service Connection.**
- 1) Grind or cut services that protrude more than 1/2 inch into the sewer main.
 - 2) Utilize a remote grinding/cutting device specifically designed to remove concrete, vitrified clay, PVC, and other types of pipe materials.
 - 3) Notify Engineer if ductile iron, steel, cast iron, or other non-typical service materials are encountered to review the ability and risks of removing the protruding services.
 - 4) Grind or cut protruding service flush to the main sewer pipe without scouring or damaging the main sewer or service connection.
 - 5) Notify the Engineer immediately if the sewer main or service pipe are not structurally sound.
- f. Post-Cleaning CCTV Inspection.**
- 1) Complete CCTV inspection of sewer upon completion of all sewer cleaning, obstruction removal, and protruding service removal activities.
 - 2) Inspect each pipe segment between manholes or access points in a single, continuous run.
 - 3) Inspect all service connections at right angles utilizing pan and tilt capabilities of the camera.
 - 4) Identify active and inactive service connections by the following:
 - a) Observe each service connection and identify active connections by active sewage flow or evidence of recent sewage flow.
 - b) If the status of the connection is inconclusive, run water down adjacent services to verify the location of each service.
 - c) Dye test connections if necessary to verify active status.
 - d) b. Accurately measure and log the location and clockwise position of all active service connections.
- g. Groundwater.**
- If significant groundwater infiltration is present, which could result in resin loss, resin contamination, reduction in CIPP thickness, or inadequate curing, notify the Engineer prior to installing CIPP liner.
- h. Inspection Reporting.**
- 1) Provide a copy of the pre-cleaning and post-cleaning video inspections. Include on-screen continuous footage, pipe diameter, direction of viewing, manhole number, and street location reference in the recording. Affix labels to the recording media to include the name of the project, the date, and the location of the inspection.
 - 2) Provide a written report of the inspections. Include true to scale drawings of all sewer defects and observation locations. Reference the time stamp on each line item entry on the written report.
- 4. Bypassing Sewage.**
- a. Submit a bypassing plan to the Engineer for review.
 - b. When sewer line flows exceed the values in Table 2549.03-1, or the depth recommended by the manufacturer of the sewer rehabilitation practice being implemented, reduce flows to acceptable levels.
 - 1) Plug the line at a point upstream of pipe to be rehabilitated if bypassing is required.
 - 2) Pump flow to a downstream point or adjacent system as directed by the Engineer.
 - a) Provide pump and bypass lines of adequate capacity to handle all flows.
 - b) Provide adequate reserve pumps on-site for emergency use and for storm flows.

- c. Rehabilitation and inspection work may be completed without bypassing in certain situations including low flow conditions, adequate upstream storage, use of a flow-through packer, or other situations approved by the Engineer. If proposed work will be completed without bypassing, have equipment and plan of action available to implement bypass pumping in the event the work is delayed or sewage levels in the upstream line are in danger of causing backups.

Table 2549.03-1: Maximum Depth of Flow During Inspection, Testing, and Rehabilitation

| Main Diameter | CCTV Inspection | Joint Testing/Sealing |
|---------------|----------------------|-----------------------|
| 6" to 10" | 20% of pipe diameter | 25% of pipe diameter |
| 12" to 24" | 25% of pipe diameter | 30% of pipe diameter |
| 27" and up | 30% of pipe diameter | 35% of pipe diameter |

5. CIPP Main Lining.

a. General.

- 1) Clean, prepare, and inspect the repair point according to Article 2549.03, A, 3.
- 2) Install liner according to the manufacturer's published recommendations, ASTM F 1216, and ASTM F 2019.

b. Resin Impregnation.

- 1) Vacuum impregnate tube with resin (wet-out) at manufacturer's plant under quality controlled conditions or on-site in mobile wet-out unit.
- 2) Fill all voids in the tube material, adding 5% to 10% excess resin to allow for migration of resin into the voids and cracks.

c. Insertion.

1) General.

- a) Perform pre-lining video inspection immediately prior to insertion of the wet-out tube.
- b) Insert the wet-out tube through an existing manhole or approved access.
- c) Ensure the tube is continuous between manholes with no joints. A single tube may span several manhole reaches as allowed by the equipment, properties of the CIPP, and time limits imposed by sewage flows to the host pipe.
- d) Insertion of CIPP indicates acceptance of the host pipe conditions and the suitability of the liner inserted into the host pipe. Repair any failure of CIPP liner due to inadequate cleaning, groundwater infiltration, or defects in the liner system at no additional cost to the Contracting Authority.

2) Inverted Heat-Cured Liner.

- a) Prior to installation of the liner, place a temperature sensor on the bottom of the host pipe to monitor the temperature of the outside of the liner during the curing process. Place sensor at the termination point or location most distant from the heat source.
- b) Insert the wet-out tube into the inversion device or standpipe with the impermeable plastic liner on the outside of the tube.
- c) Turn back the end of the liner to form a cuff and secure the cuff to the inversion device or standpipe.
- d) Apply air pressure or hydrostatic head as required to invert the tube into the host pipe with the impermeable liner on the inside of the pipe.
- e) Apply lubricant directly to the tube or pour lubricant into the standpipe during the inversion process to reduce friction.
- f) Maintain and adjust pressure as necessary to invert the tube from the point of insertion to the point of termination and to hold the tube tight against the wall, producing dimples at service connections.

3) Pull-In UV Light Cured Liner.

- a) If CIPP manufacturer recommends the use of a sliding foil for the existing pipe conditions, provide sliding foil which covers the lower third to lower half of the pipe circumference. Pull sliding foil into place.
- b) Fold the wet-out liner in half and pull into place through an existing manhole. Monitor pulling speed and tension to avoid exceeding the manufacturer's recommendations.
- c) Pull 1 to 2 feet of excess liner into the termination manhole.
- d) If the product is sensitive to elongation, measure the overall elongation of the tube after pull-in. Ensure the elongation of the tube is less than 2% of the overall length of the segment specified by the manufacturer.
- e) Expand the resin-impregnated tube as necessary to hold the tube tight against the wall, producing dimples at service connections.
- f) Perform CCTV inspection of the inflated liner prior to initiating cure. Confirm alignment and fit prior to initiating cure. Make corrections as necessary to provide a finished liner free of wrinkles and defects.

d. Curing.

1) Heat Cured.

- a) Maintain consistent pressure, as recommended by the liner manufacturer, until curing is complete. Increase pressures to compensate for external ground water, if present.
- b) Cure liner using circulating heated water or steam. Ensure the temperature is sufficient to affect a cure in all sections of the pipe.
- c) Monitor and log the temperature from the sensor placed between the impregnated tube and the host pipe.

- d) Initial cure will occur during heat up and is achieved when exposed portions of the new pipe appear to be hard and sound and the temperature sensor indicates the liner has reached the temperature necessary to effect a cure in the resin.
 - e) After initial cure is reached, raise the temperature to post-cure temperatures and hold for a period of time as recommended by the resin manufacturer.
 - f) Cool the new pipe to a temperature of 100°F for water cure and 113°F for steam cure before relieving the internal pressure within the section.
- 2) UV Light Cured.**
- 1) Automatically record the time, rate of travel of the ultraviolet assembly, pressures, and amount of lamps in operation for each CIPP segment as documentation of correct curing of the fabric tube.
 - 2) Maintain consistent pressure, as recommended by the liner manufacturer, until curing is complete.
 - 3) Draw the multi-lamp ultraviolet curing assembly through the pipe at a consistent, predetermined, speed that allows for cross-linking/polymerization of the CIPP resin.
 - 4) Adjust air pressure during curing as necessary to hold liner tight to the wall. Maintain pressure by adjustment of the outlet valve.
 - 5) Remove the temporary internal calibration hose installed by the manufacturer after curing is complete.
- e. CIPP End Seal Installation.**
- 1) Hydrophilic Gasket Sleeve.**
Install sleeve according to ASTM F 3240, sleeve manufacturer's published recommendations, and the following:
- a) Do not install sleeve in host pipe more than 24 hours prior to CIPP lining.
 - b) Clean the first 6 inches of the main pipe to remove debris and visible grease deposits.
 - c) Install metal retaining clip at the leading edge of the sleeve. The metal clip may be held in place with adhesive tape if desired.
 - d) Install the sleeve in the main pipe so the leading edge is no more than 6 inches inside the end of the main pipe as measured from the manhole wall.
 - e) If the main pipe has a diameter of 18 inches or larger, utilize anchor screws to hold the sleeve in place.
- 2) Expansion Band System.**
Install system according to manufacturer's published recommendations and the following:
- a) After installation of the CIPP liner, trim the end of the liner squarely a distance of 2 to 6 inches from the inside face of the manhole.
 - b) Clean the exposed face of the main pipe to remove debris and loose resin.
 - c) Slide the rubber gasket into the pipe, centering it over the end of the liner. Ensure one expansion band will seat against the liner and the other will seat against the main pipe.
 - d) Expand the expansion bands using a hydraulic expansion tool approved by the band manufacturer.
- f. Service Reinstatement.**
- 1) Do not leave sanitary service blocked for more than 24 hours.
 - 2) Reinstatement active service lines from within the main with a CCTV camera and remote cutting tool. Do not reinstate inactive service connections.
 - 3) Machine the opening to full size of the service connection opening area. Ensure the bottom of the liner opening and service line are flush.
 - 4) Ensure the opening does not have pipe fragments or CIPP fragments that may obstruct flow or snag debris.
 - 5) In the event that service reinstatement results in a liner opening greater than 100% of the service connection opening, or damage to the service connection occurs, install a CIPP service repair to cover the over-cut service connection at no additional cost to the Contracting Authority.
 - 6) If service connection cannot be reinstated remotely and requires excavation complete according to the local plumbing code at no additional cost to Contracting Authority.
- g. Inspection.**
- 1) Perform CCTV video inspection of completed CIPP lining, including observance of reinstated service connections. Provide copy of video inspection to Jurisdiction.
 - 2) Ensure the tube is free of dry spots, lifts (spots cured away from the sewer), and delaminations. Remove and replace deficient sections.
 - 3) If the CIPP does not fit tight against the original pipe at its termination point, seal the space between the pipes by filling with a resin mixture or hydrophilic seal compatible with the CIPP.
- 6. CIPP Point Repair.**
- a. Preparation:** Clean, prepare, and inspect the repair point according to Section 4050, 3.01.
- b. Bypass Pumping:** Develop a plan for flow diversion or stoppage. Review with Engineer prior to initiating repair.
- c. Installation.**
- 1) Bypass mainline flow according to the submitted bypass plan.
 - 2) Install CIPP point repair according to system manufacturer's published recommendations.
 - 3) Wet-out the liner with the entire volume of resin recommended by the manufacturer.
 - 4) Load the wet-out liner onto the packer and secure in place. Ensure the ends of the packer extend beyond the ends of the liner.
 - 5) Pull the packer into position within the pipe. Verify position with CCTV observation.
 - 6) Apply air pressure to the packer to expand the CIPP point repair liner against the host pipe.
 - 7) Maintain consistent pressure for the duration of the curing period.

- d. **Inspection.**
 - 1) Perform CCTV video inspection of completed CIPP point repair. Provide copy of video inspection to Jurisdiction.
 - 2) Ensure the tube is free of foreign inclusions, dry spots, pinholes, wrinkles greater than 2% of the pipe diameter, and delamination. Remove and replace deficient sections.
- 7. CIPP Service Repair.**
- a. **Preparation.**
 - 1) Prior to installation of the system, clean and prepare the interior of the host and service pipe in according to the manufacturer's written instructions.
 - 2) Remove all debris and obstructions.
 - 3) Perform a post cleaning CCTV inspection in preparation for installation of the lining system.
 - 4) If any obstructions, joint misalignments, broken or collapsed pipe, or other conditions are identified that will prohibit proper installation of the system, notify the Engineer immediately.
 - b. **Installation.**
 - 1) Install CIPP service repair according to system manufacturer's published recommendations and to the length specified in the contract documents.
 - 2) Bypass main line flow according to the submitted bypass plan. Coordinate installation with service owner to prevent service line flows.
 - 3) Wet-out the entire liner, including lateral and mainline portions, using vacuum impregnation.
 - 4) Load the lining system inside or on a pressure apparatus and move into position in the mainline pipe at the service connection.
 - 5) Align and verify the position of liner and service line via CCTV prior to initiating installation.
 - 6) Apply air pressure to invert or expand the resin impregnated CIPP into the lateral pipe and push the mainline portion of the system against the main pipe. Maintain pressure until the curing process is complete.
 - 7) Apply heat or UV light as required by the manufacturer to properly cure the liner.
 - 8) If liner is heat cured, follow manufacturer's recommendations for cool-down before relieving pressure.
 - 9) If liner is ambient cured, maintain pressure according to the manufacturer's recommendations before relieving pressure.
 - 10) Remove frayed ends of the system.
 - c. **Inspection and Documentation.**
 - 1) Provide Engineer with video documentation of pre-installation conditions and post-installation conditions showing the repair.
 - 2) Ensure the finished CIPP service repair is free of any leakage and visual defects including foreign inclusions, dry spots, lifts, pinholes, major wrinkles, and delamination. Repair any defects that could affect the structural integrity of the system or allow leaks.
 - 3) Maintain a written log of installation conditions according to system manufacturer's recommendations. At a minimum, include time of wet out, time and location of insertion, time of inflation, bladder pressure requirements, required cure time, actual cure time, and cool down duration.
 - 4) Submit documentation of results for CIPP liner material to Engineer.
- 8. Pressure Testing and Grouting of Sewer Joints.**
- a. **General.**
 - 1) Clean, prepare, and inspect the repair point according to Article 2549.03, A, 3.
 - 2) Complete sewer joint and service connection testing and grouting according to the grout supplier and equipment manufacturer's published recommendations, ASTM F 2304, and ASTM F 2454.
 - b. **Equipment.**
 - 1) **Joint Testing Device:** Provide a joint testing device (packer), with means for introducing air under pressure into the void area created by the expanded ends of the packer against the host pipe and a means of continuously measuring, viewing, and recording the static pressure of the test medium and grout within the void area only. Provide packer constructed in a manner to allow a limited amount of sewage to flow through at all times.
 - 2) **Service Connection Testing Device:** Provide a service connection testing device with inflatable mainline end elements and a service line grouting plug that creates a void area extending beyond the main connection. Use a service line grouting plug sized to match the diameter of the service being grouted with an effective sealing length of at least 18 inches, unless otherwise specified in the contract documents.
 - 3) **Pumping Equipment.**
 - a) Provide positive displacement metering grout pump and hose delivery system capable of supplying a mixed volume of grout at a minimum of 3 gallons per minute and 30 gallons of uninterrupted flow within 10 minutes.
 - b) Ensure pump system has sufficient discharge pressure (in excess of system pressure losses and groundwater) to deliver grout volume to fill void space within the gel set time of the chemical grout.
 - 4) **Grout Tanks:** When using non-soluble additives, ensure grout tanks have mechanical mixing devices to keep additives in suspension.
 - 5) **Measuring Equipment:** Provide means of measuring and recording the volume of mixed grout pumped for each grouted joint or service connection.
 - c. **Control Tests.**

- 1) Prior to beginning testing and grouting, perform a demonstration test in an above ground 8 inch nominal diameter test cylinder suitable to contain the full length of the packer and sustain the void test pressure. For service line testing, provide an 8 inch test cylinder with 6 inch service tee to receive the lateral bladder.
 - 2) Equip the test cylinder with a pressure gauge to monitor internal pressure and a release valve to exercise a controlled release of pressurized air from the void area to test the packer under both sound and leaking conditions.
 - a) With the void release valve closed, inflate the packer and air test the void at 7 to 10 psi. Ensure the observed void pressure at the test cylinder pressure gauge is within + 1/2 psi of the test monitoring equipment.
 - b) Crack open the release valve to simulate a small leak. Ensure the pressure drop of the cylinder gauge is within + 1/2 psi of the test monitoring equipment.
 - 3) After entering each pipeline segment, but prior to commencement of joint testing, position the packer on a section of sound and clean sewer between two consecutive pipe joints and perform a pressure test. Pressurize packer to between 7 and 10 psi and hold for a period of 15 seconds with a pressure drop of less than 1.0 psi. Deflate packer and ensure that void pressure monitoring equipment drops + 1/2 psi of initial reading.
 - 4) If any of the control tests are unsuccessful, clean equipment of excess grout or make necessary repairs and retest.
- d. Sewer Main Joint Pressure Testing.**
- 1) Test joints at a target pressure equal to 1/2 psi per vertical foot of pipe depth plus 2 psi (not exceeding 10 psi).
 - 2) Position the packer within the pipe so the packer straddles the pipe joint to be tested. Verify location via CCTV monitoring.
 - 3) Expand the packer ends to isolate the joint from the remainder of the pipe and to create a void area between the pipe joint and testing device.
 - 4) Pump air into void space until the pressure reaches the required test pressure.
 - 5) Stop the flow of air into the void space and observe the void pressure for 15 seconds.
 - 6) If the pressure is maintained with a drop of less than 1 psi, the joint will be considered as having passed the test.
 - 7) If the pressure drops more than 1 psi during the test period, the joint will be considered as having failed and sealing will be required.
 - 8) Deflate packer and verify the void pressure monitor drops to within + 1/2 psi of 0 psi. Clean equipment if pressure fails to return to 0 psi.
- e. Service Line Pressure Testing.**
- 1) Test service lines at a target pressure equal to 1/2 psi per vertical foot of pipe depth plus 2 psi (not exceeding 10 psi).
 - 2) Position the testing device within the line segment to straddle the service connection. Verify location via CCTV.
 - 3) Align the service bladder with the service connection.
 - 4) Apply air pressure to invert or inflate the bladder from the mainline assembly into the service pipe.
 - 5) Expand the packer ends to isolate the section of the service connection to be tested.
 - 6) Introduce air into the void area until a pressure equal to or up to 10% greater than the required test pressure is observed.
 - 7) Stop the flow of air into the void space and observe the void pressure for 15 seconds.
 - 8) If the pressure is maintained, with a pressure drop of less than 2 psi, the connection will be considered as having passed the test.
 - 9) If the pressure drops more than 2 psi during the test period, the connection will be considered as having failed and sealing will be required.
 - 10) Deflate packer and bladder and verify the void pressure monitor drops to within + 1/2 psi of 0 psi. Clean equipment if pressure fails to return to 0 psi.
- f. Sewer Main Joint Sealing by Injection Grouting.**
- Perform joint sealing according to ASTM F 2304, equipment manufacturer, grout supplier, and the following:
- 1) Position packer over the faulty joint and expand packer ends, isolating the joint with a tight seal.
 - 2) Pump two-part chemical sealant material into the ratio specified by the grout supplier.
 - 3) Continue to pump grout, in stages if necessary, until "refusal" is achieved.
 - a) Refusal indicates the grout has flowed throughout the void, into the surrounding soil, forming a cohesive seal stopping further flow of grout.
 - b) Under pumping conditions, void pressure will slowly rise as grout is forced into the surrounding soil and begins to set. When void pressure spikes an additional 8 psi or more in a short pumping period of 1 to 5 seconds, the point of refusal is achieved.
 - c) If a quantity of grout equal to 1/2 gallon per inch diameter of pipe size is pumped without reaching the point of refusal, staging may be required. Staging is accomplished by repetitive cycles of pumping and curing until refusal is achieved. Notify Engineer for approval before staging is attempted.
 - d) If joint cannot be sealed by staging, abandon sealing operations at that joint and notify Engineer.
 - 4) Upon reaching refusal, stop grout pumps and allow grout to cure for 30 to 40 seconds.
 - 5) Deflate packer to break away the ring of gel formed in the void and move at least one packer length away from the joint in either direction.

- 6) Ensure pressure gauge reads zero pressure + 1/2 psi. If gauge does not return to zero clean equipment.
 - 7) Reposition packer over joint and retest at a pressure equal to the initial test pressure.
 - 8) If joint fails pressure test, repeat grouting and pressure testing procedure until the joint is sealed or Engineer determines grout consumption is too high and continued attempts to seal joint are abandoned.
 - 9) Remove residual sealing materials that extend into the pipe or restrict the flow. Ensure sealed joint surfaces are left flush with existing pipe surface. Remove residual grout material from manhole; do not allow grout to be flushed down the sewer.
- g. Service Connection Sealing by Injection Grouting.**
Perform service sealing according to ASTM F 2454, equipment manufacturer, grout supplier, and the following requirements.
- 1) Pump two-part chemical sealant material at the ratio specified by the grout supplier.
 - 2) Continue to pump grout, in stages if necessary, until refusal is achieved.
 - a) Under initial pumping conditions, the void pressure will slowly rise to a range of approximately 2 to 4 psi.
 - b) Continue pumping until there is a sudden increase to over 8 psi in a few seconds, indicating refusal.
 - c) If a quantity of grout equal to 1 gallon per foot of service line bladder plus 3 gallons is pumped without reaching the point of refusal, staging may be required.
 - d) Stage grouting by pumping additional grout equivalent to 1 gallon plus 0.25 gallons per foot of bladder, waiting 1 full minute and retesting. Do not exceed two stages unless approved by Engineer.
 - 3) Upon reaching refusal, stop grout pumps and allow grout to cure for 1 full minute.
 - 4) Deflate service packer, re-inflate, and repeat service line pressure testing.
 - 5) If the service connection test fails, repeat injection grouting and pressure testing procedures until service is sealed or Engineer determines grout consumption is too high and continued attempts to seal service are abandoned.
 - 6) Confirm flow after sealing of each service. If a grout blockage exists, immediately clear the service of the blockage.
 - 7) A thin film of residual grout inside the service, which does not significantly impede flow, is a normal result of sealing and is not considered a blockage.
- h. Inspection and Reporting.**
Comply with ASTM F 2304 Section 12.9 as noted below.
- 1) **Inspection.**
 - a) Perform CCTV observation and recording of initial pressure testing, sealing operations (if required), and final pressure testing (if required) for each joint or service.
 - b) Perform final CCTV video inspection of sewer main rehabilitated by injection grouting after all grouting work is completed. Provide copy of video to the Jurisdiction.
 - 2) **Reporting.**
Upon completion of each pipe segment, submit a report showing the following information for each joint and service connection tested, grouted or both.
 - a) Identification of sewer pipe section tested.
 - b) Type of pipe material, diameter, and depth of pipe to surface at manholes.
 - c) Length of pipe sections between joints.
 - d) Test pressure used before and after sealing and duration of test.
 - e) Location of each joint or service connection tested and any joints or service connections not tested with and explanation for not testing.
 - f) Pass/fail results for each joint or service connection tested.
 - g) Volume of grout material used on each joint or service connection.
 - h) Grout mix record of the batches mixed including amount of grout and catalyst, additives, temperature of the grout solution in the tanks, and gel set time used.

10 9. Spot Repairs by Pipe Replacement.

- a. Excavate trench according to Section 2552.
- b. Remove existing pipe to the extent required and disconnect affected sewer services.
- c. Install replacement pipe of the same nominal size as the existing pipe.
 - 1) Use the same materials as specified in the contract documents that comply with Section 2504.
 - 2) Place bedding material according to Section 2552.
- d. Install pipe repair coupling.
 - 1) Cut pipes to length require allowing no more than a 1/2 inch gap between butted pipe ends at coupling location. Cut pipes perpendicular to centerline.
 - 2) Clean the outside surface of the existing and replacement pipes as required to provide a positive seal with the pipe repair coupling.
 - 3) Wrap coupling around pipes, centered on butt joint, and tighten bolts according to manufacturer's recommendations.
- e. Reconnect sewer services.
- f. Place backfill material in trench according to Section 2552.

14 10. Cleanup and Closeout.

- a. Verify that the services are reconnected and fully operable, with at least 90% of original capacity.
- b. Submit initial and final video tapes, CDs, or DVDs to the Engineer.

- c. Remove all equipment and debris.

B. Manhole Rehabilitation.

1. Submittals.

- a. Concrete mix design, if required by the Engineer.
- b. Catalog cuts of all mortar mixes, sealants, and liners.

2. Infiltration Barrier.

Apply Article 2435.03, A.

3. Urethane Chimney Seal.

- a. Prepare the surface according to the manufacturer's recommendations, including sandblasting, pressure washing, sealing leaks or gaps, and drying the surface.
- b. Apply primer, prepare product, and brush-apply the seal to a minimum thickness of 175 mils, covering 2 inches above the bottom of the frame and the entire adjustment ring area to 3 inches below the bottom adjustment ring.

4. In-Situ Manhole Replacement, Cast-in-place Concrete.

a. Preparation.

Prepare according to the forming system manufacturer's recommendations, including the following:

- 1) Clean the existing surface to remove loose material and debris.
- 2) Remove existing steps that might interfere with the erection of the forms.
- 3) Control infiltration that may affect placement of concrete.

b. Installation.

Install and test according to the forming system manufacturer's recommendations, including the following:

- 1) Place pipe extensions through the structure to maintain flow during installation.
- 2) Erect forms inside the manhole. Secure the assembled internal forms to prevent shifting and to provide sufficient stiffness and strength to prevent collapse.
- 3) Install a plastic liner when specified.
- 4) Seal the forms at the bottom of the manhole to ensure the concrete does not enter the sewer.
- 5) Carefully place concrete between the forms and the existing manhole walls. Place concrete from the bottom up to prevent segregation of concrete.
- 6) Consolidate concrete as required to fill all pockets, seams, and cracks within the existing manhole wall.
- 7) Remove the forms when the concrete has cured sufficiently.
- 8) Weld and test joints if a plastic liner is installed.
- 9) Apply a sealing strip around the circumference of the invert top where it meets the vertical wall and around all pipe penetrations to form a waterstop.
- 10) Overlay the invert top with concrete or high-strength mortar. Vary thickness from 3 inches at the wall to 1/2 inch at the edge of the channel.
- 11) Apply an epoxy lining to the invert top. Apply clean sand to the epoxy to create a non-slip surface.
- 12) Seal the plastic liner to the manhole casting and existing pipe stubs as recommended by the manufacturer.
- 13) Install a new casting.

5. Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal.

a. Surface Preparation.

Prepare according to the manufacturer's recommendations, including the following:

- 1) Wash the interior with a high pressure washer.
- 2) Plug active leaks with the appropriate sealing material.

b. Mortar Application.

Apply according to the manufacturer's recommendations, including the following:

- 1) Apply with a rotating centrifugal casting applicator, beginning at the bottom of the manhole.
- 2) Retrieve the applicator head at the manufacturer's recommended speed to achieve the desired thickness.
- 3) Apply to the full required thickness utilizing multiple passes as necessary. Minimize the time between passes so subsequent passes are cast against fresh mortar.
- 4) Verify thickness with a wet gage at several locations to ensure proper depth.
- 5) Hand-apply high-strength mortar to the invert surface. Vary thickness from 3 inches at the wall to 1/2 inch at the edge of the channel.

c. Epoxy Seal Application.

Seal according to the manufacturer's recommendations, including the following:

- 1) Apply with a rotating centrifugal casting applicator or airless sprayer onto the fresh mortar liner.
- 2) If the epoxy seal is applied more than 24 hours after application of the mortar liner, or if the mortar liner is contaminated, clean the liner and then apply the epoxy.

d. Finishing.

Install a new casting.

2549.04 METHOD OF MEASUREMENT.

A. ~~Pipe Lining.~~

~~Measurement for each type and size of pipe lining will be in linear feet along the centerline of the pipe lining from center of manhole to center of manhole.~~

B. ~~Building Sanitary Sewer Service Reconnection.~~

~~Each active existing building sanitary sewer service reconnected to the pipe lining, including the services reconnected by excavating and reconnecting services or by trenchless reconnection methods, will be counted.~~

A. Pipe Cleaning and Inspection for Rehabilitation.**1. Pre-Rehabilitation Cleaning and Inspection.**

Measurement will be made for each diameter range of sewer main cleaned and inspected prior to rehabilitation. Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch.

2. Additional Sewer Cleaning.

Measurement will be made on an hourly basis for additional pipe cleaning for each diameter range. Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch.

B. Remove Protruding Service Connections.

Each protruding service connection removed will be counted. Quantity will be based on number of protruding service connections identified in the pre-rehabilitation CCTV inspection and removed from the post-rehabilitation CCTV inspection.

C. Cured-in-Place Pipe Lining.**1. Cured-in-Place Pipe Main Lining.**

Each diameter of main pipe lining will be measured in linear feet along the centerline of the pipe lining from center of manhole to center of manhole.

2. Building Sanitary Sewer Service Reinstatement.

Each active sanitary sewer service reinstated, including those reinstated by excavation, will be counted.

3. Cured-in-Place Pipe End Seal.

Each size of CIPP end seal installed will be counted.

D. Cured-in-Place Pipe Point Repair.

Each diameter of CIPP point repair will be counted. Repairs in excess of 10 feet in length will be counted as multiple repairs.

E. Cured-in-Place Pipe Service Repair.**1. Cured-in-Place Pipe Service Pipe, Connection.**

Each size combination of main and service connection diameters repaired will be counted.

2. Cured-in-Place Pipe Service Repair, Partial Pipe.

Each size combination of main and service diameters and specified service length lined will be counted.

F. Pressure Testing and Grouting of Sewer Joints and Service Connections.**1. Pressure Testing of Mainline Sewer Joints.**

Each mainline sewer joint tested will be counted. Separate measurement will be made for each diameter of sewer main. Visually leaking joints, whether tested or not, will be counted if they are grouted.

2. Injection Grouting of Mainline Sewer Joints.

Each mainline sewer joint grouted will be counted. Separate measurement will be made for each diameter of sewer main.

3. Pressure Testing of Service Connections.

Each sewer service connection tested will be counted. Separate measurement will be made for service connections on each diameter of sewer main.

4. Injection Grouting of Service Connections.

Each service connection grouted will be counted. Separate measurement will be made for service connections on each diameter of sewer main.

5. Chemical Grout.

Each gallon of chemical grout used for sealing mainline sewer joints and service connections will be counted.

G. Bypass Pumping.

Lump sum item, no measurement will be made.

C H. Spot Repairs by Pipe Replacement.

Both of the following methods will be specified for measurement of spot repairs by pipe replacement:

1. Spot Repairs by Count.

Each spot repair location will be counted.

2. Spot Repairs by Linear Foot (Meter).

Measurement will be in linear feet along the centerline of the replacement pipe.

D I. Infiltration Barrier.

Each infiltration barrier installed on an existing manhole will be counted.

E J. Urethane Chimney Seal.

Each urethane chimney seal installed on an existing manhole will be counted.

F K. In-Situ Manhole Replacement, Cast-in-place Concrete.

Measurement of the vertical dimension of in-situ manhole replacement will be in feet from the lowest flowline to the top of the rim.

G L. In-Situ Manhole Replacement, Cast-in-place Concrete with Plastic Liner.

Measurement of the vertical dimension of in-situ manhole replacement with plastic liner will be in feet from the lowest flowline to the top of the rim.

H M. Manhole Lining with Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal.

Measurement for depth of the vertical dimension of manhole lining will be in feet from the bottom of the lining to the top of the lining for each liner thickness specified.

2549.05 BASIS OF PAYMENT.**~~A. Pipe Lining.~~**

~~1. Payment will be made at the contract unit price per linear foot for each type and size of pipe lining.~~

~~2. Payment is full compensation for pipe lining removal of internal obstructions, pipe cleaning, inspection, and all costs associated with the public information and notification program.~~

~~B. Building Sanitary Sewer Service Reconnection.~~

~~1. Payment will be made at the contract unit price for each reconnection.~~

~~2. Payment is full compensation for building sanitary sewer service reconnection.~~

A. Pipe Cleaning and Inspection for Rehabilitation.**1. Pre-Rehabilitation Cleaning and Inspection.**

a. Payment will be made at the unit price per linear foot for each diameter of pre-lining cleaning and inspection.

b. Payment is full compensation for pre-cleaning CCTV inspection, light sewer cleaning, debris removal and transport, post cleaning CCTV inspection for Engineer review, and identification and logging of active service taps. If specified in the contract documents, unit price also includes disposal and associated costs for all debris removed from sewer.

2. Additional Sewer Cleaning.

a. Payment will be made at the unit price per hour for additional pipe cleaning.

b. Payment is full compensation for heavy sewer cleaning; root cutting; deposit cutting; and removing, transporting, disposing, paying associated costs for all debris removed from sewer, and post cleaning CCTV inspection for Engineer review.

B. Remove Protruding Service Connections.

1. Payment will be made at the unit price for each protruding service connection removed.

2. Payment is full compensation for removal of protruding service connections and debris removal.

C. Cured-in-Place Pipe Lining.

1. **Cured-in-Place Pipe Main Lining.**
 - a. Payment will be made at the unit price per linear foot for each diameter of pipe lining.
 - b. Payment is full compensation for furnishing and installing the liner and appurtenances, CCTV inspection immediately prior to lining, bypass pumping unless otherwise specified, sliding foil, post-lining CCTV inspection, and all costs associated with the public information and notification program.
 2. **Building Sanitary Sewer Service Reinstatement.**
 - a. Payment will be made at the unit price for each active sewer service reinstated.
 - b. Payment is full compensation for reinstating sanitary sewer service connections, removal of debris, and coordination with service owners.
 3. **Cured-in-Place Pipe End Seal.**
 - a. Payment will be made at the unit price for each CIPP end seal installed.
 - b. Payment is full compensation for end seal and installation.
- D. Cured-in-Place Pipe Point Repair.**
1. Payment will be made at the unit price for each diameter of CIPP point repair.
 2. Payment is full compensation for furnishing and placing point repair liner, bypass pumping unless otherwise specified, sewer cleaning, removal of obstructions, debris removal, pipe preparation, and pre and post repair CCTV inspection.
- E. Cured-in-Place Pipe Service Repair.**
1. **Cured-in-Place Pipe Service Pipe, Connection.**
 - a. Payment will be made at the unit price for each size combination of CIPP service pipe, connection.
 - b. Payment is full compensation for furnishing and placing service connection liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.
 2. **Cured-in-Place Pipe Service Repair, Partial Pipe.**
 - a. Payment will be made at the unit price for each size combination of CIPP service repair, partial pipe.
 - b. Payment is full compensation for furnishing and installing service repair liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.
- F. Pressure Testing and Grouting of Sewer Joints and Service Connections.**
1. **Pressure Testing of Mainline Sewer Joints:**
 - a. Payment will be made at the unit price for each sewer joint tested.
 - b. Payment is full compensation for by-pass pumping unless otherwise specified, control testing, and documentation.
 2. **Injection Grouting of Mainline Sewer Joints:**
 - a. Payment will be made at the unit price for each sewer joint grouted.
 - b. Payment is full compensation for bypass pumping unless otherwise specified, material testing, pressure testing after grouting, re-grouting of failed joints, and documentation. Unit price does not include the quantity of chemical grout used.
 3. **Pressure Testing of Service Connections.**
 - a. Payment will be made at the unit price for each service connection tested.
 - b. Payment is full compensation for bypass pumping unless otherwise specified, and documentation.
 4. **Injection Grouting of Service Connections.**
 - a. Payment will be made at the unit price for each service connection grouted.
 - b. Payment is full compensation for bypass pumping unless otherwise specified, material testing, pressure testing after grouting, and documentation. Unit price does not include the quantity of chemical grout used.
 5. **Chemical Grout:**
 - a. Payment will be made at the unit price for each gallon of chemical grout used.
 - b. Payment is full compensation for grout additives; root inhibitor; and supplying, mixing, and measurement of chemical grout.
- G. Bypass Pumping.**
1. Payment will be made at the lump sum price for bypass pumping.
 2. Payment is full compensation for development and submittal of the bypassing plan, all staffing, equipment, and appurtenances necessary to accomplish the approved bypassing plan, including reserve equipment.

C H. Spot Repairs by Pipe Replacement.

Both of the following methods will be specified for payment of spot repairs by pipe replacement:

1. Spot Repairs by Count.

- a. Payment will be made at the contract unit price for each spot repair.
- b. Payment is full compensation for uncovering and removing existing pipe, placing backfill material for replacement pipe, and restoring the surface.

2. Spot Repairs by Linear Foot.

- a. Payment will be made at the contract unit price per linear foot of spot repair.
- b. Payment is full compensation for furnishing and installing replacement pipe and connections.

D I. Infiltration Barrier.

1. Payment will be made at the contract unit price for each infiltration barrier.
2. Payment is full compensation for all necessary compression or expansion bands and extension sleeves as necessary to complete infiltration barrier.

E J. Urethane Chimney Seal.

Payment will be at the contract unit price for each urethane chimney seal.

F K. In-Situ Manhole Replacement, Cast-in-place Concrete.

1. Payment will be at the contract unit price per vertical foot.
2. Payment is full compensation for handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, and testing the manhole upon completion.

G L. In-Situ Manhole Replacement, Cast-in-place Concrete with Plastic Liner.

1. Payment will be at the contract unit price per vertical foot.
2. Payment is full compensation for handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, sealing at the frame and cover, sealing pipe penetrations as recommended by the manufacturer, and testing the manhole upon completion.

H M. Manhole Lining with Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal.

1. Payment will be at the contract unit price per vertical foot for each liner thickness properly installed.
2. Payment is full compensation for the handling of sewer flows during lining operations as required to properly complete the installation, and replacement of the existing casting with a new casting.

Section 2550**2550.04, Traffic Control.****Replace the Article:**

- ~~A. Ensure all vehicles and equipment (except for hand operated equipment) operating or parked within 15 feet of an open lane of traffic and all vehicles and equipment entering or exiting the work area display amber high intensity rotating, flashing, or oscillating lights.~~
- B A.** Place and remove all traffic control devices during daytime hours, when possible, unless specified otherwise in the contract documents.
- C B.** Continually review all traffic control devices, including monitoring of lights, to ensure proper installation and working order.

Section 2552**2552.02, B, Bedding (Class I) Material.**

Renumber and retitle the Article:

B C. Bedding (Class I) Material (Non-Primary Roadways Projects).**2552.02, C, Backfill Material (Under Interstate and Primary Roadways).**

Renumber, retitle, and replace the Article:

C B. Pipe Bedding and Backfill Material (Under Interstate and Primary Roadways Projects).

Meet requirements of Article 2102.02, A, and Section 4119.

2552.02, D, Backfill Material (Other Areas).

Retitle the Article:

Backfill Material (Other Areas Non-Primary Roadways Projects)**2552.02, F, Stabilization (Foundation) Material.**

Replace the Article:

1. ~~Clean 2 1/2-inch crushed stone with the following gradation:~~

| Sieve | Percent Passing |
|------------|-----------------|
| 2 1/2-inch | 100 |
| 2-inch | 90 to 100 |
| 1 1/2-inch | 35 to 70 |
| 1-inch | 0 to 20 |
| 1/2-inch | 0 to 5 |

2. ~~The Engineer may authorize a change in gradation subject to materials available locally at time of construction.~~

3. ~~Crushed concrete may be used, if approved by the Engineer, if it is within $\pm 5\%$ of the gradation for each size of material.~~

Meet the requirements of Section 4128.

2552.03, E, Pipe Bedding and Backfill Material.

Add to Article 1:

f. Refer to Standard Road Plan SW-101 for bedding and backfill zones.

Replace Articles 2 and 3:

2 3. Pipe Bedding (Non-Primary Roadways Projects).**a. Granular Material.**

- 1) Class I granular material is required for all gravity mains. Use when specified for pressure pipes.
- 2) Place bedding material in the bottom of the trench in lifts no greater than 6 inches thick. Consolidate and moderately compact bedding material.
- 3) Shape bedding material to evenly support pipe at the proper line and grade, with full contact under the bottom of the pipe. Excavate for pipe bells.
- 4) Install pipe and system components.
- 5) Place, consolidate, and moderately compact additional bedding material adjacent to the pipe to a depth equal to 1/6 the outside diameter of the pipe.

b. Suitable Backfill Material.

- 1) Only use with pressure pipe.
- 2) Use suitable backfill material to shape trench bottom to evenly support pipe at the proper line and grade, with full contact under the bottom of the pipe. Excavate for pipe bells.

c. Special Pipe Embedment and Encasement Materials.

- 1) If required in the contract documents, use concrete, flowable mortar, or CLSM in lieu of other bedding materials.
- 2) Secure pipe against displacement or flotation prior to placing concrete, flowable mortar, or CLSM.

3 2. Bedding and Backfill Under (Interstate and Primary Roads Projects).

~~a.~~ Place in lifts no greater than 6 inches thick. Thoroughly tamp or vibrate each layer to ensure compaction.

~~b.~~ Thoroughly tamp or vibrate each layer to insure compaction.

a. Pipe Bedding.

- 1) Use material meeting requirements of Section 4119. Shape bedding material to evenly support pipe at proper line and grade, with full contact under bottom of pipe. Excavate for pipe bells.
- 2) Install pipe and system components.
- 3) Place, consolidate, and moderately compact additional bedding material adjacent to pipe to a depth equal to 1/6 the outside diameter of pipe.

b. Backfill.

- c. Place backfill material after recording locations of connections and appurtenances or at the Engineer's direction. ~~Terminate backfill material at subgrade elevation.~~
- d. ~~Terminate backfill material at subgrade elevation.~~
 - 1) **Under Interstate and Primary Roadway.**
 - a) Use material meeting requirements of Section 4119 for haunch support, primary backfill, and secondary backfill, ~~and final trench backfill.~~
 - b) For trench installations through the subgrade, terminate final trench backfill material at subgrade elevation. Use final backfill material meeting requirements of Section 4119.
 - c) For fill or partial trench installations, terminate final trench backfill material at the top of the trench. Use final backfill material meeting the requirements of Section 4119. For fill above the trench, use Class 10 material meeting the requirements of Article 2102.02, A.
 - 2) **Outside of Interstate and Primary Roadway.**
Use material meeting requirements of Section 4119 for haunch support, primary backfill, and secondary backfill. Use Class 10 material meeting requirements of Article 2102.02, A, for final trench backfill.

Retitle Articles 4, 5, and 6:

- 4. **Haunch Support (Other Areas Non-Primary Roadways Projects).**
- 5. **Primary and Secondary Backfill (Other Areas Non-Primary Roadways Projects).**
- 6. **Final Trench Backfill (Other Areas Non-Primary Roadways Projects).**

2552.05, A, 5.

Replace the Article:

Placing and compacting backfill material, including furnishing backfill material for Interstate and Primary Road Projects.

2552.05, A, 6.

Replace the Article:

Dewatering including, but not limited to, equipment such as generators, pumps, rock for sump pits, discharge piping, and any extra excavation needed to facilitate dewatering.

Section 2553

2553.02, A, 2, e, Roadway Pipe Culvert.

Replace the Article:

- 1) **Reinforced Concrete Pipe:** Apply Section 4145.
- 2) Substitution with welded or seamless steel pipe meeting the ASTM/API standard and grade requirements of Article 2553.02, B, 1 will be allowed. Concrete transition end sections are required. Meet the requirements of Materials I.M. 440 for material acceptance, minimum steel carrier pipe wall thickness, welding criteria and concrete transition end sections.

2553.02, B, 1, Pipe.

Replace the Article:

Use only new steel pipe meeting the requirements of ASTM A 139, Grade B; ASTM A 252, Grade 2; or ASTM A 53, Grade B or API 5L X Grade. Pipe may be welded or seamless. Wall thickness will be as specified in the contract documents. Meet the requirements of [Materials I.M. 440](#) for material acceptance.

2553.02, B, 2, a.

Replace the Article:

Comply with AWS Code D1.1 or D1.5. ~~Weld all joints with full penetrating weld.~~ Weld joints the full perimeter of the pipe to withstand pipe installation without joint separation. Welders shall be qualified according to Materials I.M. 560. Welds shall comply with Materials I.M. 558.

Section 2554

2554.03, A, 2, a.

Replace the second sentence:

Alternatively, use a MJ gland or other approved method to field gage pipe selected for cutting to verify the outside diameter is within allowable tolerances.

2554.03, A, 2, b.

Replace the third sentence:

Bevel cut, file, or grind the ends for push-on joints according to the manufacturer’s recommendations.

2554.03, A, 2, Additional Requirements for DIP Installation.

Add the Article:

- d. Install pipe according to AWWA C600, except as modified herein.

2554.03, A, 3, Additional Requirements for PVC Pipe Installation.

Add the Article:

- c. Install pipe according to AWWA C605, except as modified herein.

2554.03, B, 3, a.

Add to the end of the Article:

Ensure a 3 foot clear space around the circumference of the fire hydrant.

2554.03, B, 3, f.

Replace the Article:

Orient fire hydrant nozzles parallel with or at right angles to the curb, with the pumper nozzle facing the curb. Set hydrants having two hose nozzles 90 degrees apart with each nozzle facing the curb at an angle of 45 degrees or as directed by the Engineer.

2554.03, C, Testing and Disinfection.

Replace the Article:

1. General.

- a. Notify the Engineer at least 2 working days in advance of testing or disinfection operations to coordinate the operations. The Engineer will be in attendance during testing or disinfection.
- b. Perform operations according to AWWA C651 in the sequence below. Successfully complete each operation before continuing to the next operation. The Contracting Authority will provide reasonable quantities of water for flushing and testing.

1.2. Sequence of Testing and Disinfection

Perform operations according to AWWA C651 in the sequence below. Successfully complete each operation before continuing to the next operation. The Engineer will provide reasonable quantities of water for flushing and testing.

a. Continuous Feed or Slug Method (After Water Main Installation).

The sequence of testing and disinfection may be modified with approval of the Engineer.

- 1) Perform initial flush.
- 2) Perform disinfection.
- 3) Flush after disinfection.
- 4) Perform pressure and leak testing.

b. Tablet Method (Concurrent with Water Main Installation).

Use this method only if approved by the Engineer. Modify the procedure for flushing, disinfection, and pressure and leak testing as needed if tablet method is used.

- 1) Perform disinfection.
- 2) Flush after disinfection.
- 3) Perform pressure and leak testing.

2.3. Initial Flushing.

a. Flushing.

- 1) Coordinate flushing with the Engineer.
- 2) Flush pipe prior to disinfection using potable water.
- 3) Measure flushing velocity.
- 4) Obtain a minimum flushing velocity of 2.5 3 feet per second in the pipe to be disinfected.

b. Minimum Flushing Rate.

According to AWWA C651, Table 3, based on 40 psi residual pressure (see Table 2554.03-1 below).

Table 2554.03-1: Minimum Flushing Rate

| Pipe Diameter, inches | Flow Rate for Flushing, gallons/minute | Number of Taps ^(b) | | | Number of 2 1/2 inch Fire Hydrant Outlets ^(a) |
|-----------------------|--|-------------------------------|------------|--------|--|
| | | 1 inch | 1 1/2 inch | 2 inch | |
| 4 | 100 | 1 | - | - | 1 |
| 6 | 200 260 | - | 1 | - | 1 |

| | | | | | |
|----|-----------|---|---|-----|---|
| 8 | 400 470 | - | 2 | 1 | 1 |
| 10 | 600 730 | - | 3 | 2 | 1 |
| 12 | 900 1060 | - | - | 2 3 | 2 |
| 16 | 1600 1880 | - | - | 4 5 | 2 |

(a) With a 40 psi pressure in the main with the hydrant flowing to atmosphere, a 2 1/2 inch fire hydrant outlet will discharge approximately 1000 gallons per minute; and a 4 1/2 inch fire hydrant will discharge approximately 2500 gallons per minute

(b) Number of taps on pipe based on discharge through 5 feet of galvanized iron pipe with one 90 degree elbow.

c. Property Protection.

Protect public and private property from damage during flushing operations.

3 4. Disinfection.

a. General.

- 1) Disinfect according to AWWA C651. The tablet method contained in AWWA C651 shall not be used unless approved by the Engineer.
- 2) Keep piping to be chlorinated isolated from lines in service and from points of use.
- 3) Coordinate disinfection and testing with the Engineer.
- 4) Obtain and test water samples, unless otherwise provided by the Engineer.

b. Procedure.

- 1) Induce a flow of potable water through the pipe.
- 2) Introduce highly chlorinated water to the pipe at a point within 5 pipe diameters of the pipe's connection to an existing potable system, or within 5 pipe diameters of a closed end, if there is no connection to an existing system.
- 3) Introduce water containing a minimum of 25 mg/L free chlorine until the entire new pipe contains a minimum of 25 mg/L free chlorine.
- 4) Retain chlorinated water in the pipe for at least 24 hours and no more than 48 hours.

4 5. Final Flushing.

- a. Flush pipe using potable water until chlorine residual equals that of the existing potable water system.
- b. Dispose of chlorinated water to prevent damage to the environment. Dechlorinate highly chlorinated water from testing before releasing into the ground or sewers. Obtain Engineer approval prior to flushing activities.
 - 1) Check with the local sewer department for the conditions of disposal to the sanitary sewer.
 - 2) Chlorine residual of water being disposed will be neutralized by treating with one of the chemicals listed in Table 2554.03-2:

Table 2554.03-2: Amounts of Chemicals Required to Neutralize Various Residual Chlorine Concentrations in 100,000 Gallons of Water

| Residual Chlorine Concentration mg/L | Sulfur Dioxide (SO ₂) pounds | Sodium Bisulfite (NaHSO ₃) pounds | Sodium Sulfite (Na ₂ SO ₃) pounds | Sodium Thiosulfate (Na ₂ S ₂ O ₃ + 5H ₂ O) pounds | Ascorbic Acid (C ₆ O ₈ H ₆) pounds |
|--------------------------------------|--|---|--|---|--|
| 1 | 0.8 | 1.2 | 1.4 | 1.2 | 2.1 |
| 2 | 1.7 | 2.5 | 2.9 | 2.4 | 4.2 |
| 10 | 8.3 | 12.5 | 14.6 | 12.0 | 20.9 |
| 50 | 41.7 | 62.6 | 73.0 | 60.0 | 104 |

5 6. Pressure and Leak Testing.

- a. Remove debris from within pipe. Clean and swab out pipe if required.
- b. Secure unrestrained pipe ends against uncontrolled movement.
- c. Isolate new piping from the existing water system.
- d. Fill and flush all new piping with potable water. Ensure all trapped air is removed.
- e. Pressurize the new pipe to the test pressure at the highest point in the isolated system. Do not pressurize to more than 5 psi over the test pressure at the highest point in the isolated system.
- f. Test and monitor the completed piping system at 1.5 times the system working pressure or 150 psi, whichever is greater, for 2 continuous hours.
- g. If at any time during the test the pressure drops to 5 psi below the test pressure, repressurize the pipe by pumping in potable water in sufficient quantity to bring the pressure back to the original test pressure.
- h. Accurately measure the amount of water required to repressurize the system to the test pressure.
- i. Maximum allowable leakage rate according to AWWA C600:

$$L = \frac{(S)(D)(P)^{0.5}}{148,000}$$

Where:

L = allowable leakage, in gallons per hour.

S = length of pipe tested, in feet.

D = pipe diameter, in inches.

P = average test pressure, in pounds per square inch.

Table 2554.03-3 assumes an average test pressure (P) of 150 psi and 1000 feet of test section:

Table 2554.03-3: Maximum Allowable Leakage Rate

| Pipe Diameter | Maximum Allowable Leakage Rate |
|---------------|--------------------------------|
| inches | gallons/hour/1000 feet of pipe |
| 4 | 0.33 |
| 6 | 0.50 |
| 8 | 0.66 |
| 10 | 0.83 |
| 12 | 0.99 |
| 14 | 1.16 |
| 16 | 1.32 |
| 18 | 1.49 |
| 20 | 1.66 |
| 24 | 1.99 |
| 30 | 2.48 |
| 36 | 2.98 |

- j. If the average measured leakage per hour exceeds the maximum allowable leakage rate, repair and retest the water main.
- k. If the measured pressure loss does not exceed 5 psi the test will be considered acceptable.
- l. Repair all visible leaks regardless of the amount of leakage.

6 7. Bacteria Sampling.

Test water mains according to AWWA C651, except as modified below. ~~If the initial disinfection procedure fails to produce satisfactory bacteriological results or if other water quality is affected, repeat the disinfection procedure.~~

- a. Collect samples every 1200 feet of new water main plus one set from the end of the line and at least one from each branch greater than one pipe length. If trench water entered the new main during construction, or if excessive quantities of dirt and debris entered the main, ~~the Engineer may~~ reduce the sampling interval to every 200 feet of new main.
- b. Collect samples according to one of the following methods as directed by the Engineer:
 - 1) Collect an initial set of samples after flushing and then an additional set after a minimum of 24 hours without any water use. The Engineer may reduce the sampling interval to 16 hours.
 - 2) Allow water to sit in the new main for a minimum of 16 hours after flushing without any water use. Collect an initial set of samples and allow the sampling ports to run for a minimum of 15 minutes. Collect a second set of samples from the sampling ports.

7 8. Re-Disinfection.

If the initial disinfection fails to produce satisfactory bacteriological samples, flush the main again and reinitiate the sampling process. If check samples show the presence of coliform organisms, rechlorinate the main prior to flushing and sampling until satisfactory results are obtained.

8 9. Putting Water Main in Service

Put the completed water system in service only after ~~both sets of bacterial samples have passed and~~ obtaining permission of the Engineer.

2554.04, A, Pipe and Fittings.

Replace Article 4 title:

Water Service Stubs by Each.

Add the Article:

5. Water Service Stubs by Length.

a. Water Service Pipe.

Each type and size of water service pipe will be measured in linear feet along the centerline of the pipe.

b. Water Service Corporation.

Each type and size of water service corporation will be counted.

c. Water Service Curb Stop and Box.

Each type and size of water service curb stop and box will be counted.

2554.04, B, Valves, Fire Hydrants, and Appurtenances.

Add the Articles:

10. Fire Hydrant Assembly Removal.

Each fire hydrant assembly removed will be counted.

11. Valve Removal.

Each size of valve removed will be counted.

12. Valve Box Removal.

Each valve box removed will be counted.

2554.05, A, Pipe and Fittings.

Replace Article 4 title:

Water Service Stubs by Each.

Add the Article:

5. Water Service Stubs by Length.

a. Water Service Pipe.

Payment will be the contract unit price per linear foot for each type and size of water service stub.

b. Water Service Corporation.

Payment will be made at the contract unit price for each type and size of water service corporation.

c. Water Service Curb Stop and Box.

Payment will be made at the contract unit price for each type and size of water service curb stop and box.

2554.05, B, Valves, Fire Hydrants, and Appurtenances.

Add the Articles:

10. Fire Hydrant Assembly Removal.

a. Payment will be at the contract unit price for each fire hydrant assembly removed.

b. Payment is full compensation for:

- Excavation,
- Removal of the fire hydrant, hydrant valve, and thrust block,
- Capping of the pipe,
- Delivery of the fire hydrant to the Contracting Authority (if specified),
- Backfill,
- Compaction, and
- Surface restoration to match the surrounding area.

11. Valve Removal.

a. Payment will be at the contract unit price for each size of valve removed.

b. Payment is full compensation for:

- Excavation,
- Removal of the valve,
- Replacing the removed valve with pipe and connections (if required) or capping the former valve connection,
- Delivery of the valve to the Contracting Authority (if specified),
- Backfill,
- Compaction, and
- Surface restoration to match the surrounding area.

12. Valve Box Removal.

a. Payment will be at the contract unit price for each valve box removed.

b. Payment is full compensation for:

- Excavation,
- Removal of the valve box,
- Delivery of the valve box to the Contracting Authority (if specified),
- Backfill,
- Compaction, and
- Surface restoration to match the surrounding area.

Section 2556

2556, Dowel Bar Retrofit.

Add the Section:

2556.01 DESCRIPTION.

Install epoxy coated dowel bars on transverse joints and transverse cracks as shown in the plans. Place dowels after concrete repair operations and prior to diamond grinding operation. Areas with random cracks passing through dowel bar retrofit locations will be reviewed by the Engineer prior to construction.

2556.02 MATERIALS.

A. Epoxy Coated Dowel Bars.

1. Ensure epoxy coated dowel bars, 1.5 inches by 15 inches, conform to requirements of Section 4151. Uniformly coat dowel bars with approved bond breaker according to Article 4151.02, B.
2. Dowel bars shall have tight fitting end caps made of nonmetallic material that allow for at least 0.25 inch bar movement at each end of the bar.
3. Chair devices for supporting dowel bars shall be either epoxy coated or made of a nonmetallic material. Chair devices shall provide a minimum clearance of 0.5 inch between the bottom of the bar and the surface upon which the bar is placed, and between the bar and the walls of the slot. Chairs shall be designed to prevent movement of the bar during placement of the grout. Submit samples of end caps and chairs to Engineer for approval before installation.

B. Caulking Filler.

Acceptable caulking filler used for sealing the existing transverse joint or crack at the bottom and sides of the slot includes any commercial caulk designed as a concrete sealant that is compatible with the patch material being used.

C. Foam Core Inserts.

Foam core board filler material shall be a closed cell foam faced with plastic film, foil, or poster board material on each side. Foam core board filler shall be 3/8 inch \pm 1/8 inch thick. Foam core board filler shall be approved by the Engineer before installation.

D. Grout.

1. Grout material placed around bars shall be a shrinkage compensated rapid set patch material listed in Materials I.M. 491.20, Appendix B.
2. Grout material may be from packaged bags or proportioned on site from bulk cementitious materials.
 - a. Packaged bags shall be extended with pea gravel, proportioned, and mixed according to the manufacturer's recommendations. Fine aggregate additions and water in excess of manufacturer's recommendations are not allowed.
 - b. Bulk cementitious materials shall be equivalent in composition to cementitious materials used in packaged bags and shall be proportioned with fine aggregate and water and extended with pea gravel to produce a mixture equivalent to packaged bag mix meeting manufacturer's recommendations. Water in excess of manufacturer's recommendation will not be allowed.
3. Fine aggregate shall meet the requirements of Section 4110.
- 2 4. ~~Extend grout according to the manufacturer's recommendations. Aggregate for extending grout shall be pea gravel meeting Section 4112, with shall have a minimum durability of Class 2 and the following gradation: meet the requirements of Article 4112.03, B and Gradation No. 9 of the Aggregate Gradation Table, Article 4109.02.~~

| Sieve Size | Percent Passing |
|------------|-----------------|
| 1/2 inch | 100 |
| 3/8 inch | 85-100 |
| No. 8 | 0-8 |

3. ~~The rapid set cement used to produce any of the rapid set patch materials in Materials I.M. 491.20, Appendix B may be approved to produce a concrete patch mix utilizing sand meeting Section 4110 and pea gravel meeting Section 4112, at maximum aggregate extension. Concrete patch mix shall meet the following strength requirements:~~
 - ~~3 hour minimum compressive strength of 3000 psi, ASTM C 39~~
 - ~~24 hour minimum compressive strength of 5000 psi, ASTM C 39~~
 - ~~24 hour bond to dry PCC, 1000 psi, ASTM C 882~~
5. Water shall meet the requirements of Section 4102.

4 6. Furnish a list of materials for use in making the grout, and the mix design, to the Engineer at least 30 calendar days prior to installation. District Materials Engineer may waive mix design testing based on previous testing with the patching materials. Grout shall meet the following strength requirements:

- Three hour minimum compressive strength of 3000 psi, ASTM C 39.
- 24 hour minimum compressive strength of 5000 psi, ASTM C 39.

5 7. Testing of the grout by the Engineer may be done anytime during production.

2556.03 CONSTRUCTION.

A. Process Control Plan.

Provide the Engineer a process control plan at least one week prior to the beginning of retrofit work. This plan shall include:

- Description of materials and process to be used to achieve required dowel bar alignment.
- Description of materials and processes to be used to prevent grout from entering existing joints.
- Description of materials and processes to be used to place and align foam core inserts.
- Mix design and proportion control for grout mixture

B. Preparing Slots for Dowel Bars.

1. Cut slots in pavement with gang saw capable of cutting at least three slots in each wheel path simultaneously. Cut slots to required depth to place center of dowels at mid-depth of concrete slab. Multiple saw cuts parallel to centerline may be required to remove material from slot.
2. Use jackhammers not larger than 30 pound class to remove concrete from slots. Prevent damage to pavement or vehicles traveling in the adjoining lane.
3. Sandblast and clean exposed surfaces and cracks in slots before bar installation. Fill transverse contraction joint on bottom and sides with non-sag caulking filler.

C. Placing Dowel Bars.

1. Use chair devices to support dowel bars at depth shown on the plans.
2. Place dowel bars parallel to centerline of pavement and parallel to pavement surface.
3. Place dowel bars within $\pm 1/4$ inch of desired alignment.
4. Center dowel bars over transverse joints or cracks so a minimum of 7 inches of dowel bar extends into adjacent panel.
5. Cut a piece foam core board material (angled if joints are skewed) to fit tightly around dowel bar. Place foam core board at center of dowel bar flush with surface of concrete pavement, or slightly recessed. Maintain foam core board in vertical position, tight to edges, during grout placement operations.

D. Grouting Dowel Bars.

1. Produce grout with a portable mixer approved by the Engineer or a volumetric mixer meeting the requirements of Article 2001.20, E for miscellaneous pours. Place grout immediately after mixing and before grout has attained initial set. Do not re-temper grout with water.
2. Thoroughly moisten all surfaces of the sawed slot immediately prior to filling with grout. Remove all excess water with compressed air.
3. Place grout according to the manufacturer's recommendations. Thoroughly consolidate grout with a hand held vibrator so the grout completely surrounds dowel bars and support chairs. Place grout so that the material is at least 1/8 inch higher than the pavement if the pavement is to be diamond ground. If the pavement is not to be ground, finish the grout flush with the surface.
4. Immediately after placement, thoroughly coat grout with white pigmented curing compound.

E. Re-establishing Joints or Cracks.

Re-establish joint or crack above foam board insert within 8 hours of grout placement by means of sawing when grout has attained sufficient strength. If foam board is visible, sawing of joint or crack will not be required.

F. Replacing Deficient Work.

Replace dowel bars that are to be removed due to poor quality work or material failure with new bars. Provide additional

traffic control needed due to required retrofit repairs at no additional cost to the Contracting Authority.

2556.04 METHOD OF MEASUREMENT.

Dowel Bar Retrofit will be measured by each bar satisfactorily placed.

2556.05 BASIS OF PAYMENT.

Payment for Dowel Bar Retrofit will be paid at the contract unit price per each bar. Payment shall be considered full compensation for furnishing all labor, equipment, and materials necessary to perform the work prescribed in this specification.

Division 26. Roadside Development.

Section 2601

2601.01, Description.

Replace the tenth bullet:

~~Outlet or channel scour protection (Transition mat), and~~

2601.03, A, 7, a.

Replace the first sentence:

Use hydraulic seeding equipment with a pump rated at no less than 100 gallons per minute and is capable of continuous agitation action to uniformly distribute seed over the area.

2601.03, A, 14, Straw Mulching Machine.

Replace the second sentence:

~~Engineer may consider excessive pulverization as is the general absence of straw longer than 6 inches after distribution.~~

2601.03, A, 15, a.

Delete the second bullet:

~~• Have a nominal minimum diameter of 20 inches, and~~

2601.03, A, 15, b.

Delete the second and third sentences:

~~Use equipment that weighs approximately 1000 pounds. When directed by the Engineer, increase the weight (mass) of the equipment by the addition of ballast.~~

2601.03, A, Equipment.

Add the Articles:

18. Slit Seeder.

Use a gas, diesel, or electric powered mechanical slit seeder that:

- Is capable of cutting vertical grooves a maximum of 1/4 inch deep into the soil with a maximum horizontal blade spacing of 3 inches,
- Deposits metered seed directly behind the vertical grooves, and
- Contains packer wheels that press and firmly pack seed into the soil.

19. Drop Seeder.

One piece of equipment containing the following:

- Pulverizer rollers in front of the seed tubes.
- Ground driven seed meters.
- Max seed tube spacing of 3 4 inches delivering seed between the pulverizer rollers and packer wheels. If seeder does not have tubes, equipment shall have the ability to uniformly spread seed.
- Packer wheels pressing and firmly packing seed into the soil.

2601.03, B, 4, b, 1.

Add to the end of the Article:

A fertilizer will be considered equivalent when it meets the minimum total pounds per acre of nitrogen (N), available phosphoric acid (P₂O₅), and water soluble potassium (K₂O).

2601.03, B, 4, c, 1.

Replace the Article:

Except when a hydraulic seeder is used, thoroughly mix all seed specified for the contract prior to placing seed in seed hopper. For Seed mixing, shall meet comply with the requirements of Materials I.M. 469.02. Use Ppermanent rural, permanent urban, urban stabilizing, salt tolerant seeding, 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.

2601.03, B, 4, d, 2, Seeding and Fertilizing with Hydraulic Seeder.

Replace the title and Article:

Seeding and Fertilizing with Hydraulic Seeder Seeding.

- 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 of water slurry per acre. Add 50 pounds of Wood Cellulose Fiber complying with Article 4169.07, B, 1, as a tracer for each 500 gallons of water in hydraulic seeder tank.
- 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. Use flood type nozzles and manufacture's recommended water volume to apply mixture.
- c) Once seed has been added to tank mixture, a 1 hour time limit is set for spreading mixture on soil. Once 1 hour time limit has expired, discard remaining mixture.
- d) Perform hydraulic seeding separate from placing hydraulic mulch.

2601.03, C, 2, b, Seed Mixture.

Replace Table 2601.03-2:

Table 2601.03-2: Urban Stabilizing Crop Seeding Rates

| | |
|--|-----------------------|
| Bluegrass, Kentucky ¹ | 422 195 lbs. per acre |
| Ryegrass, Perennial (fineleaf turf-type variety) ² | 35 40 lbs. per acre |
| Fescue, Creeping Red | 48 25 lbs. per acre |
| 1. Choose three different cultivars of Kentucky bluegrass, at 42 65 lbs. per acre each. | |
| 2. Choose two different cultivars of turf-type perennial ryegrass, at 20 lbs. per acre each. | |

2601.03, C, 2, d, Application Dates.

Replace the Article:

Normal seed application dates are March 1 through May 31, and August 10 through September 30. Seed may be applied throughout the year unless ground conditions are unsuitable for seeding due to moisture or frost.

2601.03, C, 3, a, Preparation and Application.

Replace the Article:

- 1) Prepare seedbed according to Article 2601.03, B, 4, a c.
- 2) Prepare seed according to Article 2601.03, B, 4, c. In areas without existing stabilized crop seeding residue, pPrepare seedbed according to Article 2601.03, B, 4, a, and apply seed according to Article 2601.03, B, 4, d, using only a drop seeder complying with Article 2601.03, A, 19.
- 3) Apply seed according to Article 2601.03, B, 4, d. In areas with existing stabilized crop residue, apply seed with a native grass seed drill with a no till attachment through the small seed box slit seeder. Seedbed preparation will not be required, except for areas with rills and gullies.

2601.03, C, 4, a, Preparation and Application.

Renumber Articles 2, 3, 4 and **Add** the Article:

- 2) In areas with existing urban crop stabilizing of 50% or greater density, full seedbed preparation and rolling will not be required. Apply seed using a slit seeder as defined in Article 2601.03, A, 18.
- 2 3)
- 3 4)
- 4 5)

2601.03, C, 4, b, Seed Mixture.

Replace Table 2601.03-4:

Table 2601.03-4: Permanent Seed Rates, Urban Area

| | |
|--|-----------------------|
| Bluegrass, Kentucky ¹ | 122 195 lbs. per acre |
| Ryegrass, Perennial (fineleaf turf-type variety) ² | 35 40 lbs. per acre |
| Fescue, Creeping Red | 18 25 lbs. per acre |
| 1. Choose three different cultivars of Kentucky bluegrass, at 42 65 lbs. per acre each. | |
| 2. Choose two different cultivars of turf-type perennial ryegrass, at 20 lbs. per acre each. | |

2601.03, C, 5, a, Preparation and Application.

Replace the Article:

- ~~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. Apply seed with native grass seed drill with a no till attachment. Seedbed preparation and cultipacking will not be required. Mowing according to Article 2601.03, B, 4, a, 3, may be required. In areas where rills and gullies are present, prepare seedbed according to Article 2601.03, B, 4, a, and then apply seed with a native grass seed drill with a no till attachment.~~
- ~~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 project prior to operation on project.~~
- ~~5) Plant seed at a maximum 1/8 inch 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 below soil surface.~~
- ~~8) Operate drill so 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 to prevent drill from bouncing.~~
- ~~10) Remove seed remaining in drill at end of each day. At completion of seeding, remove remaining seed from drill by vacuum or other means. Hand broadcast remaining seed on project.~~

2601.03, C, 5, b, Seed Mixture.

Add row to Table 2601.03-5:

| | |
|--|----------------|
| Butterfly weed (<i>Asclepias tuberosa</i>) | 3 oz. per acre |
|--|----------------|

2601.03, C, 7, d, Application Dates.

Replace the Article:

~~Normal seed application dates are April 15 through June 30. Normal seed application dates are April 1 through May 31 and November 1 until ground conditions are unsuitable for seeding due to moisture or frost.~~

2601.03, C, Types of Seeding.

Add the Article:

9. Salt Tolerant Seeding.

a. Preparation and Application.

- 1) Prepare seed according to Article 2601.03, B, 4, c.
- 2) Prepare seedbed according to Article 2601.03, B, 4, a, and apply seed according to Article 2601.03, B, 4, d using only a drop seeder according to Article 2601.03, A, 19.

b. Seed Mixture.

Use seeding rates in Table 2601.03-7 for permanent seeding of rural areas, unless otherwise specified in the contract documents:

Table 2601.03-7: Salt Tolerant Seed Rates

| | |
|--|-------------------|
| Alkali grass | 109 lbs. per acre |
| Turf-type Tall Fescue ¹ | 109 lbs. per acre |
| Perennial ryegrass | 66 lbs. per acre |
| Crested wheatgrass | 66 lbs. per acre |
| Hard fine fescue | 44 lbs. per acre |
| Sheep fine fescue | 44 lbs. per acre |
| ¹ Turf-type Tall Fescue shall contain a minimum 36 lbs. of each cultivar Inferno and Quest. | |

c. Fertilizing.

- 1) Spread over the areas at the rate of 300 pounds per acre 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.

2601.03, E, 2, a, Straw Mulch.

Add the Articles:

- 3) Crimp/tuck straw to a minimum of 2 inches below ground surface.
- 4) Do not operate mulch-blowing equipment on slopes steeper than 2.5:1 or on slopes that may rut. Use blower attachments to apply mulch without traversing slopes. Hydraulic mulching, as described in Article 4169.07, B, 2, may be substituted at no additional cost to the Contracting Authority.
- 5) Do not mulch when wind velocities are greater than 15 mph.

2601.03, E, Mulching.

Add the Article:

3. Organic Fiber Matrix.

- a. Apply at no less than 4500 pounds per acre using standard hydraulic mulching equipment, unless specified otherwise in the contract documents.
- b. If using with hydraulic seeding, apply as a separate operation.

2601.03, G, 3, d, 4.

Replace the Article:

After sodding and seeding, water the sod, sodbed, and disturbed areas according to Article 2601.03, G, 3, e 2601.03, I, 2.

2601.03, G, 3, e, Watering Sod.

Delete the Article:

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 of sod. Perform the 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.~~
- 3) ~~Each watering may require a maximum of 100 gallons of water per square. Apply water as a spray or dispersion to prevent damage to the 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.~~

2601.03, G, 3, f, Urban, Island, and Safety Rest Area Sodding.

Renumber the Article:

f e. Urban, Island, and Safety Rest Area Sodding.**2601.03, H, Special Ditch Control, Turf Reinforcement Mat, Slope Protection, and Outlet or Channel Scour Protection (Transition Mat).**

Replace the title of the Article and Articles 1, 6, and 7, and **delete** Article 8:

Special Ditch Control, Turf Reinforcement Mat, Slope Protection, and Outlet or Channel Scour Protection (Transition Mat).

1. ~~Preparation of Area to be Treated with Special Ditch Control, Turf Reinforcement Mat, Slope Protection, and Outlet or Channel Scour Protection (Transition Mat).~~
6. ~~Outlet or Channel Scour Protection (Transition Mat) (TM).~~
7. ~~Finishing Adjacent to Special Ditch Control, Turf Reinforcement Mat, Slope Protection Areas, and Outlet or Channel Scour Protection (Transition Mat).~~
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.
 - d. Each watering may require a maximum of 50 gallons of water per square. 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.

2601.03, H, 5, a, 2.

Replace the Article:

Use mixture specified. Seed slopes using seeding rates in Tables 2601.03-7 for slopes adjacent to native grass seedings and 2601.03-8 for slopes adjacent to rural seedings.

2601.03, H, 5, b, Fertilizing.

Replace the Article:

For slope protection, use fertilizer specified. Apply provisions of Article 2601.03, B, 4, b.

- 1) After area is prepared and prior to laying slope protection, 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, apply 300 pounds per acre of 6-24-24 (or equivalent) to slopes adjacent to rural seedings.
- 3) No fertilizer will be required for slopes adjacent to native grass seedings.

2601.03, Construction.

Add the Article and renumber subsequent Articles:

I. Watering.

1. Watering of Special Ditch Control, Turf Reinforcement Mat, Slope Protection, and Transition Mat.

- a. Provide watering equipment and an approved water supply before starting special ditch control, turf reinforcement mat, slope protection, or transition mat 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 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 watering is completed.
- c. Ensure waterings are sufficient to thoroughly saturate seedbed to a depth of approximately 2 inches.
- d. Each watering may require a maximum of 50 gallons of water per square. 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.

2. Watering Sod.

- a. Provide watering equipment and an approved water supply before beginning sodding operation. Six waterings will be required. Allow no more than 1 hour to elapse between laying and initial watering of sod. 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 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 watering from the day watering is to commence.
- b. Ensure waterings are sufficient to thoroughly saturate sod, sodbed, and adjacent disturbed areas to a depth of approximately 4 inches.
- c. Each watering may require a maximum of 100 gallons of water per square. Apply water as a spray or dispersion to prevent damage to the 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.

I J. Mowing.

J K. Completion of the Work.

2601.04, A.

Add as the third bullet:

- Hydraulic Seeding,

2601.04, D.

Replace the Article:

Special Ditch Control, Turf Reinforcement Mat, and Slope Protection: squares of 100 square feet calculated from measurements to the nearest foot. 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 are incidental. ~~Seed, and fertilizer for Special Ditch Control and TRM are incidental.~~

2601.04, E.

Replace the Article:

~~Outlet or Channel Scour Protection (Transition Mat):~~ square feet calculated from measurements to the nearest foot.

2601.04, H.

Replace the Article:

Mowing described in Article 2601.03, † J: acres to the nearest 0.1 acre of surface area.

2601.05, A, 2.

Add as the third bullet:

- Hydraulic Seeding,

2601.05, A, 6.

Replace the Article:

Mulch furnished and placed: ~~predetermined contract unit price per acre (hectare)~~ contract unit price per acre to the nearest 0.1 acre for mulching. Payment is full compensation for preparing the area and furnishing and applying mulch.

2601.05, A, 10, b.

Replace the Article:

Payment is full compensation for slope protection preparation and materials ~~in addition to the amount paid for seed and fertilizer.~~ This includes seedbed preparation, seed and fertilizer, slope protection, stapling, and installation of materials.

2601.05, A, 11.

Replace the Article:

Square feet of ~~Outlet or Channel Scour Protection (Transition Mat)~~ with material as specified:

- Contract unit price per square feet.
- 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.

2601.05, A, 12.

Replace the Article:

~~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 2601.03, I, 2), 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. When an item for watering is not included, the cost of watering is included in the amount paid for the item to be watered.~~

2601.05, A, 14.

Replace the Article:

Mowing as described in Article 2601.03, † J: contract unit price per acre to the nearest 0.1 acres.

Section 2602

2602.01, D, Water Pollution Control Quality Control.

Replace the Article:

- ~~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. However, when the Contractor is not mobilized onsite, the Contractor may delegate this responsibility to a subcontractor.
 - 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.~~
1. For projects regulated by a NPDES storm water permit:
 - a. Designate a Water Pollution Control Manager (WPCM) from the Contractor prior to initiating any construction activities. The WPCM shall:
 - 1) Complete Iowa DOT Erosion & Sediment Control Basics (ESC Basics) web-based training (which is valid for 2 years) or Erosion Control (ECT) certification (which is valid for 5 years through the Technical Training and Certification Program of the Department);
 - 2) Be authorized by the Contractor and have the authority to supervise all work performed by the Contractor and subcontractors that involves storm water requirements or affects storm water compliance;
 - 3) Be authorized by the Contractor and have the responsibility to order the Contractor's employees and subcontractors to take appropriate corrective action to comply with storm water requirements, including requiring any such person to cease or correct a violation of storm water requirements and to order or recommend such other actions or sanctions as necessary to meet storm water requirements,
 - 4) Be familiar with the Project Pollution Prevention Plan (PPP);
 - 5) Be the point of contact for Contracting Authority regarding storm water compliance;
 - 6) Be responsible for reviewing and signing or delegating review and signing of inspection reports to a trained or certified individual from the Contractor, acknowledging awareness of any deficiencies and ensuring the correction of all deficiencies; and
 - 7) Visit the Project on a frequent basis and in no instance less than once per week during construction activities. When the Contractor is not mobilized onsite, the Contractor may delegate this responsibility to a subcontractor.
 - b. Maintain an individual that will be onsite daily during construction activities. This individual shall have completed at a minimum ESC Basics training. This individual shall be responsible for coordinating all erosion and sediment control operations. For this daily requirement, the Contractor may subcontract this responsibility.
 - 1) Additional responsibilities of an ESC Basics trained individual that shall not be subcontracted include:
 - Attend required storm water inspections with the Contracting Authority. However, when the Contractor is not mobilized onsite, the Contractor may delegate this responsibility to a subcontractor.
 - Prepare required initial Erosion Control Implementation Plan (ECIP) submittal and ECIP updates.
 - Attend construction progress meetings to discuss erosion and sediment control issues.
 - 2) Contractor's WPCM may fulfill these responsibilities.
 - c. 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. Contractor's WPCM may fulfill these responsibilities if ECT certified.
2. For projects regulated by a NPDES storm water permit and where the Department is the Contracting Authority, the Department may use Permixon, a web-based software application, to record storm water permit compliance information.
 - a. Project and permit set-up will be performed by the Department.
 - b. Contractor shall be responsible for:
 - Managing its own company users and adding subcontractor companies.
 - Uploading Erosion Control Implementation Plan and amended PPP documents.
 - Uploading subcontractor co-permittee certifications.
 - Reviewing and signing inspection reports (if not already signed in the field).
 - c. If Permixon is not used on a project, the above referenced documents shall be uploaded to or signed in DocExpress per Section 1113.
 - d. Costs associated with the use of Permixon are incidental to Mobilization.
3. For projects regulated by a NPDES storm water permit, submit an amended PPP site map that identifies erosion and sediment control work performed during the project. Submittal is required prior to payment for corresponding erosion and sediment control contract items from Sections 2601 and 2602, but shall be submitted no later than one week

after installation completion of such items. Submittal of amended PPP site map shall be incidental to payment for erosion and sediment control items.

2602.03, A.

Replace the Article:

For projects regulated by a NPDES storm water permit, Prior to the preconstruction conference furnish the Engineer an initial ECIP for accomplishment of temporary and permanent erosion and sediment control.

In the ECIP, include stages for erosion and sediment control work to address Contractor's timetable and sequence for major activities or stages on the contract. including ECIP stages shall consider as a minimum:

Initial controls required prior to land disturbing activities,

- Intended timetable and sequence of major land disturbing activities,
- Number of earthwork balances for the contract, Construction staging to limit disturbed areas,
- Sensitive areas requiring special consideration,
- Anticipated suspension of work and stabilization of disturbed areas,
- Compliance with Pollution Prevention Plan (PPP), and
- Method of erosion control on haul roads, and borrow pits, and
- Removal of excess materials from project.

2602.03, C.

Replace the second bullet:

Constructing or installing perimeter and slope and ditch check sediment control devices (~~straw wattles, wood excelsior logs, or filter socks filled with compost filter material~~), and

2602.03, E.

Replace the Article:

~~Stabilize disturbed areas, in which construction activity will not occur for a period of 21 calendar days, no later than the 14th calendar day after no construction activity has occurred.~~ For projects regulated by an NPDES storm water permit, initiate stabilization of disturbed areas immediately after clearing, grading, excavating, or other earth disturbing activities have:

- Permanently ceased on any portion of site, or
- Temporarily ceased on any portion of site and will not resume for a period exceeding 14 calendar days.

Stabilization measures include temporary seeding, permanent seeding, mulching, sod, or other methods the Engineer approves.

If stabilization measures are not initiated as required by the NPDES storm water permit, there will be a deduct of \$750 per calendar day, unless such delay is authorized by the Engineer. Additionally, if stabilized areas are re-disturbed within 7 days after completion of stabilization measures, the amount paid for stabilization of the area will be deducted from payment, unless such re-disturbance is directed by the Engineer.

2602.03, L, 1.

Replace the Article:

Mobilizations, Erosion Control, applies to projects not identified as erosion control or landscaping and ~~containing at least one of the following items:~~ contain a Storm Water Pollution Prevention Plan (SWPPP).

- ~~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.~~

2602.03, L, 7.

Replace the Article:

Mobilize within 72 hours of a written order with sufficient labor, equipment, and materials to perform erosion and sediment control work included in ECIP or PPP, or as ordered or approved by Engineer. Complete work within 7 calendar days of a written order. ~~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.~~

2602.03, L, 8.

Replace the Article:

Failure to mobilize and complete work 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.

2602.03, M, Mobilizations, Emergency Erosion Control.

Add as the first sentence:

Mobilizations, Emergency Erosion Control, applies to projects not identified as erosion control or landscaping and containing a Storm Water Pollution Prevention Plan (SWPPP).

2602.03, Construction.

Add the Article:

O. Stabilized Construction Entrance.

Construct stabilized construction entrance to prevent tracking of material onto roadways. Construct according to the contract documents at locations approved by the Engineer.

2602.04, K, Mobilizations, Erosion Control.

Add to the end of the Article:

For multi-project contracts, count will be on a per project basis, except for projects where limits are overlapping or contiguous.

2602.04, Method of Measurement.

Replace the titles of the Articles:

I. Perimeter and Slope or Ditch Check Sediment Control Device.

Linear feet to the nearest foot of each size.

J. Removal of Perimeter and Slope or Ditch Check Sediment Control Device.

Linear feet to the nearest foot.

Add the Articles:

N. Rock Check Dam.

Linear feet to the nearest 0.1 feet.

O. Maintenance of Rock Check Dam.

By count.

P. Removal of Rock Check Dam.

By count.

Q. Temporary Sediment Control Basin.

By count.

R. Maintenance of Temporary Sediment Control Basin.

By count.

S. Removal of Temporary Sediment Control Basin.

By count.

T. Open-throat Curb Intake Sediment Filter.

Feet to the nearest foot.

U. Maintenance of Open-throat Curb Intake Sediment Filter.

By count.

V. Removal of Open-throat Curb Intake Sediment Filter.

By count.

W. Stabilized Construction Entrance.

Linear feet measured along the length of the entrance at the entrance centerline shown in the contract documents adjusted for:

- Any decrease based on site restrictions approved by the Engineer, or
- Any extensions approved by the Engineer to prevent tracking of material onto roadways.

2602.05, A, 7, Removal of Silt Basins.

Delete the last sentence:

~~Overhaul will not be paid for this item.~~

2602.05, A.

Replace the titles of the Articles:

9. Perimeter and Slope or Ditch Check Sediment Control Device.

Per linear foot for length of device of each size properly installed.

10. Removal of Perimeter and Slope or Ditch Check Sediment Control Device.

Per linear foot for the length of device removed.

Add the Articles:

11. Rock Check Dam.

Per linear foot. Payment is full compensation for all materials, labor, and equipment required to construct the Rock Check Dam. Class 10 excavation required to cut trench and engineering fabric installed prior to placing revetment are incidental and will not be paid for separately.

12. Maintenance of Rock Check Dam.

Each occurrence. Payment is full compensation for clean out and disposal of material when capacity reaches 50%, and for any repair that is needed during the project.

13. Removal of Rock Check Dam.

Each. Payment is full compensation for all labor and equipment required to remove all rock and material above original ditch grade. Rock, silt, and engineering fabric that is flush with and/or below final ditch grade will be allowed to remain in the excavation trench.

14. Temporary Sediment Control Basin.

Each. Payment is full compensation for furnishing all equipment, labor, and materials required to construct the Temporary Sediment Control Basin as shown.

15. Maintenance of Temporary Sediment Control Basin.

Each occurrence. Payment is full compensation for clean out and disposal of material when capacity reaches 50%, and for any other repair needed during the project.

16. Removal of Temporary Sediment Control Basin.

Each. Payment is full compensation for all labor and equipment required to remove all rock and material above designed ditch grade and to place topsoil. Rock and engineering fabric that is flush with and/or below designed ditch grade will be allowed to remain in place.

17. Open-throat Curb Intake Sediment Filter.

Per foot. Payment is full compensation for furnishing all equipment, labor, and materials required to install the Open-throat Curb Intake Sediment Filter as shown.

18. Maintenance of Open-throat Curb Intake Sediment Filter.

Each occurrence. Payment is full compensation for clean out and disposal of material when sediment accumulation depth reaches 2 inches, and for any other repair needed during the project.

19. Removal of Open-throat Curb Intake Sediment Filter.

Each. Payment is full compensation for all labor and equipment required for removal.

20. Stabilized Construction Entrance.

Per linear foot. Payment is full compensation for furnishing all materials and work necessary for installation, maintenance, and removal of stabilized construction entrance. Maintenance includes installing additional material or cleaning required to maintain the entrance in a functional condition.

2602.05, C.

Add as the second sentence:

Dispose of cleaned-out silt material off the project unless Engineer approves a suitable site within the project limits.

2602.05, D.

Replace the Article:

If water control measures (including clean-out or repair of installed items) 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.

Section 2611

2611.03, F, 1, Plant Establishment Period and Replacement.

Replace second sentence:

The establishment period will begin when the last tree and shrub plant of the initial installation is planted and incidental work related to the plantings is complete.

2611.05, D, 1

Retitle and Replace Article:

After Initial Installation of All Trees and Shrubs is Complete.

Sixty-five percent of the placed quantity will be paid for all live plants of each size and variety installed with the specified mulch, and meeting the staking and guying requirements. This payment will be made after the initial inspection by the Engineer confirming all trees and shrubs are furnished and installed according to the contract documents.

Division 41. Construction Materials.

Section 4100

4100.06, A.

Delete the last sentence:

~~Test Method 804 may be used when a coating is specified by uniformity.~~

Section 4101

4101.01, B, 2.

Replace the Article:

Slag constituent of Type IS cement no more than 35 40 weight percent of the Portland blast-furnace slag cement.

Section 4108

4108.01, Fly Ash.

Replace the Article and title:

FLY ASH AND NATURAL POZZOLANS.

- A. Comply with ~~AASHTO M 295~~ ASTM C 618 or ASTM C 1697, either Class N, Class F, or Class C; except the value of ~~available total equivalent alkalis is~~ are not to exceed ~~1.50% 3.80%~~ as determined by Materials I.M. 491.17. ~~Sources with fly ash between 1.5% and 2.5% available alkalis may be approved based on satisfactory results of the mortar bar expansion test specified in Materials I.M. 491.17. For Class C fly ash, the pozzolanic activity test with lime will not be required.~~
- B. When Class F is required, a Class C fly ash with minimum total oxides ($\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$) of 66% and minimum SiO_2 of 38% may be used.
- C. Approval of the source of fly ash will be required. This shall be based on fly ash produced when the power plant is using specific materials, equipment, and processes. Any change in materials, equipment, and processes voids the source approval, and a new approval of the source will be required. Initial approval of Class N pozzolans will be based on meeting the additional requirements of Materials I.M. 491.17.
- D. Inspection and acceptance of fly ash and natural pozzolans will be according to Materials I.M. 491.17.
- E. Fly ash for soil stabilization shall meet ASTM C 618, Class C, except loss of ignition (LOI) requirement will not apply. Fly ash shall also contain a minimum of 22% calcium oxide (CaO).

Section 4109

4109, Aggregate Gradations.

Add the Article:

4109.04 STOCKPILING OF AGGREGATE.

- A. For PCC aggregate, driving on stockpiles is not considered an acceptable production or handling practice and may be grounds for rejection of the stockpile.
- B. For all other aggregate stockpiles, if a ramp (incline or decline) is used to build the stockpile the ramp cannot be used as certified material. Incorporation of a ramp into a stockpile may be grounds for rejection of the stockpile.

Section 4110**4110.01, Description.**

Replace the first sentence of the Article:

Natural sands resulting from disintegration of rock through erosional processes unless specified otherwise on the source approval.

Section 4115**4115.01, Description.**

Add to the end of the first paragraph:

Unless stated otherwise on the source approval, coarse aggregate for Portland Cement Concrete shall be washed with sufficient agitation to cause material coatings to be separated and removed.

4115.02, Quality.

Replace the first sentence of the Article:

Meet the requirements of Tables 4115.02-1 and 4115.02-2 and Section 4109:

Section 4118**4118, Pipe Bedding Material.**

Replace the title:

Pipe Bedding Material for Non-Primary Road Projects.

4118.03, Quality.

Replace Table 4118.03-1:

Table 4118.03-1: Coarse Aggregate Quality (Virgin Material)

| Coarse Aggregate Quality | Maximum Percent Allowed | Test Method |
|---|-------------------------|--|
| Abrasion | 50 | AASHTO T 96 |
| C – Freeze ^(a) | 20 | Iowa DOT Materials Laboratory Test Method No. 211, Method C |
| A – Freeze ^(a) | 6 | Iowa DOT Materials Laboratory Test Method No. 211, Method A |
| Alumina ^(a) | 0.5 | Iowa DOT Materials Laboratory Test Method No. 222 |
| (a) Meet at least one of the C – Freeze, A – Freeze, or Alumina requirements. | | |

Section 4119**4119, Pipe Backfill Material Under Interstate and Primary Roadways.**

Retitle the Section:

Pipe Bedding and Backfill Material Under for Interstate and Primary Roadways Projects.

4119.02, Crushed Stone.

Replace the Article title:

CLASS A CRUSHED STONE.

4119.03, Crushed Gravel.

Replace the Article title:

CLASS C CRUSHED GRAVEL.

Section 4120

4120.04, Class A Crushed Stone.

Replace Table 4120.04-1:

Table 4120.04-1: Coarse Aggregate Quality (Class A Crushed Stone)

| Coarse Aggregate Quality | Maximum Percent Allowed | Test Method |
|--|-------------------------|--|
| Abrasion | 45 | AASHTO T 96 |
| C Freeze | 15 | Office of Materials Test Method No. Iowa 211, Method C |
| Clay Lumps and Friable Particles | 4.0 | Materials I.M. 368 |
| Note: For shoulders Granular Shoulder Aggregate only, the abrasion limits may be raised to 55 if Alumina does not exceed 0.7 or A Freeze does not exceed 10 is 50. | | |

Section 4122

4122, Crushed Stone Base Material.

Replace the Section:

4122.01 DESCRIPTION.

Crushed stone meeting the following requirements.

4122.02 GRADATION.

- A. Produce Macadam Crushed Stone with a nominal maximum size of 3 inches. Screen over a 3/4 inch screen, or when specified in the contract documents, a 1 inch screen. This is identified as Gradation No. 13a of the Aggregate Gradation Table, Article 4109.02.
- B. The aggregate passing the 3/4 inch or 1 inch screen may be furnished as the Choke Stone material; however, 6% to 16% of the material shall pass the No. 200 sieve. This is identified as Gradation No. 13b of the Aggregate Gradation Table, Article 4109.02.

4122.03 QUALITY.

- A. For Macadam Stone Base and Choke Stone, meet the requirements of Table 4122.03-1 when crushed to a 3/4 inch or 1 inch nominal size for testing:

Table 4122.03-1: Crushed Stone Base Quality

| Macadam Quality | Maximum Percent Allowed | Test Method |
|-----------------|-------------------------|---|
| Abrasion | 50 | AASHTO T 96 |
| C Freeze | 10 15 | Iowa DOT Materials Laboratory Test Method No. 211, Method C |

- B. ~~Choke Stone that is a byproduct of the Macadam production need not be tested. For Choke Stone that is not a byproduct of Macadam production, meet the requirements of Table 4122.03-2:~~

Table 4122.03-2: Choke Stone Quality

| Choke Stone Quality | Maximum Percent Allowed | Test Method |
|---------------------|-------------------------|---|
| Abrasion | 45 | AASHTO T 96 |
| C Freeze | 15 | Iowa DOT Materials Laboratory Test Method No. 211, Method C |

Section 4123

4123.01, Description.

Add as the last bullet:

- Do not place RAP below high water table.

4123.03, Quality.**Replace the Article:**

- A.** The requirements of Table 4123.03-1 apply to ~~blended and non-blended~~ virgin materials:

Table 4123.03-1: Aggregate Quality (Blended and Non-Blended Virgin Materials)

| Aggregate Quality | Maximum Percent Allowed | Test Method |
|---|-------------------------|---|
| Abrasion ^(a) | 45 50 | AASHTO T 96 |
| C Freeze | 15 | Office of Materials Test Method No. Iowa 211, Method C |
| Alumina ^(b) ^(a) (minus No. 40 material) | 4.7 | Office of Materials Test Method No. Iowa 222 |
| <p>(a) Virgin material with Al₂O₃ not exceeding 0.7 (+4) or A-freeze not exceeding 10 may have an abrasion maximum of 55.</p> <p>(b) For gravel or gravel/non-gravel blend, have a plasticity index not exceeding 7 for each source.</p> <p>(a) The alumina requirement does not apply to gravel and recycled PCC.</p> | | |

- B.** ~~Acquire gravel or gravel/non-gravel blend products from a gravel source with a plasticity index not exceeding 7. The requirements of Table 4123.03-1 apply to recycled PCC when the aggregate source is unknown as outlined in Materials I.M. 210.~~

Section 4126**4126, Aggregate for Polymer-Modified Microsurfacing.****Add the Section:****4126.01 DESCRIPTION.**

Crushed stone. For non-Interstate mixes steel slag may also be used.

4126.02 GRADATION.

For quartzite, granite, and slag meet requirements for Gradation No. 37 of the Aggregate Gradation Table, Article 4109.02. For limestone and dolomite meet requirements for Gradation No. 38 of the Aggregate Gradation Table, Article 4109.02

4126.03 QUALITY.

Meet requirements of Table 4126.03-1 and 4126.03-2 with the exception that use of Friction Type 2 crushed stone requires a maximum abrasion loss of 30% and sand equivalence of not less than 60. Testing is based on aggregate crushed to 3/4 inch nominal size.

Table 4126.03-1: Aggregate Quality

| Aggregate Quality | Maximum Percent Allowed | Test Method |
|--|-------------------------|--|
| Abrasion | 40 | AASHTO T 96 |
| A Freeze | 10 | Office of Materials Test Method No. Iowa 211, Method A |
| Alumina ^(a) | 0.7 | Office of Materials Test Method No. Iowa 222 |
| Sand Equivalence | 45 (Minimum) | AASHTO T 176 |
| Organic Materials | 0.01 | Office of Materials Test Method No. Iowa 215 |
| (a) If the Alumina value fails, determine the A Freeze value for specification compliance. Office of Materials Test Method No. Iowa 222 does not apply to gravel or quartzite. | | |

Table 4126.03-02: Maximum Permissible Amounts of Objectionable Material

| Objectionable Materials | Maximum Percent Allowed | Test Method |
|---|-------------------------|--------------------|
| Unsound chert particles retained on No. 4 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 | Iowa DOT Materials Laboratory Test Method No. 215 |

Section 4127

4127.01, Description.

Replace the Article:

- A. Crushed stone, gravel, slag, sand, and filler from an approved source. Crushed gravel may be used to satisfy crushed particle and friction requirements for HMA mixtures. Produce crushed gravel as a separate operation by crushing the portion of a gravel aggregate retained on a screen at least 1/4 inch larger than the sieve size that 100% of the gravel will pass after crushing.
- B. If a gravel aggregate has 100% passing the 3/8 inch sieve, the Engineer may replace the requirements of Table 4127.02-1 with the requirements of Article 4127.03.

4127.02, Coarse Aggregate.

Replace Table 4127.02-1:

Table 4127.02-1: Coarse Aggregate Quality (Flexible Paving Mixtures)

| Coarse Aggregate Quality | Type A Maximum % | Type B Maximum % | | Test Method |
|---|------------------|------------------|-------|---|
| | | Primary | Other | |
| Abrasion | 45 | 45 | 45 | AASHTO T 96 |
| Absorption ^(a) | 6.0 | 6.0 | 6.0 | Iowa DOT Materials Laboratory Test Method No. 201 |
| Alumina ^(b) | 0.7-1.0 | 1.5 | 2.5 | Iowa DOT Materials Laboratory Test Method No. 222 |
| A Freeze | 40-15 | 25 | 45 | Iowa DOT Materials Laboratory Test Method No. 211, Method A |
| C Freeze | N/A | 10 | 10 | Iowa DOT Materials Laboratory Test Method No. 211, Method C |
| Clay Lumps/Friable Particles | 0.5-2.0 | N/A | N/A | Materials I.M. 368 |
| Organic Material | 0.01 | 0.01 | 0.01 | Iowa DOT Materials Laboratory Test Method No. 215 |
| (a) When a coarse aggregate for use in asphalt fails absorption using Iowa DOT Materials Laboratory Test Method No. 201; absorption determined by Materials I.M. 380 (Vacuum-saturated specific gravity & absorption) will be used. (b) If the Alumina value fails, determine the A Freeze value for specification compliance. Iowa DOT Materials Laboratory Test Method No. 222 does not apply to gravel. | | | | |

4127.03, A.

Replace the Article:

Natural sand containing no more than 0.01% organic matter when tested using Iowa DOT Materials Laboratory Test Method No. 215 meeting the requirements of Table 4127.03-1. A gradation for wearing course mixture of no more than 50% retained between two consecutive standard sieves below the No. 4 sieve or gravel aggregate with 100% passing the 3/8 inch sieve meeting these requirements.

Table 4127.03-1: Fine Aggregate Quality (Flexible Paving Mixtures)

| Fine Aggregate Quality | Type A Maximum % | Type B Maximum % | Test Method |
|------------------------|------------------|------------------|---|
| Organic Matter | 0.01 | 0.01 | Iowa DOT Materials Laboratory Test Method No. 215 |

| | | | |
|------------------------------|-----|-----|-----------------------------------|
| Clay Lumps/Friable Particles | 1.5 | 3.0 | Materials I.M. 368 ^(a) |
| Shale | 2.0 | 5.0 | Materials I.M. 344 |

(a) Use Method A for initial test. If Method A fails, Method B may be used.

4127.04, B.

Replace the Article:

Maximum shale allowed in the fine portion of the combined materials: Coarse and fine aggregate shall meet quality requirements of Articles 4127.02 and 4127.03 before combining aggregates.

Table 4127.04: Maximum Shale Allowed

| Aggregate Type | Maximum Percent Allowed | Test Method |
|----------------|-------------------------|---------------------------|
| Type A | 2.0 | <u>Materials I.M. 344</u> |
| Type B | 5.0 | <u>Materials I.M. 344</u> |

Section 4128

4128, Stabilization (Foundation) Material

Add the Section:

4128.01 DESCRIPTION.

Aggregate of the following types:

- Crushed stone, or
- Crushed PCC, if approved by the Engineer.

4128.02 GRADATION.

Meet the requirements of Gradation No. 13a of the Aggregate Gradation Table, Article 4109.02.

4128.03 QUALITY.

The requirements of Table 4128.03-1 apply to individual virgin aggregates when crushed to a 3/4 inch or 1 inch nominal size for testing:

Table 4128.03-1: Stabilization Material Quality

| Macadam Quality | Maximum Percent Allowed | Test Method |
|-----------------|-------------------------|--|
| Abrasion | 50 | AASHTO T 96 |
| C Freeze | 20 | Office of Materials Test Method No. Iowa 211, Method C |

Section 4130

4130.02, B.

Replace the Article:

~~Additional processing is not required for Class D material.~~ Mechanically process Class D and Class E material to remove material 3 inches and less.

Section 4132

4132.01, Description.

Add as the last bullet:

- Do not place Reclaimed HMA below high water table.

Section 4133

4133.01, Description.

Replace the Article:

Crushed stone or natural sand and gravel. If approved by the Engineer, manufactured sand may be substituted in applications where drainage is not a purpose for use of the granular material.

Section 4134

4134.02, Gradation.

Replace the Article:

~~A. For natural sand and gravel use Gradation No. 35 of the Aggregate Gradation Table, Article 4109.02.~~

~~B. For natural sand use Gradation No. 1 or Gradation No. 36 of the Aggregate Gradation Table, Article 4109.02. Meet requirements for Gradation No. 1, Gradation No. 35, or Gradation No. 36 of the Aggregate Gradation Table, Article 4109.02.~~

Section 4136

4136.02, A, 2.

Replace the Article:

~~Cold applied: Use sealers that meet the above physical requirements of ASTM D 5893.~~

4136.03, Expansion Joint Fillers and Seals.

Add the Article:

E. Preformed, Pre-Compressed, Self-Expanding, Sealant System with Silicone Pre-Coated Surface.

1. Furnish an expansion joint system comprised of the following three components:
 - a. Cellular polyurethane foam impregnated with a hydrophobic polymer and factory coated with highway-grade, low modulus, fuel resistant silicone.
 - b. Field-applied epoxy adhesive.
 - c. Field-applied silicone sealant edging.
2. Use an impregnation agent having proven non-migratory characteristics. The highway grade, low modulus, fuel resistant silicone facing shall be factory applied to the impregnated foam when the foam is at a width greater than the maximum working joint opening and once cured and compressed will form a bellows. The self-expanding foam sealant system shall have a depth as recommended by the manufacturer.
3. Furnish material capable of movements of +/-50% (100% total) of nominal material size.
4. Approved sources of sealant systems are listed in Materials I.M. 436.07, Appendix A.

Section 4137

4137, Asphalt Binder.

Replace the Section:

4137.01 GENERAL REQUIREMENTS.

- A. Meet the requirements for the type and grade specified in the contract documents and comply with the Combined States Binder Group.
- B. Determine performance grade according to AASHTO R29.
- C. ~~Do not add acids to modify asphalt binders.~~ Polyphosphoric Acid may be used as a co-modifier up to 0.4 0.5% by weight of binder. The Engineer may verify with laboratory testing.
- D. ~~For asphalt binder grades with a temperature spread of 92° or greater¹, meet the requirements of the Combined State Binder Group as follows: Except for Standard Traffic grades, meet CSBG requirements for Minimum Percent Recovery when tested per AASHTO T 350 at the high temperature identified by the PG grade.~~

Table 4137.01-1: PG+ Requirements

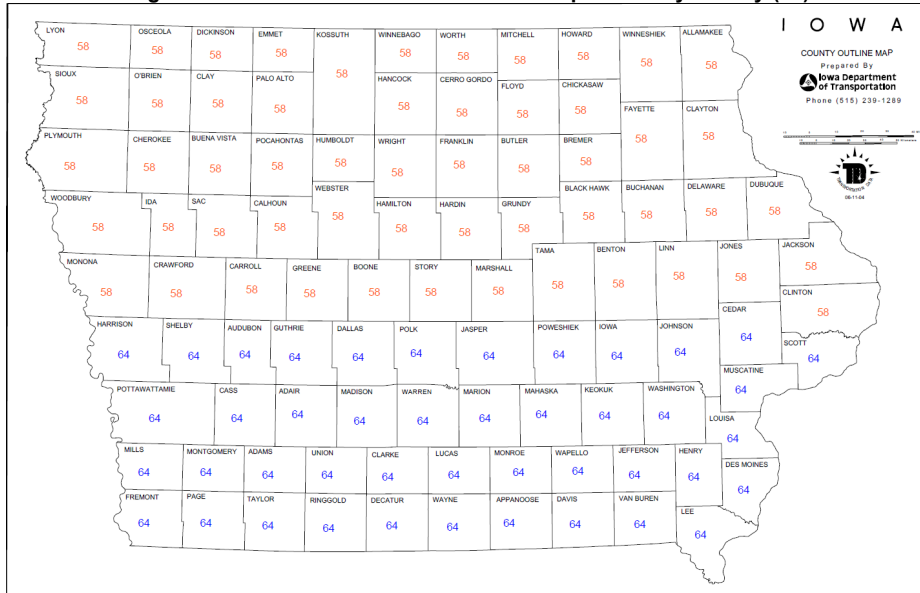
| AASHTO R 29 Grade | AASHTO T 350 Minimum Percent Recovery (R _{3.2}) | | DSR Phase Angle; degrees (original binder) |
|----------------------|--|------|---|
| | Test Temperature ² | | |
| | 58°C | 64°C | |
| 58-34P | 30 | 25 | ?? |
| 64-28P | 30 | 25 | ?? |

| | | | |
|--------|----|----|----|
| 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 |

1 Temperature spread is determined by subtracting low temperature from high temperature; for example PG 64-28: $64 - (-28) = 92$.

2 See Figure 4137.01-01 for test temperatures.

Figure 4137.01-01: AASHTO T 350 Test Temperature by County (°C)



(Delete figure)

- E. Waive stress sensitivity limits (J_{nr} Diff) for AASHTO M 332 when J_{nr} at 3.2 kPa is below 0.5 kPa⁻¹.
- F. When PG 58-34E+ is specified, the binder shall comply with requirements of PG 58-34E except that a minimum percent recovery of 90% when tested at 58°C per AASHTO T 350 at 3.2 kPa is required.
- G. When PG 64-34E+ is specified, the binder shall comply with requirements of PG 64-34E except that a minimum percent recovery of 90% when tested at 64°C per AASHTO T 350 at 3.2 kPa is required.

Section 4141

4141.01, B, Corrugated Aluminum Pipe.

Replace the first bullet:
Circular corrugated steel aluminum culvert pipe, Type I.

Section 4143

4143.01, B, 4.

Delete the Article:
4. Cover outlet with a rodent guard meeting the requirements of Materials I.M. 443.01. Attach as shown in the contract documents. Engineer will inspect and accept according to Materials I.M. 443.01.

Section 4147

4147, Pipe and Manhole Rehabilitation Materials

Replace the Section:
4147.01 PIPE REHABILITATION.

A. Polyethylene and Polyolefin Manufactured Pipe for Sliplining.

1. **Pipe.**
 - a. Comply with ASTM D 3035, minimum pipe stiffness of 46 psi.
 - b. Polyethylene complying with ASTM D 1248, Type III, Class C, Category 5, Grade P 34 or ASTM D 3350 Cell Classification PE 335434C.
 - c. Maximum outside diameter as specified in the contract documents.
2. **Joints.**
 - a. Joined into continuous length on job site.
 - b. Fuse butt joints according to the pipe manufacturer's recommendations with approved equipment and complying with ASTM D 2657.

B. Polyvinyl Chloride Pipe Corrugated Pipe 12 Inch to 36 Inch for Sliplining.

1. **Pipe.**
 - a. Comply with ASTM F 949, minimum pipe stiffness, 46 psi).
 - b. PVC plastic complying with ASTM D 1784, Cell Classification 12454.
2. **Joints.**
Gasketed joints complying with ASTM F 477 and ASTM D 3212.

C. Polyvinyl Chloride Pipe Closed Profile Pipe 21 Inch to 48 Inch for Sliplining.

1. **Pipe.**
 - a. Comply with ASTM F 1803, minimum pipe stiffness, 46 psi.
 - b. PVC plastic complying with ASTM D 1784, Cell Classification 12364.
2. **Joints.**
Gasketed joints complying with ASTM F 477 and ASTM D 3212.

D. Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe (CCFRPM) 18 Inch to 48 Inch for Sliplining.

1. **Pipe.**
Comply with ASTM D 3262.
2. **Joints.**
Gasketed joints complying with ASTM D 4161.

E. Resin-Impregnated Tube for Cured-in-place Pipe (CIPP) Lining.

1. **Pipe Lining.**
 - a. Comply with ASTM F 1216.
 - b. Use one or more layers of flexible needled felt or equivalent non-woven material.
 - c. Stretch material to fit irregular pipe and negotiate bends.
 - d. Outside layer plastic coated with a translucent flexible material. No delamination of plastic coating.
 - e. Fabricated to a size that when installed tightly fits length without joints.
 - f. Designed as per Equation X-1, ASTM F 1216.
2. **Resin and Catalyst.**
 - a. Unsaturated, styrene-based, thermoset resin and catalyst system or an epoxy resin and hardener that is compatible with the inversion process.
 - b. Cure in the presence of water with temperature greater than 150°F and less than 180°F.
 - c. Initial structural properties complying with ASTM F 1216. Comply with Table 4147.01-1.

Table 4147.01-1: CIPP Lining Properties

| CIPP Properties | ASTM Test Method | Minimum Value |
|--------------------------------|------------------|---------------|
| Flexural Strength | D 790 | 4500 psi |
| Flexural Modulus of Elasticity | D 790 | 250,000 psi |

3. **CIPP Lining Dimensions.**
 - a. Use nominal internal diameter and length such that CIPP forms to internal circumference and length of original pipe.
 - b. Field verify diameter and length.
 - c. Use one continuous length without joints.

F. Deformed/Reformed High Density Polyethylene Pipe Lining (DRP-HDPE).**1. Pipe Lining.**

- a. Manufactured in deformed shape from HDPE pipe compound complying with ASTM D 1248, Class C, Category 5 and Grade P 34.
- b. Comply with long term hydrostatic strength rating of 1600 psi or more according to ASTM D 2837.
- c. Environmental stress crack resistance (ESCR) less than 2000 hours in 100% solution, Igepal CO-630 at 100°C before failure according to ASTM D 1693, Condition C.
- d. Comply with Table 4147.01-2 for minimum DRP lining structural standards.

Table 4147.01-2: DRP-HDPE Lining Properties

| FIPP Properties | ASTM Test Method | Minimum Value |
|--------------------------------|------------------|---------------|
| Flexural Strength | D-790 | 3300 psi |
| Flexural Modulus of Elasticity | D-790 | 136,000 psi |
| Tensile Strength | D-638 | 3200 psi |

2. DRP Lining Dimensions.

- a. Nominal internal diameter and length of existing pipe as specified in the contract documents.
- b. Field verify diameter and length.
- c. Outside diameter fabricated to fit tightly.
- d. Use one continuous length without joints between manholes.
- e. Minimum wall thickness complying with SDR as specified in the contract documents.

G. Folded/Formed Polyvinyl Chloride Pipe Lining.**1. Pipe Lining.**

- a. Manufacture in deformed shape complying with ASTM D 1784, Cell Classification 12454 B. Compounds with different cell classifications because one or more properties are superior to those specified are acceptable.
- b. Performance requirements complying with ASTM D 3034.
- c. Comply with Table 4147.01-3 for FPP lining structural properties.

Table 4147.01-3: FPP Lining Properties

| FIPP Properties | ASTM Test Method | Minimum Value |
|-------------------------------|------------------|---------------|
| Tensile Modulus of Elasticity | D-638 | 350,000 psi |
| Tensile Strength | D-638 | 6000 psi |

2. FPP Lining Dimensions.

- a. Nominal internal diameter and length of existing pipe as specified in the contract documents.
- b. Field verify diameter and length prior to manufacturing.
- c. Use one continuous length without joints between manholes.
- d. Outside diameter fabricated to fit tightly.
- e. Minimum wall thickness complying with the specified SDR as specified in the contract documents and complying with ASTM F 1216.

A. CIPP Main Lining.**1. Fabric Tube and Resin.**

Comply with ASTM F 1219 1216 for heat cure or ASTM F 2019 and D 5813 for UV light cure.

2. CIPP Lining Dimensions.

- a. Use nominal internal diameter and length such that CIPP forms to internal circumference and length of original pipe.
- b. Field verify diameter and length.
- c. Use one continuous length without joints.

3. Structural Requirements.

- a. Design the CIPP liner according to ASTM F 1216.
- b. Unless otherwise specified in the contract documents, assume fully deteriorated conditions and the following properties for design at each location:

Table 4147.01-1: CIPP Main Lining Design Values

| Design Criteria | Value |
|-----------------|-------|
|-----------------|-------|

| | |
|---|--------------------------------|
| Factor of safety, N | 2.0 |
| Soil modulus, E's | 1000 psi |
| Soil density, ω | 120 lb/ft ³ |
| Live load, Ws | H20 |
| Ovality reduction factor, C | As specified for each location |
| Height of soil above pipe, H | As specified for each location |
| Height of water above top of pipe, Hw | 1/2 depth of cover |
| Long term flexural strength, σ_L | Use value for 50 year design |

- c. Set the long term (50 year extrapolated) creep retention factor at 50% of the initial design flexural modulus as determined by ASTM D 790 unless long term test data according to ASTM D 2990 substantiates a different retention factor.
- d. Design for internal pressure or vacuum is not required.

4. CIPP Lubricant.

Provide a non-toxic, oil based product that has no detrimental effects on the tube or boiler and pump system, will not support the growth of bacteria, and will not adversely affect the fluid to be transported.

5. CIPP End Seal.

a. Hydrophilic Gasket Sleeve.

Provide a seamlessly molded gasket and retaining ring system complying with ASTM F 3240.

b. Expansion Band System.

- 1) Provide a one-piece rubber gasket and a pair of stainless-steel expansion bands in a system manufactured specifically for CIPP end seal applications.
- 2) Provide bands with positive locking mechanism permanently securing the bands in their expanded position after tightening.
- 3) Comply with material requirements of ASTM C 923 for rubber gasket and stainless steel.

B. CIPP Point Repair.

1. Utilize a repair system that complies with the following requirements.
 - a. Meet or exceed the material requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.
 - b. Provides a full wrap section sized to create a circular liner equal to the inner diameter of the pipe. Ensure one end of the CIPP point repair sheet overlaps the second end by a minimum of 10% to allow for variation in pipe diameter.
 - c. Sufficient strength to bridge missing pipe segments and ability to stretch to fit irregular pipe sizes.
 - d. Uniform thickness and 10% extra resin.
 - e. Utilizes a thermoset resin system comprised of a base resin and hardener that cure at ambient temperatures.
 - f. Has a shrinkage value of less than 0.5% when measured according to ISO 2577 or ASTM D 6289.
 - g. Designed against corrosion and typical chemicals found in domestic sewage.

2. Liner Length.

Minimum length as specified in the contract documents. Lengths beyond 10 feet may be completed with multiple liners.

3. Structural Requirements.

Design the CIPP point repair according to the structural requirements for CIPP main lining described herein. Assume an ovality of 2% unless otherwise specified in the contract documents.

C. CIPP Service Repair.

1. Utilize a repair system that provides the following.
 - a. Full circumferential CIPP liner inside the main pipe and a tube that extends continuously from the sewer main into the service for the distance specified in the contract documents.
 - b. Installation of system from within the sewer main without the need for excavation or access through a clean out.
 - c. The ability to seal a combination of tees and wyes of varying angles.
 - d. The ability to seal the connection of the service to the mainline in a continuous, tight fitting, watertight pipe within a pipe that eliminates infiltration and root intrusion between the liner and host pipe.
2. Liner Length.
 - a. **CIPP Service Connection Repair:** Provide service liner with a length of 12 to 24 inches to seal the connection between the main line and the wye or tee.
 - b. **Partial Service Pipe:** Provide service liner with a length between 12 and 24 inches, as specified in the contract documents, to seal the connection from the main line to the first service pipe joint.

- c. **Main Pipe Liner Length:** Provide main pipe liner with a length of 18 inches minimum.

3. Fabric Tube.

- a. Provide a fabric tube consisting of one or more layers of absorbent non-woven felt fabric, felt/fiberglass, or fiberglass complying with the requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.
- b. Provide nominal fabric tube wall thickness to the nearest 0.5 mm increment as required by the thickness design. Ensure the wet-out fabric tube has a uniform thickness that, when compressed at installation pressures, meets or exceeds the design thickness after cure.
- c. Coat inside (after installation) of fabric tube with an impermeable, flexible membrane that will contain the resin and facilitate vacuum impregnation.
- d. Mark the fabric tube with the name of the lining system manufacturer and manufacturing lot or production footage. Ensure print is visible during final CCTV inspection.

4. Resin.

- a. Provide a chemical-resistant thermoset (heat or UV light) resin and catalyst system or epoxy resin and catalyst / hardener system that, when cured within the fabric tube, complies with requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.
- b. Method of cure may be by heat source, UV light, or ambient temperature.
- c. Provide resin to tube ratio as recommended by the manufacturer.

5. Structural Requirements.

- a. Design the cured-in-place service liner according to ASTM F 1216 utilizing the following assumptions, unless otherwise specified in the contract documents:

Table 4147.01-2: CIPP Main Service Design Values

| Design Criteria | Value |
|---------------------------------------|--------------------------------|
| Factor of safety, N | 2.0 |
| Soil modulus, E's | 1000 psi |
| Soil density, ω | 120 lb/ft ³ |
| Live load, Ws | H20 |
| Ovality reduction factor, C | 2% |
| Height of soil above pipe, H | As specified for each location |
| Height of water above top of pipe, Hw | 1/2 depth of cover |

- b. Set the long term (50 year extrapolated) creep retention factor at 50% of the initial design flexural modulus as determined by ASTM D 790 unless long term test data according to ASTM D 2990 substantiates a different retention factor.
- c. Comply with the following minimum structural properties:

Table 4147.01-3: Minimum Structural Properties for CIPP Service

| Property | Test Method | Minimum Value |
|--------------------------------|-------------|---------------|
| Flexural modulus of elasticity | ASTM D 790 | 250,000 psi |
| Flexural Strength | ASTM D 790 | 4500 psi |

- d. Do not consider the bond to the existing pipe in determining the structural performance of the lining system.

D. Chemical Grout.

1. Grout.

Provide a chemical grout (chemical sealing material) complying with ASTM F 2304 or ASTM F 2454.

2. Additives.

Strengthening agents, shrinkage reducers, dyes, viscosity modifiers, gel time modifiers, and freeze/thaw inhibitors, are allowed at the Contractor's discretion. Provide additives compatible with the chemical grout and complying with chemical grout manufacturer's requirements.

3. Root Inhibiter.

When specified in the contract documents, provide a root deterrent chemical to control root regrowth. Ensure root inhibitor is compatible with chemical grout and additives and complies with grout manufacturer's requirements.

E. Sewer Dye.

Provide tracer dye complying with NSF/ANSI 60.

H F. Pipe Repair Couplings for Spot Repairs by Pipe Replacement.

1. **Style.**
Full circle, fully lined, bolted.
2. **Length.**
As recommended by the manufacturer for pipe diameter; 12 inches, minimum.
3. **Materials and Manufacturer.**
 - a. Shells, armors, side bars, lugs, Turner lifting bars, bolts, and nuts complying with ASTM A 240, Type 304 stainless steel.
 - b. MIG welds, fully passivated.
 - c. Rubber gasket complying with ASTM D 2000, AA415 with full coverage and grid pattern.
 - d. Stainless steel armor bonded to gasket to bridge lug area.
4. **Nuts and Bolts.**
1/2 inch or 5/8 inch, complying with ASTM A 240, Type 304 stainless steel, Teflon coated threads.

I G. Sewer Main Pipe (For Spot Repairs).

1. Apply Section 2504.
2. Use materials for pipe replacement as specified in the contract documents or approved by the Engineer.

4147.02 MANHOLE REHABILITATION.**A. Rubber Chimney Seal.**

Apply Article 4149.02, J, for external and internal rubber chimney seals.

B. Urethane Chimney Seal.

1. Use only when specified in the contract documents.
2. Comply with Table 4147.02-1 for the physical properties:

Table 4147.02-1: Physical Properties

| Property | ASTM Test Method | Acceptable Value |
|---------------------|------------------|--------------------|
| Elongation | D 412 | 800%, minimum |
| Tensile Strength | D 412 | 1150 psi, minimum |
| Adhesive Strength | D 903 | 175 lb/in, minimum |
| Pressure Resistance | C 1244 | 2 minutes |

C. In-Situ Manhole Replacement, Cast-in-place Concrete.

1. **Forming System.**
Provide an internal forming system capable of forming a new and structurally independent manhole wall within the existing manhole, with the specified thickness and conforming to the general shape of the existing manhole.
2. **Concrete.**
Type I/II Portland cement with 5/8 inch minus coarse aggregate with fiber reinforcement and water reducer, 4000 psi minimum 28 day compressive strength or as approved by the Engineer.
3. **Plastic Liner.**
When specified, provide a PVC or PE plastic liner resistant to degradation by sulfuric acid. Use a liner capable of being attached to the exterior of the forming system during erection of the forms. Use a plastic liner with a ribbed or studded exterior surface suitable for anchoring to the newly formed interior wall.
4. **Casting.**
Provide new casting. Apply Article 4149.02, I.

D. Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal.

1. **Cementitious Lining.**
 - a. Use a high-strength, high-build, corrosion-resistant mortar, based on Portland cement fortified with micro silica. Mixed mortar is to have a paste-like consistency that may be sprayed, cast, pumped, or gravity-flowed into any area 1/2 inch and larger.

- b. Comply with Table 4147.02-2 for physical properties:

Table 4147.02-2: Physical Properties

| Property | Value |
|--|-------------------------------------|
| Unit Weight | 125 102-130 pcf |
| Set Time at 70°F ASTM C 403 Initial Set / Final Set | 240 minutes / 440 480 minutes |
| Modulus of Elasticity ASTM C 469 24 hours / 28 days | 180,000 psi min / 1,150,000 psi min |
| Flexural Strength ASTM C 293 24 hours / 28 days | 650 psi min / 800 psi min |
| Compressive Strength ASTM C 109 24 hours / 28 days | 3000 psi / 10,000 psi |
| Tensile Strength ASTM C 307 | 600 psi |
| Shear Bond ASTM C 882 | >1000 psi |
| Shrinkage ASTM C 157 | None |
| Chloride Permeability ASTM C 1202 | <550 Coulombs |

- c. Use a lining containing a liquid admixture for the prevention of micro-biologically induced corrosion.

2. Corrosion-Resistant Epoxy Lining.

- a. Use a two-component 100% solids epoxy formulated for use in sewer systems.
b. Comply with Table 4147.02-3 for physical properties:

Table 4147.02-3: Physical Properties

| Property | Value |
|---|---|
| Dry Time | 4-6 hours at 75°F; 50% Relative Humidity |
| Compressive Strength ASTM D 695 | 16,800 15,000 psi min |
| Flexural Strength ASTM D 790 | 13,900 11,000 psi min |
| Tensile Strength ASTM D 638 | 12,400 4500 psi min |
| Hardness ASTM D 2240 | 68-72 68-90 Shore D |
| Heat Distortion ASTM D 648 | 220°F |
| Ultimate Elongation ASTM D 638 | 4.5 3.5-5.5% |
| Adhesive Shear ASTM C 882 Adhesion ASTM D 7234 | 1000 psi Substrate Failure |

3. Casting.

Provide new casting. Apply Article 4149.02, I.

Section 4149

4149.02, A, 6, b, Pipe Lining.

Replace the Article:

1) Epoxy Coal Tar.

- 1 a) Coat interior pipe barrel and all joint surfaces with two-component coal-tar epoxy-polyamide black paint or approved equal.
2 b) Lining Material: SSPC Specification No. 16, Table 1.
a (1) Minimum epoxy resin content 34% to 35% by dry film weight.
b (2) Minimum sag resistance 40 mils.
c (3) Minimum solids 80% by volume.
3 c) Apply according to the lining material manufacturer's recommendations.

2) PVC.

- a) Minimum thickness of 0.65 inch.
b) Locking extensions extruded from the same material as the liner a minimum of 0.375 inches tall spaced a maximum of 2.5 inches.
c) Liner to cover the entire interior of the concrete pipe.
d) Minimum tensile strength of liner is 2200 psi with a minimum elongation of 200% at breaking.
e) Meet EPA 9090 for chemical resistance.
f) Free of cracks, cleavages, pinholes, or other defects.
g) Joint sealer strip to be from the same material as the liner.

3) HDPE.

- a) Minimum thickness of 0.080 inches according to ASTM D5199.

- b) Minimum density of 0.90 g/cm³.
- c) Meet EPA 9090 for chemical resistance.
- d) Locking extensions made from the same material as the liner with minimum pullout strength of 14,000 pounds per square foot.
- e) Free of cracks, cleavages, pinholes, or other defects.
- f) Joint sealer strip to be from the same material as the liner.

4149.02, A, Sanitary Sewer (Gravity Mains).

Add the Articles:

- 9. **Double Walled Polypropylene Pipe 12 inch to 30 inch.**
 - a. Comply with ASTM F 2736
 - b. Minimum pipe stiffness per ASTM D 2412, 46 psi.
 - c. Integral bell and spigot joint complying with ASTM D 3212 and ASTM F 477.
- 10. **Triple Walled Polypropylene Pipe 30 inch to 36 inch.**
 - a. Comply with ASTM F 2764
 - b. Minimum pipe stiffness per ASTM D 2412, 46 psi.
 - c. Integral bell and spigot joint complying with ASTM D 3212 and ASTM F 477.

4149.02, B, 3, Sewage Air Release Valve.

Replace Articles a and b:

- a. **General.**
Consists of an elongated tapered or conical body with outward-slanting walls and a float to operate (open and close) under pressure without spillage. Provide valves suitable for pressures up to 150 psi. Use a float with a flexible linkage connection to the seal plug assembly to prevent irregular air release and protect the connecting rod. Ensure the bottom of the valve body is sloped or funnel-shaped to encourage the accumulated sewage and solids to drain from the valve. Preserve a volume of air at all times between the liquid sewage and the seal plug assembly. Provide a flushing port with attachments for backwashing.
- b. **Materials.**
 - 1) **Body and Cover:** ~~Stainless steel, fiberglass-reinforced nylon, or other corrosion-resistant materials.~~
 - a) Stainless steel: ASTM A 351.
 - b) Cast Iron: ASTM A 126, Grade B.
 - c) Ductile Iron: ASTM A 536, Grade 65-45-12.
 - d) Other corrosion resistant materials.
 - 2) Internal Metal Components: Stainless steel.
 - 3) Float: Stainless Steel, ASTM A 240/A 240M, Type 304 or Type 316, or foamed polypropylene.
 - 4) Seal Plug Assembly: Stainless steel, foamed polypropylene, EPDM rubber, Nitrile (Buna-N) rubber, and reinforced nylon.

4149.03, Storm Sewer Pipe.

Replace Articles A and B:

A. Reinforced Concrete Pipe.

- 1. Comply with Section 2419 and ASTM C 76.
- 2. Minimum Class 2000D (Class III, Wall B).
- 3. Tongue and groove joints ~~with cold-applied bituminous or rubber rope jointing materials, unless otherwise specified~~ wrapped with engineering fabric. ~~If specified, use rubber O-ring or profile gasket complying with ASTM C 443 (AASHTO M 315).~~
- 4. ~~If specified, wrap exterior of each joint with engineering fabric~~ use rubber O-ring or profile gasket complying with ASTM C 443.

B. Low Clearance Reinforced Concrete Pipe.

- 1. Comply with Section 2419 and ~~ASTM C 506~~ either AASHTO M 206 (RCAP) or M 207 (RCEP).
- 2. Minimum Class 2000D (A-III or HE-III).
- 3. ~~Use~~ Tongue and groove joints ~~with cold-applied bituminous or rubber rope gasket jointing materials, unless specified otherwise~~ wrapped with engineering fabric.

4. If specified, wrap exterior of each joint with engineering fabric use rubber O-ring or profile gasket complying with ASTM C 443.

Delete Article E:

E. ~~Jointing Material for Concrete Apron.~~

1. ~~Bituminous Jointing Material.~~

Use a cold-applied mastic sewer joint sealing compound recommended by the manufacturer for the intended use and approved by the Engineer. Comply with ASTM C 990.

2. ~~Rubber Rope Gasket Jointing Material.~~

Comply with ASTM C 990.

3. ~~Rubber O-Ring or Profile Gasket.~~

Comply with ASTM C 443 (for RCP) or ASTM C 361 (for RCPP).

Add the Articles:

J. Storm Sewer Pipe Aprons.

Comply with the requirements of Article 4149.03 for the pipe material of which the apron is constructed.

L. Storm Sewer Apron Guard.

Per Standard Road Plan DR-213.

4149.04, H, 1.

Replace the Article:

Use one of the following methods for grade adjustments of manhole or intake frame and cover assemblies:

a. Reinforced Concrete Adjustment Rings.

Comply with ASTM C 478. Provide rings free from cracks, voids, and other defects.

b. High Density Polyethylene Adjustment Rings.

Comply with ASTM D 1248 for recycled plastic.

- 1) Test and certify material properties by the methods in Table 4149.04-1:

Table 4149.04-1: Test Methods

| Property | Test Method | Acceptable Value |
|------------------|-------------|--------------------------------|
| Melt Flow Index | ASTM D 1238 | 0.3 to 30 g/10 min. |
| Density | ASTM D 792 | 0.94 to 0.98 g/cm ³ |
| Tensile Strength | ASTM D 638 | 2000 to 5000 psi |

- 2) Do not use polyethylene grade adjustment rings when they are exposed to HMA pavement or heat shrink infiltration barriers.
- 3) When used in a single configuration, provide tapered adjustment ring with thickness that varies from 1/2 inch to 3 inches.
- 4) Install adjustment rings on clean, flat surfaces according to the manufacturer's recommendations with the proper butyl rubber sealant/adhesive.

c. Expanded Polypropylene Adjustment Rings.

Comply with ASTM D 4819 for expanded polypropylene when tested according to ASTM D 2375 3575.

- 1) Use adhesive meeting ASTM C 920, Type S, Grade N5, Class 25.
- 2) Provide finish rings with grooves on the lower surface and flat upper surface.
- 3) Do not use when heat shrinkable infiltration barrier is used.

4149.04, J, 1, Infiltration Barrier.

Add the Article:

d. Heat Shrink Sleeve.

Heat-shrinkable wrap around sleeve designed for protection of buried and exposed sanitary sewer manholes. Do not use with polypropylene or polyethylene adjustment rings.

- 1) **Primer.**
Compatible with concrete, ductile and cast iron, and sleeve material.
- 2) **Sleeve and Backing.**

Table 4149.04-2: Heat Shrink Sleeve

| Property | Test Method | Acceptable Value |
|------------------|-------------|------------------|
| Water Absorption | ASTM D 570 | 0.05% maximum |

| | | |
|-----------------------------|-------------|------------------|
| Low Temperature Flexibility | ASTM D 2671 | -40°F |
| Tensile Strength | ASTM D 638 | 2900 psi minimum |
| Elongation | ASTM D 638 | 600% minimum |
| Hardness | ASTM D 2240 | Shore D: 46 |
| Shrink Factor | | 40% minimum |
| Thickness | | 0.1 inch minimum |

- 3) **Adhesive.**
Softening point of 212°F maximum meeting ASTM E 28.

4149.04, K, Invert.

Replace the title and Article:
Invert Fillet.

1. **Cast-in-place Structure.**
Provide cast-in-place invert fillet with concrete meeting the requirements of Section 2403 Article 4149.04, B.
2. **Precast Base Section.**
 - a. For sanitary sewers, provide a precast invert fillet, unless allowed otherwise by the Engineer. Apply Article 2435.03, A 4149.04, A.
 - b. For storm sewers, provide a cast-in-place invert fillet with concrete meeting the requirements of Article 4149.04, A B.

4149.04, L, 1.

Replace the Article:
Provide steps in all circular precast manholes unless specified otherwise in the contract documents. For manholes and intakes less than 20 feet deep, do not install steps unless otherwise specified in the contract documents. For manholes and intakes deeper than 20 feet, install steps to meet OSHA regulations and the following requirements.

4149, Sanitary and Storm Sewer Pipe and Structures Materials.

Add the Article:
4149.05 Linear Trench Drain.

- A. **Linear Trench Drain:** A product supplied per Materials I.M. 449.
- B. **Concrete for Linear Trench Drain:** Meet requirements of Section 2301.

Section 4150

4150.02, A, 1, Polyvinyl Chloride Pipe.

Replace the Article:
Comply with AWWA C900 or AWWA C905 with gray ductile iron pipe equivalent outside diameters.

- a. **Minimum Wall Thickness.**
 - 1) 4 inch through 24 inch sizes: DR 18.
 - 2) Sizes over 24 inch: As specified in the contract documents.
- b. **Joint Type.**
Use push-on joint type, except as otherwise required in the contract documents or as authorized by the Engineer.
 - 1) **Push-on:** According to AWWA C900 or AWWA C905.
 - 2) **Integral Restrained Joint:** AWWA C900 or AWWA C905 pipe with restraining system manufactured integrally into pipe end.
 - 3) **Mechanical Restrained Joint:** Ductile iron mechanical device designed for joint restraint of AWWA C900 or AWWA C905 pipe complying with the requirements of ASTM F 1674.

4150.02, A, 2, c.

Replace the Article:
External coating: Asphalt Seal coat according to AWWA C 151.

4150.02, A, 2, d, 4.

Replace the Article:

Restrained, in Structures: Restraining gland, flanged or grooved/shouldered.

4150.02, A, 2, d, 6.

Replace the Article:

Grooved/Shouldered: According to AWWA C606.

4150.02, C, 1, c.

Replace the Article:

Cement mortar lined complying with AWWA C104 with asphalt coating seal coat or protective fusion bonded coatings per AWWA C116.

4150.02, E, 2, a, Tracer Wire.

Replace the Article:

1) Open Cut.

1 a) Solid Single Copper Conductor.

(a 1) **Size:** No. 12 AWG.

(b 2) **Insulation Material:** Linear low-density polyethylene (LLDPE) installation insulation suitable for direct burial applications.

(c 3) **Insulation Thickness:** 0.045 0.030 inches, minimum.

(4) **Tensile Strength:** 150 pounds, minimum

(5) **Operating Voltage:** Rated for 30 volts

2 b) Bimetallic Copper Clad Steel Conductor.

(a 1) **Size:** No. 42 14 AWG.

(b 2) **Rating:** Direct burial.

(c 3) **Operating Voltage:** 30 volts.

(d 4) **Conductivity:** 21%.

(e 5) **Copper Cladding:** 3% of conductor diameter, minimum.

(f 6) **Insulation Material:** High density polyethylene.

(g 7) **Insulation Thickness:** 0.030 inches, minimum.

(8) **Tensile Strength:** 175 pounds, minimum

b. Directional Drilling/Boring:

2) Directional Drilling/Boring.

a) Bimetallic Copper Clad Steel Conductor.

b) **Size:** No. 12 AWG.

c) **Rating:** Direct burial.

d) **Operating Voltage:** Rated for 30 volts.

e) **Conductivity:** 21%.

f) **Copper Cladding:** 3% of conductor diameter, minimum.

g) **Insulation Material:** High density, high molecular weight polyethylene.

h) **Insulation Thickness:** 0.045 inches, minimum.

i) **Tensile Strength:** 1100 pounds, minimum.

Section 4151

4151.02, B, 1.

Replace the Article:

Use either of the following

a. Solid dowels.

Use plain round bars meeting requirements of:

- ASTM A 663, Grade 60 or higher,
- ASTM A 675, Grade 60 or higher, or
- ASTM A 615, Grade 40 or higher.

b. Tubular dowels.

- 1) Provide welded carbon and alloy steel tubular dowel bar meeting requirements of ASTM A 513, with a minimum wall thickness of 0.120 inches.
- 2) Galvanize exterior and interior of tubular dowel bars according to ASTM A 653 Coating Designation G90.
- 3) Cap ends of tubular dowel to prevent intrusion of concrete or other materials. Caps shall be manufacturer supplied and designed for this purpose.

4151.02, B, 3

Add as the second sentence:

Use tubular dowels in load transfer assemblies only.

4151.03, A, General.

Replace the Article:

1. Unless otherwise specified, use deformed bars meeting the requirements of ASTM A 615 Grade 60, ASTM A 706 Grade 60, or ASTM A 996 Grade 60. 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: steel meeting the physical and chemical requirements of ASTM A 1064 or ASTM A 615 Grade 40.
 - ~~Material meeting the requirements of ASTM A 1064 reinforcement specified above, or~~
 - ~~Steel meeting physical and chemical requirements of ASTM A 615 Grade 40.~~
3. For spirals in precast and prestressed concrete piling and all wire ties, use steel wire with a minimum tensile yield strength of 40,000 psi 40 ksi, 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.

4151.03, B, 2.

Replace the Article:

Galvanize reinforcing bar hangers, 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.~~

4151.03, Reinforcement for Structures.

Replace Articles C, D, E, F, G, and H:

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.
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.~~

E. ~~Surface Preparation.~~

- 4 3. 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). Apply the coating within 0.5 hour after cleaning.

- 2 4. Ensure blast media meets the requirements of ASTM A 775. A maximum of 10% steel shot may be added to blast media.

F. ~~Repair to Damage Incurred During Fabrication.~~

5. 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. The fabricator is responsible for the repair.

G. ~~Repair of Damage Incurred during Shipment and Handling at the Job Site.~~

Comply with the following:

- 4 6. Repair visible damage incurred during shipment, storage, and /or placement of epoxy-coated bars at the job site.
- 2 7. 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 8. Repair damage to the coating caused by shipment, storage, and/or placement at the job site.
- 4 9. 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 10. The maximum amount of repaired, damaged areas is not to exceed 2% of the total surface area in each 1.0 linear foot of the bar. Should the amount of damage exceed the 2% in 1.0 linear foot, then remove that bar and replace with an acceptable bar. Coating the cut ends will not be included in the repair percentage.
- 6 11. Apply a minimum coating thickness of 7 mils to areas to be repaired.
- 7 12. Allow patches to cure (dry to the touch) before placing concrete over the coated bars.
- 8 13. Prepare the surface, repair it, and apply patches according to the resin manufacturer's recommendations.

H D. 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.

E. Stainless Steel Reinforcement.

1. Stainless steel reinforcement bars shall be deformed and meet requirements of ASTM A 955 and be one of the following grade, UNS designations, and (types): listed in Materials I.M. 452.
 - ~~S24100 (XM-28)~~
 - S31653 (316LN)
 - S31803
 - S32304 (2304)

UNS designations (types) listed in this specification meet the requirements of ASTM A 955. Bars shall be heat treated using one of the three methods listed in ASTM A 955.

2. Supply bars free of dirt, mill scale, oil and debris. Stainless steel reinforcing bars shall be pickled to a bright or uniform light finish. Bars supplied displaying rust/oxidation, questionable blemishes, or lack of bright uniform pickled surface may be rejected.
3. Employ lifting, handling, securing and transport equipment and processes that will prohibit contamination of stainless steel reinforcing from fragments of carbon steel or other material residues/fragments. Minimize handling and re-handling of stainless steel reinforcing bars. Do not drop or drag stainless steel reinforcing bars or bundles.

4. Store stainless steel reinforcing bars or bundles above ground on wooden supports with timbers placed between bundles when stacking is necessary. Place supports to prevent sags in the bundles. Store stainless steel reinforcing separately from coated or uncoated reinforcing bars.
5. Fabricate and bend stainless steel bars using tools and equipment that have been thoroughly cleaned or otherwise modified to prohibit contamination from fragments of carbon steel or other material residues/fragments.
6. Protect stainless steel from contamination during construction operations including cutting, grinding, or welding above or in the vicinity of the stainless steel.
7. Stainless steel reinforcing bars shall not be permitted to come in direct contact with uncoated reinforcing bars, bare metal form hardware, or other bare or galvanized metals unless specifically approved herein or otherwise approved in writing by the Engineer. When practicable, stainless steel reinforcing shall maintain a minimum 1 inch clearance from bare or galvanized metals. When 1 inch clearance is not practicable, stainless steel reinforcing shall be isolated from contact with bare or galvanized metals by a wrap of electrical tape or other approved means. Protective wrap shall encompass the full perimeter of the bar and extend at least 1 inch in each direction past the point of closest contact between the stainless bar and dissimilar metal. Stainless steel reinforcing bars may be in direct contact with undamaged epoxy coated reinforcing bars. Stainless steel reinforcing bars may be in direct contact with shear studs on steel girders.
8. **Bar Chairs.**
 - a. Bar chairs for support of stainless steel reinforcing shall comply with one of the following:
 - 1) Bar chairs fabricated from solid plastic, meeting requirements of Materials I.M. 451.01.
 - 2) Bar chairs fabricated from stainless steel. Stainless steel materials for bar chairs shall be compatible with the type of stainless steel materials used for reinforcing bars.
 - 3) Epoxy coated bar chairs meeting requirements of Materials I.M. 451.01, except where prohibited by the contract documents. Care shall be taken during installation of epoxy coated bar chairs to prevent damage to epoxy coating. Bar chairs exhibiting cracked or otherwise damaged epoxy coating shall be replaced.
 - b. Non-coated carbon steel bar chairs shall not be permitted to support or come into direct contact with stainless steel reinforcing.
9. **Tie Wire.**
 - a. Tie wire for stainless steel reinforcing shall comply with one of the following:
 - 1) Tie wire coated with epoxy, plastic, nylon, or other non-conductive materials. Care shall be taken during installation of coated wire ties to prevent damage to protective coating. Wire ties exhibiting cracked or otherwise damaged protective coating shall be discarded and replaced with undamaged ties.
 - 2) Stainless steel tie wire. Stainless steel materials for tie wire shall be compatible with the type of stainless steel materials used for reinforcing bars.
 - b. Coated wire ties or stainless steel wire ties as noted herein shall be required for bar tie locations in which a stainless steel reinforcing bar is present (includes stainless-to-stainless bar tie locations and stainless-to-epoxy coated bar tie locations.)
10. Prior to placing concrete, ensure reinforcing bars are clean and exhibit a bright finish free of contaminants, oxidation, or rust. Oxidation or rust on bar surface will not be permitted and shall be immediately brought to the attention of the Engineer.
11. At the discretion of the Engineer, isolated areas exhibiting minor oxidation or rust attributable to trace contaminants on bar surface shall be thoroughly cleaned and treated with pickling paste marketed for such application. Bars exhibiting evidence of oxidation/rust not attributable to trace contaminants on bar surface, or oxidation/rust otherwise suspected to have a negative impact on the intended performance and/or service life of the bar, may be rejected.
12. 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 the Engineer.
 - b. Welding procedure suitable for the chemical composition and intended use shall be submitted to the Engineer for approval prior to welding.
 - c. Perform welding using a state certified welder.
 - d. Perform welding and/or tack welding in accordance with the requirements of the contract documents, and latest edition of AWS D1.6, including requirements for minimum preheat and interpass temperature.

4151.07, A, Reinforcement Couplers.

Replace Articles A, B, C, and D:

A. Strength Requirements.

1. ~~Withstand 80,000 cycles of fatigue tensile loading from 5000 psi to 30,000 psi at a maximum frequency of 5 cycles per second. Ultimate Tensile Strength of splice shall be minimum 90% of ultimate tensile strength of reinforcement bars.~~
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 tension and unloaded to 3000 psi tension:
 - For bar size up to No. 14 (45) - 0.01 inches
 - For No. 18 (60) Bars - 0.03 inches

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 B. 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 C. Install couplers following manufacturer's requirements.

Section 4152

4152.02, Structural Steel.

Renumber and Replace Article C and Add the Article:

- C.** For members designated in the contract documents as Fracture Critical, apply Charpy V-notch toughness requirements of Table 4152.02-2. Ensure members are sampled and tested according to AASHTO T 243 (ASTM A 673).
- C D.** The contract documents may also designate other members to which toughness requirements apply.

Table 4152.02-1: Non-Fracture Critical Impact Test Requirements

| Grade | Thickness (in.) | Minimum Average Energy, ft.lbf. at °F |
|---|--|---------------------------------------|
| 36T ^(a) | to 4, mechanically fastened or welded incl. | 15 at 40 |
| 50T ^(a, b) , 50WT ^(a, b) | to 2, mechanically fastened or welded incl. over 2 to 4, mechanically fastened over 2 to 4, welded incl. | 15 at 40 15 at 40 20 at 40 |
| HPS 50WT ^(a, b) | to 4, incl. | 20 at 10 |
| 400T HPS 70WT ^{(c), (d)} | to 4, incl. | 25 at -10 |
| HPS 100WT ^(c) | to 2 1/2, mechanically fastened or welded incl. over 2 1/2 to 4, mechanically fastened over 2 1/2 to 4, welded incl. | 25 at 0 -30 25 at 0 35 at 0 -30 |
| (a) CVN-impact testing of shall be at "H" heat frequency testing according to in accordance with ASTM A 673. (b) If the yield point of the material structural product exceeds 65 ksi, reduce the testing temperature for the minimum average energy required shall be reduced by 15°F for each increment or fraction of 10 ksi above 65 ksi. The yield point is the value given on the certified "Mill Test Report". (c) CVN-impact testing of shall be at "P" plate frequency testing according to in accordance with ASTM A 673. (d) If the yield strength of the structural product exceeds 85 ksi, the testing temperature for the minimum average energy required shall be reduced by 15°F for each increment or fraction of 10 ksi above 85 ksi. The yield strength is the value given in on the certified "mMill tTest rReport". | | |

Table 4152.02-2: Fracture Critical Impact Test Requirements

| Grade | Thickness (in.) | Minimum Test Value Energy, ft.lbf. | Minimum Average Energy, ft.lbf. at °F |
|--|---|------------------------------------|---------------------------------------|
| 36F ^(a) | to 4, incl. | 20 | 25 at 40 |
| 50F ^(a, b) , 50WF ^(a, b) | to 2, incl. over 2 to 4, incl. | 20 24 | 25 at 40 30 at 40 |
| HPS 50WF ^(a, b) | to 4, incl. | 24 | 30 at 10 |
| HPS 70WF ^(a, c) | to 4, incl. | 28 | 35 at -10 |
| HPS 100WF ^(a) | to 2 1/2, incl. over 2 1/2 to 4, incl. | 28 Not Applicable | 35 at -30 Not Permitted |

- (a) CVN-impact testing shall be at "P" frequency in accordance with ASTM A 673 except for plates, for which the sampling shall be as follows:
- (1) As-rolled (including control-rolled and TMCP) plates shall be sampled at each end of each plate-as-rolled.
 - (2) Normalized plates shall be sampled at one end of each plate, as heat treated.
 - (3) Quenched and tempered plates shall be sampled at each end of each plate, as heat treated.
- (b) If the yield point of the structural product exceeds 65 ksi, the testing temperature for the minimum average energy and minimum test value energy required shall be reduced by 15°F for each increment or fraction of 10 ksi above 65 ksi. The yield point is the value given on the certified "Mill Test Report".
- (c) If the yield strength of the structural product exceeds 85 ksi, the testing temperature for the minimum average energy and minimum test value energy required shall be reduced by 15°F for each increment or fraction of 10 ksi above 85 ksi. The yield strength is the value given on the certified "Mill Test Report".

Section 4153

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~~ fasteners are defined and listed by ASTM numbers as:
 - Bolts A 325 F 3125: type 1 black, type 1 galvanized or type 3 weathering.
A 449: type 1 black, type 1 galvanized or type 3 weathering.
A 490 are not allowed.
 - Nuts A 563: Grade DH3 black, grade DH galvanized or grade DH3 weathering.
A 194: Grade 2H black or grade 2H galvanized.
 - Washers F 436: Type 1 black, type 1 galvanized or type 3 weathering.
- b. For galvanized high strength fasteners, the fasteners meet the requirements of ASTM B 695, Class 55 Type I or ASTM F 2329 with a zinc bath temperature not exceeding 850°F.
- c. For weathering steel, bolts are ASTM A-325 F 3125 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 F 3125, refer to ASTM A 449.

4153.06, B, 4, a, 3.

Replace the Article:

~~Article 7.2 of ASTM A 325~~ Article 7.3 of ASTM F 3125 is changed to read as follows:

"Threads shall be the Unified Coarse Thread Series as specified in ANSI/ASME B1.1 and shall have Class 2A tolerances."

4153.06, B, 4, c, Specifications for Bolts.

Replace Articles 1 and 2:

- 1) ASTM A-325 F 3125, High Strength Bolts for Structural Steel Joints.
- 2) Proof load tests (ASTM F 606, Method 1), are required. Galvanizing if required, completed prior to proof load testing. The minimum frequency of tests according to ASTM A 325 Paragraph 9.5.1 F 3125 Paragraph 9.6.1.

Section 4154

4154, Fence Materials.

Replace the Section:

4154.01 DESCRIPTION.

- A. Materials covered by this section include woven wire farm field and deer fence 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 FABRIC.

- A. Field fence shall conform to AASHTO M 279 ~~and~~ or ASTM A 116 and shall be, unless otherwise specified:
1. Type Z, Class 3.
 2. 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. Use galvanized (as determined by visual inspection) steel rod for splicing fence material.
- B. Deer fence shall be woven wire that meets the following requirements:
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, chain link fabric shall conform to one of the following:
1. Zinc coated fabric meeting requirements of ASTM A 392, Class 2 (2.0 ounces per square foot) 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. Unless otherwise specified in contract documents, use:
1. 9 gauge coated wire with a breaking strength of 1290 pounds.
 2. Height of fabric of 72 inches.
 3. Selvage knuckled at both the top and bottom.
 4. Mesh size $2 \pm 1/8$ inches.

4154.04 BARBED WIRE.

Unless otherwise specified in contract documents, use barbed wire conforming to ASTM A 121 or AASHTO M 280, Design Number 12-4-5-14R, Type Z Class 3.

4154.05 BRACE WIRE, TENSION WIRE, AND TIE WIRE.

- A. Tension wire shall meet requirements of AASHTO M 181 or one of the following:
1. ASTM A 824 or A 817, Type II, Class 3.
 2. ~~ASTM A 121, Type Z, Class 3 zinc coated or aluminum coated.~~
 - 3 2. ASTM A 824 or A 817, Type I.
 - 4 3. 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.
- 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 |
| Brace wire | No. 9 |
| Tie wires or clips for fastening field fence to steel posts | No. 12 |
| Use tie wires for chain link fence no smaller than No. 9 diameter for post ties or No. 12 diameter for rail and brace ties. Equivalent steel clips or aluminum wires or clips may be used if the Engineer approves. | |

4154.06 STAPLES.

- 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.
- 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 |
|---|--------------|
| Line posts, 4 inch top | 7 |
| End, corner, gate, pull, angle, and brace posts, 6 inch top | 8 |

- 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. Unless otherwise specified in the contract documents, use either of the following between wood pull posts:
 1. 2 3/8 inch SS-40 ASTM F 1043 steel pipe.
 2. 5 inch diameter wood posts.
- B. 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.

4154.09 STEEL LINE POSTS FOR FIELD FENCE AND DEER FENCE.

- A. Use T-section steel posts, of the length specified, as line posts with wood posts, as shown in the contract documents. Do not use them for corner, brace, pull, end, or gate posts.
- B. Only one type of steel post may be used in any installation 1000 feet or less in length.
- C. Equip posts with lugs or other approved means to prevent the fence fabric from moving vertically.
- D. Use nominal 1.33 pounds per foot T-section post meeting requirements of ASTM A 702 and hot dip galvanizing requirements of ASTM A 123.
- E. Completely paint the finished post with a prime coat with no limitation on color or tip identification except as provided for 1000 foot installations. Ensure the paint is thoroughly dry before posts are bundled for shipment.

4154.10 STEEL POSTS, BRACES, AND RAILS FOR CHAIN LINK FENCE.

- A. Steel pipe length shall be designated in the contract documents and shall conform to AASHTO M-181 (ASTM) one of the following requirements:
 1. AASHTO M 181 Grade 1 or (ASTM F 1083); minimum average zinc coating weight of 1.8 ounces per square foot Schedule 40.

2. AASHTO M 181 Grade 2 or (ASTM F 1043, Group I-C IC); ~~external zinc coating minimum of 0.9 ounces per square foot and internal zinc coating minimum 0.9 ounces per square foot.~~ Group IC galvanized before forming product shall be minimum G-210 (ASTM A 653).
- B. When specified, PVC thermoplastic coating shall be fused and adhered to zinc-coated posts with a minimum coating thickness of 0.010 inch conforming to ASTM F 934 & ASTM F 1043 ~~Sections 7 and 8.~~

4154.11 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 truss rods of 3/8 inch 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. Furnish a suitable sleeve or coupling device, recommended by the manufacturer, to connect sections of top rail and to provide for expansion and contraction.
 5. Use stretcher bars no less than 3/8 inch diameter, or equivalent cross section area, with suitable clamps for attaching fabric to corner, end, or gate posts.
- B. Ensure fittings also conform to AASHTO M 181 or ASTM F 626.

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 wide. Where the width of opening specified is:
 - 16 feet or less, provide a single gate frame.
 - More than 16 feet, 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 nominal diameter pipe for gates 6 feet wide or more, and
 - 1 1/4 inch nominal diameter pipe for gates less than 6 feet 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 wide or more.
6. Ensure materials are galvanized with no less than 0.8 ounce per square foot 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 and unit weight of 4.32 pounds per foot.
3. Support plates, hinges, and top braces.

Section 4155

4155.04, B, 3.

Replace the first sentence:

Ensure steel posts and blocks are galvanized according to requirements of ASTM A 123.

4155.05, B, Blockouts.**Replace** the Article:

Blockouts manufactured from alternate materials that have received FHWA acceptance for use on the National Highway System and complying with Materials I.M. 455.02 may be substituted for wood blockouts.

4155.05, C.**Delete** the Article:

~~C.—Ensure galvanizing is done after fabrication and after all bolt holes have been drilled.~~

Section 4156**4156, Glass Fiber Reinforced Polymer Dowel Bars.****Add** the Section:**4156. 01 Description.**

Dowels consisting of a single uncoated non-metallic material, glass fiber reinforced polymer. Use only in load transfer assemblies for CD joints and individual dowels for dowel bar retrofits on non-Interstate PCC pavements with 20 year design truck traffic of less than 1000 per day, as approved by the Engineer.

4156. 02 General Requirements.

- A.** Use the size and type specified in the contract documents. Meet the requirements for the type and use specified.
- B.** Approved manufacturers and suppliers are listed in Materials I.M. 451.03B, Appendix C.
- C.** Consisting of a single nonmetallic material meeting the following requirements:
 - 1.** Glass fiber content greater than 70%, per ASTM D2584.
 - 2.** Glass transition midpoint temperature $\geq 212^{\circ}\text{F}$, per ASTM E1356.
 - 3.** Long term absorption at $122^{\circ}\text{F} \leq 1.0\%$, per ASTM D570.
 - 4.** Transverse shear strength $\geq 19,000$ psi, per ASTM D7617.
 - 5.** Mean tensile modulus of elasticity $\geq 6,500,000$ psi ASTM D7205.
 - 6.** No deformation, burrs, or projections on ends of cut dowels.
 - 7.** Uncoated diameter measured at both ends and third points with the average not to exceed $-1/16$ inch of specified diameter.
 - 8.** Uncoated length measured end to end not to exceed $\pm 1/4$ inch of specified length.
 - 9.** Average approach and leave section deflections not to exceed 7.5 mils at 1 million cycles and not to increase by more than 3.5 mils at 10 million cycles when tested according to Annex A of ACPA T253 PTM No. 642.
- D.** Coated with a bond-breaker as described in Article 4151.02, B, 5 unless pull-out forces do not exceed 3000 pounds for any specimen, and no specimen shows any surface tears or perforation due to the pullout testing when tested in accordance with the provisions of Section 6 ACPA T 253-21 (no salt/freeze exposure).
- E.** Protect dowels in dowel assemblies stored outdoors, longer than 90 days either at fabricator or project site, from UV exposure with a suitable tarp/covering. Record on an identification tag the date dowel assemblies were placed outdoors.
- F.** 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.
- G.** Friction fit or clipped into assemblies to ensure stability and prevent dowels from becoming misaligned during handling and placement.

Section 4160**4160, Wood Preservatives.**

Replace the Section:

4160.01 GENERAL REQUIREMENTS.

Meet the requirements for the material specified. Meet the requirements of all Federal, State, and local regulations.

- A. Creosote.**
Meet the requirements of AASHTO M 133 (AWPA P1).
- B. Pentachlorophenol (PCP-A).**
Meet the requirements of AASHTO M 133 (AWPA P35). Ensure petroleum solvent meets the requirements of AWPA HSA for Hydrocarbon Solvent Type A.
- C. Copper Naphthenate (CuN).**
Meet the requirements of AASHTO M 133 (AWPA P36). Ensure petroleum solvent meets the requirements of AWPA HSA for Hydrocarbon Solvent Type A.
- D. Ammoniacal Copper Zinc Arsenate (ACZA).**
Meet the requirements of AASHTO M 133 (AWPA P22).
- E. Chromated Copper Arsenate (CCA).**
Meet the requirements of AASHTO M 133 (AWPA P23).
- F. Micronized Copper Azole (MCA).**
Meet the requirements of AASHTO M 133 (AWPA P61).

Section 4161

4161.02, Preservatives.

Replace the Article:

Meet the requirements of Section 4160. Unless specified otherwise, treatment may be with ~~creosote, pentachlorophenol, copper naphthenate, ammoniacal copper zinc arsenate (ACZA), or chromated copper arsenate (CCA)~~ any of the preservatives listed.

4161.03, A.

Replace Table 4161.03-1:

**Table 4161.03-1: Minimum Preservative Retention Requirements
(lb./cu. ft. of wood)**

| Material and Usage | Retention | | | | | | AWPA UC-Section-Special Req. |
|--|--------------------------|--|---------------------------------------|---------------------|----------------------|----------------------|------------------------------|
| | Creo-sote ^(a) | Pentachlorophenol PCP-A ^(a) | Copper Naphthenate CuN ^(a) | ACZA ^(b) | CCA ^(b,c) | MCA ^(b,c) | |
| Lumber and Timber for Structures ^(d) | AWPA U1 | AWPA U1 | AWPA U1 | AWPA U1 | AWPA U1 | AWPA U1 | AWPA U1 |
| Piles for Foundation, Round | | | | | | | |
| Douglas Fir | 17 | 0.85 | 0.14 | 1.0 | - | - | UC4C-E |
| Southern Pine | 12 | 0.60 | 0.10 | 0.80 | 0.80 | 0.41 | |
| Guardrail Posts, and Spacer Blocks | | | | | | | |
| Sawed Four Sides | 10 | 0.6 0.5 | 0.075 0.06 | 0.5 0.4 | 0.5 0.4 | 0.15 | UC4A-A-4.3 |
| Fence, Guide, and Sign Posts | | | | | | | |
| Round | 8 | 0.4 | 0.055 | 0.4 | 0.4 | 0.15 | UC4A-B |
| Sawed Four Sides | 10 | 0.5 | 0.060 | 0.4 | 0.4 | 0.15 | UC4A-A-4.3 |
| ^(a) Oil type preservatives. ^(b) Waterborne preservatives. ^(c) Do not use for the treatment of Douglas Fir. ^(d) Retentions based on AWPA Use Category and Commodity Specifications for different applications. | | | | | | | |

4161.03, B, 6, Handling Treated Products.

Add to the end of the Article:

End cuts, drilled holes, other fabrication after treatment, and damage/injuries require field treatment and shall be treated with preservatives as specified in AWPA M4.

4161.03, B, 7, b.

Replace the first sentence:

Ensure all treated wood material that requires a grade, with the exception of 45 inch Terminal Posts¹, displays a quality grade mark of an accredited grade monitoring and inspection agency approved under the American Lumber Standards Committee (ALSC).

Section 4164**4164.01, A.**

Replace the second sentence:

For sawed wood posts and wood sign posts, ensure a straight line from the centers of the ends of a spot does not deviate from the longitudinal axis of the post at any point by more than 0.5% of the length of the post.

Section 4169**4169.02, A.**

Replace Table 4169.02-1:

Table 4169.02-1: Seeds (Common Names, Scientific Names, Purity, and Germination)

| Common Name | Scientific Name | Purity (%) | Germination (%) |
|---------------------------------------|-------------------------------|------------|-------------------|
| DOMESTIC GRASSES | | | |
| Alkali Grass | Puccinellia Distans | 90 | 95 |
| Bluegrass, Kentucky | Poa pratensis | 85 | 80 |
| Bluegrass, Ky. RAM-1 | Poa pratensis-RAM-1 | 95 | 85 |
| Bluegrass, Ky. PARK | Poa pratensis-PARK | 95 | 85 |
| Brome, smooth-LINCOLN | Bromus inermis | 90 | 85 |
| Fescue, tall, FAWN | Festuca arundinacea-FAWN | 98 | 85 |
| Fescue, tall, turf-type | Festuca Arundinacea | 90 | 95 |
| Fescue, chewings, red | Festuca rubra var. commutate | 98 | 90 |
| Fescue, creeping, red | Festuca rubra | 98 | 85 |
| Fescue, hard fine | Festuca Ovina Spp. Duriuscula | 90 | 95 |
| Fescue, red-PENNLAWN | Festuca rubra PENNLAWN | 98 | 85 |
| Fescue, Tall, Olympic (Fineleaf) | Festuca arundinacea-Olympic | 98 | 85 |
| Fescue, Tall, Rebel (Fineleaf) | Festuca arundinacea | 98 | 85 |
| Fescue, Sheeps | Festuca ovina | 98 90 | 85 95 |
| Orchardgrass | Dactylis glomerata | 90 | 90 |
| Red top | Agrostis alba | 92 | 85 |
| Reed-Canarygrass | Phalaris arundinacea | 98 | 70 |
| Wildrye, Canada | Elymus Canadensis | 95 | 85 |
| Wildrye, Russian | Elymus junceus | 95 | 85 |
| Ryegrass, Perennial | Lolium perenne | 95 | 90 |
| Timothy | Phleum pratense | 99 | 85 |
| Wheatgrass, crested | Agropyron Cristatum | 90 | 95 |
| LEGUMES | | | |
| Alfalfa, RANGER/VERNAL | Medicago sativa | 99 | 90 ^(a) |
| Alfalfa, Travois | Medicoa spp. | 99 | 90 ^(a) |
| Birdsfoot Trefoil EMPIRE | Lotus corniculatus | 98 | 85 ^(a) |
| Crownvetch, Emerald | Coronilla varia | 98 | 70 ^(a) |
| Hairy Vetch | Vicia villosa | 96 | 85 ^(a) |
| Lespedeza, Korean | Lespedeza stipulacea | 98 | 80 ^(a) |
| Red Clover, medium | Trifolium pretense | 99 | 90 ^(a) |
| Alsike Clover | Trifolium hybridum | 99 | 90 ^(a) |
| White Clover | Trifolium repens | 98 | 90 ^(a) |
| NURSE CROP OR STABILIZING CROP | | | |
| Oats | Avena sativa | 97 | 90 |
| Rye | Secale cereale | 97 | 90 |

| | | | |
|-------------------------|-------------------------------|----|----|
| Sudangrass, PIPER | Sorghum vulgare var. sudanese | 98 | 85 |
| (a) Includes hard seed. | | | |

4169.07, B, Hydraulic Mulches.

Add as the first sentence of the Article:

Materials used shall be safe to the applicator and adjacent workers, and nontoxic to plants, fish, and other wildlife when properly applied according to EPA and other regulatory agencies.

Replace Articles 2 and 3 and add Article 4:

2. Bonded Fiber Matrix.

- ~~a.~~ Long-strand wood fibers held together by organic tackifiers and bonding agents that, when dry, become insoluble and non-dispersible.
- ~~b.~~ Upon curing (24 to 48 hours) forms a continuous, 100% coverage, flexible, absorbent, erosion-resistant blanket that encourages seed germination.
- ~~c a.~~ Manufactured to be applied with standard hydraulic mulching equipment and dyed green to facilitate visual metering during application.
- ~~d.~~ Contains no growth or germination inhibiting factors.
- ~~e.~~ Physical Properties:
 - ~~1) Fibers:~~ Virgin wood, greater than 88% by volume.
 - ~~2) Organic Material:~~ Greater than 96% by volume.
 - ~~3) Tackifier:~~ 8 to 10%.
 - ~~4) pH:~~ 4.8 minimum.
 - ~~5) Moisture Content:~~ 12% ±3%.
 - ~~6) Minimum Water Holding Capacity:~~ 1.2 gallons per pound.
- ~~f b.~~ All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.
- ~~g c.~~ Other products not meeting requirements of Article 4169.07, B, 2, e, may be approved if they mMeet 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.

3. Mechanically-Bonded Fiber Matrix.

- ~~a.~~ Long-strand wood fibers and crimped, interlocking synthetic fibers.
- ~~b.~~ Upon curing (2 hours) forms a continuous, 100% coverage, flexible, absorbent, porous, erosion-resistant blanket that encourages seed germination.
- ~~c a.~~ Manufactured to be applied with standard hydraulic mulching equipment and dyed green to facilitate visual metering during application.
- ~~d.~~ Contains no growth or germination inhibiting factors.
- ~~e.~~ Physical Properties:
 - ~~1) Virgin Wood Fibers:~~ 73% minimum.
 - ~~2) Crimped, Interlocking Synthetic Fibers:~~ 5% ±1%.
 - ~~3) Tackifier:~~ 10% ±1%.
 - ~~4) Moisture Content:~~ 12% ±3%.
 - ~~5) Minimum Water Holding Capacity:~~ 1.2 gallons per pound.
 - ~~6) pH:~~ 4.8 minimum.
- ~~f b.~~ All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.
- ~~g c.~~ Other products not meeting requirements in Article 4169.07, B, 3, e, may be approved if they mMeet 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.

4. Organic Fiber Matrix.

Provide hydraulic organic fiber matrix (OFM) meeting the following characteristics and requirements:

- a. Premixed formulation.
- b. Contains a minimum of 88% organic material derived from compost, peat moss, wood cellulose, straw fibers, wood bark, biochar, flax fibers, or other organic fibers.
- c. Phyto-sanitized to eliminate potential pathogens and weed seeds.
- d. Contains one or more of the following: humus, enzymes, vitamins, natural sugars, plant proteins, auxins, or amino acids.
- e. Contains zero ecotoxicity as per EPA 2021.0 in 48 hours.
- f. Passes EPA 503 Metal Limits.
- g. Passes 40 CFR 503 Class A for pathogen reduction.
- h. pH: 5.5 to 8.5 according to ASTM D 1293.
- i. Water Holding Capacity: 400% minimum according to ASTM D 7367.
- j. Vegetation Establishment: 400% minimum according to ASTM D 7322.
- k. Moisture Content: 10% minimum and 40% maximum according to ASTM D 2974.
- l. Use with a tackifier that is either applied separately within 24 hours of the organic material, or is premixed according to the manufacturer's recommendations. Tackifier shall meet the following requirements:
 - Safe to the applicator, adjacent workers, and the environment when properly applied according to EPA and other regulatory agencies.
 - Nontoxic to plants, fish and other wildlife and 100% biodegradable.

4169.10, Special Ditch Control, Turf Reinforcement Mat, Slope Protection, and Outlet or Channel Scour Protection (Transition Mat).

Replace the title:

SPECIAL DITCH CONTROL, TURF REINFORCEMENT MAT, SLOPE PROTECTION, AND OUTLET OR CHANNEL SCOUR PROTECTION (TRANSITION MAT).

4169.10, A, Wire Staples.

Replace the Article:

Meet the following requirements for wire staples for holding special ditch control wood excelsior mat and special ditch control jute mesh over sod:

1. U-shaped wire staples.
2. Each leg a minimum of 6 inches long for special ditch control and slope protection and 10 inches long for turf reinforcement mat. In sandy soil conditions the Engineer may require the length of each leg to be a minimum of 12 inches.
3. Minimum No. 11 diameter wire for hand installation. Machine installation with minimum No. 13 diameter wire allowed for installation of slope protection and special ditch control.
4. Staples of sufficient hardness to facilitate installation without bending.

4169.10, F, Outlet or Channel Scour Protection (Transition Mat).

Replace the title:

Outlet or Channel Scour Protection (Transition Mat).

4169.12, Perimeter and Slope Sediment Control Device.

Replace the Article and title:

Perimeter and Slope or Ditch Check Sediment Control Device

A. General.

~~Interstate and Primary highway projects shall use sediment logs only.~~

1. Provide wattles, sediment logs, and filter socks consisting of wood products (including wood mulch), cereal grain straw, or native grass straw the following materials contained in a tube of photo degradable fabric or synthetic netting:
 - a. Wattles: Cereal straw or native grass straw certified by the Iowa Crop Improvement Association or other state's Crop Improvement Associations as Certified Noxious Weed Seed Free Mulch. Wattles with observed seed heads of any type will not be accepted.
 - b. Sediment logs: Wood excelsior fibers with 80% of the wood excelsior fibers being 6 inches long or longer.

- c. Filter socks: Compost (from an approved source meeting Article 4169.08), wood chips, or mulch.
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 sediment logs, wattles, and filter socks are listed in Materials I.M. 469.10, Appendix E. ~~Wattles and filter socks will be accepted based on the manufacturer's certification.~~

B. Wattles and Sediment Logs.

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, m~~Meet the following minimum weight requirements:
 - 20 inch sediment logs and straw wattles: 3 pounds per foot with tolerance of 0.25 pounds per foot.
 - 12 inch sediment logs and straw wattles: 2 pounds per foot with tolerance of 0.25 pounds per foot.
 - 9 inch sediment logs and straw wattles: 1 pound per foot with a tolerance of 0.1 pounds per foot.
 - ~~6 inch sediment logs and straw wattles: 0.5 pounds per foot with a tolerance of 0.1 pounds per foot.~~

C. Filter Socks.

Provide filter socks with a maximum 3/8 inch opening and ~~filled with a compost/wood blend filter material consisting of~~ compost from an approved source meeting Article 4169.08.

Section 4171

4171.02, D.

Replace the Article:

Detectable warnings shall contrast visibly with adjoining adjacent surfaces, either light on dark or dark on light. Acceptable colors for polymer 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.~~

4171.03, Polymer Detectable Warning Panels.

Replace the 13th bullet:

Freeze Thaw - ASTM D C 1026 no cracking, delamination, or other defects.

4171.04, Cast Iron Detectable Warning Panels.

Delete the second bullet:

- ~~Wear resistance - ASTM C 501 greater than 8500.~~

4171.05, Steel Detectable Warning Panels.

Delete the second bullet:

- ~~Wear resistance - ASTM C 501 greater than 8500.~~

Section 4183

4183.03, B, 1, b, Resin Solids.

Replace the Article:

Composed of 100% acrylic emulsion polymer (~~Rohm & Haas E 3427, Dow Chemical DT 250, or an approved equal~~) that allow finished paint products to meet all other areas of the specifications. ~~Low Temperature Paint to use Rohm & Haas XSR Resin.~~

Section 4185

4185.02, A, 3.

Replace the third sentence:

~~Ensure the structural design of the light pole is based on the~~ Comply with AASHTO 2013 Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

4185.02, A, 4.

Replace the first sentence:

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~~ a wind load corresponding to a 90 mph basic wind speed (3 second gust) ~~of 80 mph~~ without fracture or apparent deformation of components.

4185.02, B, Anchor Bolt and Slip-Base Plate Fasteners for Lighting Poles.

Replace Articles 2 through 7:

~~2. Furnish anchor bolts that:~~

- ~~• Meet the requirements of ASTM F 1554, Grade 105~~
- ~~• Are full-length galvanized according to ASTM F 2329, and~~
- ~~• Are Unified Coarse Thread Series with Class 2A tolerance.~~

2. Anchor Bolts, Nuts, and Washers.

Furnish each anchor bolt with one leveling nut, one anchoring nut, and one jam nut (if required) on the exposed end and one of the following on the embedded end: nut, nut and plate, or nut and anchor bolt assembly ring plate. Use anchor bolts, nuts, and washers that comply with Materials I.M. 453.08. Meet the following requirements:

a. Anchor Bolts.

- 1) Use straight full-length galvanized bolts.
- 2) Comply with ASTM F 1554, Grade 105, S4 (-20°F).
- 3) Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A tolerance.
- 4) The end of each anchor bolt intended to project from the concrete is to be color coded to identify the grade.
- 5) Do not bend or weld anchor bolts.

b. Nuts.

- 1) Comply with ASTM A 563, Grade DH or ASTM A 194, Grade 2H.
- 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.
- 5) Refer to Articles 2522.03, H, 2, b through h for tightening procedure and requirements.

c. Washers.

Comply with ASTM F 436 Type 1.

d. Galvanizing.

Galvanize entire anchor bolt assembly consisting of anchor bolts, nuts, and washers (and plates or anchor bolt assembly ring plate, if used) according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F. Galvanize entire assembly by the same zinc-coating process with no mixed processes in a lot of fastener assemblies.

~~3. Color code the end of each anchor bolt intended to project from the concrete in red to identify the grade.~~

~~4.3. If slip bases are furnished, furnish 1 inch by 4 1/2 inch bolts that:~~

- ~~• Are high-strength bolts meeting the requirements of ASTM A 325, and~~
- ~~• Are fully mechanically galvanized to ASTM B 695, Class 55, Type 1.~~

~~5.4. Furnish washers that: comply with ASTM F 436 Type 1.~~

- ~~• Meet the requirements of ASTM F 436, and~~
- ~~• Are galvanized~~

~~6.5. Furnish nuts that meet the following requirements:~~

- ~~• Meet the requirements of ASTM A 563,~~
- ~~• Are grade DH,~~
- ~~• Are heavy hex, and~~
- ~~• Are galvanized according to the requirements of ASTM F 2329, or ASTM B 695, Class 55, Type 1.~~

- Comply with ASTM A 563, Grade DH or ASTM A 194, Grade 2H.
- Use heavy hex.
- Use ANSI/ASME B1.1 for UNC thread series, Class 2B tolerance.
- Nuts may be over-tapped according to the allowance requirements of ASTM A 563.
- Refer to Articles 2522.03, H, 2, b through h for tightening procedure and requirements.

6. Galvanizing.

Galvanize hardware according to the requirements of ADTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F. Galvanize entire assembly by the same zinc-coating process, with no mixed processes in a lot of fastener assemblies.

~~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.~~

4185.02, D, 2.

Replace the Article:

Designed according to AASHTO 2013 Standards and Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

4185.08, Handholes and Junction Boxes.

Add the Article:

D. HDPE Handhole and Cover.

1. **Size:** Provide handhole and cover with a minimum inside diameter of 24 inches and minimum of 24 inches depth. Handhole to be conical in shape with taper from top to bottom.
2. **Loading:** Ensure handhole, extensions, and cover comply as a complete unit with ANSI 77 with a minimum 20,000 pound load.
3. **Resin:** HDPE resin to comply with ASTM D 790 for minimum flexural modulus of 142,000 psi and ASTM D 638 for minimum yield strength of 3100 psi when using a type IV specimen, 2 inch per minute test speed, and 0.075 inch thick molded sample.
4. **Cover:** Ensure cover has skid resistant surface meeting PROWAG requirements with stainless steel bolts meeting manufacturer's requirements. Ensure cover fits handhole to meet PROWAG vertical surface discontinuity requirements when placed in pedestrian walkways.

Section 4186

4186.03, B, 1, Permanent Signs and Devices.

Replace the Article:

- a. Meet the following requirements:
 - 1) Type ~~IV~~ XI sheeting is used for all signs with white, green, red, blue, or brown background, unless otherwise specified.
 - 2) Type XI yellow sheeting is used for portions of a green sign requiring yellow sheeting.
 - ~~2~~ 3) Type XI Fluorescent sheeting is used for signs with yellow or yellow-green background.
 - ~~3~~ 4) The legend on white, yellow, and yellow-green signs is fabricated using black nonreflective sheeting that is applied directly, or by silk screening with black opaque ink.
 - ~~4~~ 5) The legend on green signs is fabricated using white Type ~~IV~~ XI sheeting that is applied directly.
 - ~~5~~ 6) The legend on red signs is fabricated using transparent red ink that is reverse silk screened on white Type ~~IV~~ XI sheeting, or is fabricated using white Type ~~IV~~ XI sheeting that is applied directly on a red Type ~~IV~~ XI sheeting background, or transparent film, as approved by the retro reflective sheeting manufacturer.
 - ~~6~~ 7) The legend on blue and brown signs is fabricated using transparent ink that is reverse silk screened on white Type ~~IV~~ XI sheeting, or white Type ~~IV~~ XI sheeting that is applied directly, or transparent film, as approved by the retro reflective sheeting manufacturer.
- b. Use Type ~~IV~~ XI sheeting for permanent road closure barricades.

4186.05, Inks, Clears, and Thinners.

Replace the title:

Inks, Clears, and Thinners, and Transparent Films.

4186.06, B, 1, A.**Replace** the Article:

Sheeting, reflective and nonreflective, and transparent film is applied mechanically with the equipment and in a manner specified by the sheeting manufacturer or by a method which will produce an equivalent result.

4186.09, A, 4, b.**Replace** the Article:

Washers shall be 3/8 inch I.D. by 4-3/8 1 1/2 inch O.D. by 0.125 inch.

4186.09, B, Type B Signs.**Replace** the Article:

Ensure the fittings described in the paragraphs below, when combined with the aluminum sections and posts, form a complete, assembled sign unit that will meet the specified strength requirements. ~~Though aluminum hardware is specified, equivalent hardware may be furnished in stainless steel or galvanized steel as approved by the Department. Galvanizing is to meet the requirements of ASTM F 2329, or ASTM B 633, Fe/Zn 25.~~

1. Stainless Steel Bolts.

Use the minor thread diameter in determining stress area.

- a. ~~Use post clip bolts and panel bolts made from aluminum wire or rod meeting the requirements of ASTM B 211, Alloy 2024-T4. Comply with ASTM A 320 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.~~
 - **Post clip bolts:** 3/8 inch in diameter and 1 3/4 inches in length, square or rectangular head, manufactured according to the dimensions and details shown in the contract documents.
 - **Panel bolts:** 3/8 inch in diameter and 3/4 inch in length with hexagonal head.
- b. Thread fit is to conform with ANSI, Class 2A.

2. Stainless Steel Nuts.

~~For Type B signs, use nuts manufactured from any aluminum alloy listed in ASTM B 211 or from stainless steel and meeting the following requirements: Comply with ASTM A 194 Grade 8, 8A, 8C, 8CA, 8M, 8MA, 8T, or 8TA; or ASTM F 594 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.~~

- a. **Post clip nuts:**
 - Finished, finished thick, regular, or heavy hexagonal, self locking nuts for 3/8 inch bolts, but all nuts to be of the same type.
 - Able to withstand a proof load, at room temperature, of 4,730 pounds.
- b. **Self locking nuts:** comply with Article 4186.09, A, 3.
- c. **Panel bolt nuts:**
 - Finished hexagonal nuts for 3/8 inch bolts. Able to stand a proof load of 4,200 pounds.
 - Thread fit is to conform with ANSI, Class 2B.

3. Stainless Steel Washers.

- a. ~~Use washers made of a quality of material approved by the Engineer. Comply with ANSI B18.22.1 for the bolts specified.~~
- b. Meet requirements of ASTM A 240. Use same alloy properties (i.e. group, alloy, class and condition) as those of the bolts specified.
- b c.** Post clip washers and panel bolt washers are to be flat 7/16 inch I.D. by 1 inch O.D. by 0.078 inch.
- c d.** A thickness tolerance of ± 0.006 inch is allowed.

4. Post Clips.

- a. Use aluminum castings manufactured according to the contract documents.
- b. Ensure clips are able to withstand the load requirements of the bolt specified.

5. Edge Trim Molding.

Meet the following requirements:

- a. Molding is attached to the signs by means of self tapping, 300 series, stainless steel, machine screws, Size 8-32.
- b. Pan head, binding head, or truss head screen is used.
- c. A screw is installed 1/2 inch from the end of each section of molding. Intermediate screws are installed no more than 12 inches apart.

4186.09, C, Delineators, Milepost Markers, and 6 Inch by 6 Inch (150 mm by 150 mm) Route Markers.**Replace** the title:

Delineators, Milepost Markers Reference Location Signs, and 6 Inch by 6 Inch (150 mm by 150 mm) Route Markers.

4186.09, C, 2.

Replace the Article:

Fasten milepost markers reference location signs and 6 inch by 6 inch route markers to the post as shown in the contract documents.

4186.10, C, Posts for Delineators, Milepost Markers, and 6 Inch by 6 Inch Route Markers.

Replace the title:

Posts for Delineators, Milepost Markers Reference Location Signs, and 6 Inch by 6 Inch Route Markers.

4186.12, A.

Add to the end of Article 3:

Microprism sheeting mounted on ASTM B 209 compliant aluminum sheeting minimum 40 mils thick is also allowed.

Replace the first sentence of Article 4:

Reflective surface exhibiting a minimum specific reflectance intensity listed in Table 4186.12-1 (Utilize ASTM D 4956 Type XI Microprism sheeting on Interstate and Primary System projects.):

Section 4187

4187.01, C, 2, a, 3.

Replace the Article:

Bolts shall be:

- ASTM F 3125 Grade A 325 Type 1 / A 325-T Type 1 or
- ASTM A 449 Type 1 with Ro-cap testing required pursuant to Articles 2408.03, S and 4153.06.

4187.01, C, 2, d, Galvanized Steel U-Bolts.

Add the Articles:

- 6) Use nuts as specified in Article 4187.01, C, 2, b.
- 7) Use washers as specified in Article 4187.01, C, 2, c.

4187.01, C, 3, Anchor Bolts, Nuts, and Washers.

Replace the Article:

~~Meet the following requirements:~~ Furnish each anchor bolt with one leveling nut, one anchoring nut, and one jam nut on the exposed end and one of the following on the embedded end if the anchor bolt is straight: nut, nut and plate, or nut and anchor bolt assembly ring plate. Use anchor bolts, nuts, and washers that comply with Materials I.M. 453.08. Meet the following requirements:

a. Anchor Bolts.

- 1) Use full-length galvanized bolts.
- 2) Comply with either ASTM F 1554, Grade 55, S1; or Grade 105, S5 S4 (-20°F).
- 3) Grade 55 anchor bolts may be straight or include a 90 degree bend.
- 4) Grade 105 anchor bolts shall be straight.
- 3 5) Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A tolerance.
- 4 6) The end of each anchor bolt intended to project from the concrete is to be color coded to identify the grade.
- 5 7) Do not bend or weld anchor bolts.

b. Nuts.

- 1) Comply with ASTM A 563, Grade DH or ASTM A 194,
- 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.
- 5) Refer to Articles 2522.03, H, 2, b through h for tightening procedure and requirements.

c. Washers.

Comply with ASTM F 436 Type 1.

d. Galvanizing.

Galvanize entire anchor bolt assembly (~~anchor bolt, nuts and washers~~) consisting of anchor bolts, nuts, and washers (and plates or anchor bolt assembly ring plate, if used) according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F. Galvanize entire assembly by the same zinc-coating process, with no mixed processes in a lot of fastener assemblies.

Section 4188

4188.01, General Requirements.

Replace the Article:

A. Meet the following material requirements for the type of traffic control devices specified.

B. Temporary Traffic Control Work Zone Devices.

1. Use crashworthy traffic control devices that meet MASH 2016 or NCHRP Report 350 as required. Upon request provide the following to the Engineer for the purpose of documenting the crashworthiness of temporary traffic control devices:
 - The vendor's self-certification for Category 1 devices.
 - FHWA Eligibility Letter for NCHRP Report 350 Category 2 and Category 3 devices.
 - FHWA Eligibility Letter for AASHTO MASH 2016 Category 2 and Category 3 devices.
2. **FHWA Eligible Devices.**
 - **NCHRP Report 350.**
https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/listing-archived.cfm?code=workzone
 - **MASH 2016.**
https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/listing.cfm?code=workzone
3. **Category 1 Devices.**
 - a. Category 1 devices include cones, tubular markers, 42 inch channelizers, flexible delineator posts, and plastic drums without attachments.
 - b. After December 31, 2021 use only MASH 2016 compliant Category 1 devices. Category 1 devices may be "self-certified" by each Manufacturer as MASH 2016 compliant if there are no attachments to the devices.
4. **Category 2 Devices.**
 - a. Category 2 devices include Category 1 devices with attachments, barricades, and portable sign supports.
 - b. Category 2 devices that meet NCHRP Report 350 requirements may be used through December 31, 2024. After December 31, 2024 use only MASH 2016 compliant Category 2 devices.
5. **Category 3 Devices.**
 - a. Category 3 devices include temporary barriers, fixed sign supports, crash cushions, and other work-zone devices not meeting the definitions of Category 1 or Category 2 devices.
 - b. Category 3 devices that meet NCHRP Report 350 may be used through December 31, 2029. After December 31, 2029 use only MASH 2016 compliant Category 3 devices.
6. **Category 4 Devices.**
 - a. Category 4 devices include trailer-mounted devices (i.e. flashing arrow panels, temporary traffic signals, area lighting supports, and portable dynamic message signs.)
 - b. Currently, there are no Category 4 devices that meet MASH 2016 or NCHRP Report 350 requirements. Category 4 devices shall meet the requirements of the contract documents.

4188.07, Portable Dynamic Message Sign.

Replace the Article:

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, 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. Characters ~~height is 18 inches and~~ shall be configured using a 7 pixel tall by 5 pixel wide ratio font. Characters shall be either yellow or orange and be displayed on a black background. Message panel may be configured as character matrix, line matrix, or full matrix.
3. PDMS (18 inch) shall have minimum 18 inch tall characters as defined by NEMA TS-4-2016 with a character width of 12.5 inches +/- 1.0 inch. Character spacing shall be 2.8 inches +/- 0.5 inch. This PDMS size shall be used on all roadways except as allowed in Article 4188.07, A, 4.

4. PDMS (12 inch) shall have minimum 12 inch tall characters as defined by NEMA TS-4-2016 with a character width of 8.5 inches (+/- 1.0 inch). Character spacing shall be 1.7 inches +/- 0.5 inch. The overall size of the PDMS display panel shall not exceed 86 inches in width. This PDMS size shall only be used on roadways where the speed is 40 mph or less when shown in the contract documents.
- 3 5. Message panel shall be visible from 1/2 mile under both day and night conditions. Letters shall be legible from 750 feet 600 feet for nighttime conditions and 800 feet for normal daylight conditions. Message sign shall include automatic dimming for nighttime operation and a power supply capable of providing service for 7 continuous days without recharging.
- 4 6. 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 7. 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 2. Cellular modem shall be capable of obtaining its location by GPS. Current location from GPS coordinates shall be stored in cellular modem's memory or PDMS controller for retrieval by ITS control NTCIP software. Modem shall have firewall security protections that ~~limit who and what can communicate to it~~ only allow communications from specified IP addresses. Cellular modem shall not use default usernames or passwords.
3. Upon deployment of PDMS and confirmation that remote communication has been successfully setup; the following information shall be supplied to the Traffic Management Center (TMC) via email at DOT-IWZ@iowadot.us for integration into the statewide ATMS software:
 - IP address
 - Port number (may not use default, 161)
 - Protocol used (TCP or UDP)
 - SNMP community name (may not use default names, i.e., "public" or "administrator")
 - Sign Number
 - Latitude and Longitude Coordinates
 - Route PDMS is on and direction of traffic flow that can view PDMS

Modem and PDMS credentials shall not be default values or recorded on any part of the trailer.

Upon relocation or removal of PDMS, send email to DOT-IWZ@iowadot.us, with the PDMS sign number and new location so it can be updated or released by the TMC's software.

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.

4188, Traffic Control Devices.

Add the Articles:

4188.08 TEMPORARY PORTABLE RUMBLE STRIPS.

Furnish temporary portable rumble strips to be used in traffic control zones. Ensure temporary portable rumble strips meet requirements of MUTCD and the following:

A. Properties.

1. Rated for posted speed limits up to 70 mph.
2. Installation without using nails or adhesive.
3. Provides auditory and tactile warnings for all vehicles.
4. Minimal lateral displacement under traffic loading.
5. Installation and removal of rumble strips in less than 5 minutes.
6. Reusable within manufacturer's recommended life of the product.

B. Acceptance.

Comply with Materials I.M. 488.07 for inspection and acceptance of temporary portable rumble strips.

4188.09 SPEED FEEDBACK SIGN.**A. General.**

Speed feedback signs shall be approved per Materials I.M. 488.09.

B. Power System.

1. Solar power system shall charge and maintain batteries automatically without intervention, designed for year round deployment in Iowa assuming minimal solar charging during winter months.
2. No component shall create a shadow on any portion of the solar panels.
3. Battery box shall be lockable to prevent unauthorized access.

C. Speed Display and Behavior.

1. Display shall be two digits displayed in miles per hour.
2. Character units shall be of one font and a minimum of 18 inches in height.
3. Legibility, must be able to determine numbers from 1/4 mile.
4. Visibility, must be able to determine if the sign is on from 1/2 mile.
5. Display shall:
 - a. Continuously show the speed of an approaching vehicle and not flash or change font color regardless of speed limit or preset thresholds.
 - b. 0 to 50% of speed limit setting –Display is blank.
 - c. 50% to 130% of speed setting –Display shows vehicle speed.

D. LEDs.**1. Requirements.**

- a. Color range, Amber, 589.5 to 592.0 nm.
- b. Operating temperature -20°F to 212°F.
- c. Viewing angle, minimum 30 degrees (15 degrees each side of the viewing axis).

2. Brightness shall vary for optimal viewing and power consumption based on ambient light. System will automatically adjust the brightness of the LEDs.

E. Controls.

1. System shall use an LCD display, keyboard, Rotary switches or other means to set and view operating

- modes, matrix displayed speed, error codes and other system information.
2. LED indicators (or similar) signify power is on, the solar charging system is active, activated alarms need for checking, battery charge is low, and power failure.

F. Operating Modes.

1. **Off.**
Except for the charging system the entire unit is off. Solar panels will continue to charge batteries in this position.
2. **Run.**
Normal operating mode.
3. **Speed Limit Settings.**
10 to 70 mph in 5 mph increments.

G. Radar.

1. K-Band, approach-only senses the largest, nearest mass moving toward it.
2. 10 to 99 mph speed range.
3. 1000 foot range.
4. Centered antenna head for maximum effectiveness regardless of which side of road the trailer is being used.

H. Regulatory Sign.

1. System shall include a regulatory speed limit sign with interchangeable speed limit numbers. Numbers shall be supplied in quantities necessary to display a speed range of 10 to 70 mph in 5 mph increments.
2. **Sign Requirements.**
 - a. Size: 30 inches by 36 inches (W x H).
 - b. Color: Black characters on white background.
 - c. Mounting Height: Minimum 5 feet measured from ground to bottom of sign.
 - d. Material: 0.063 inch minimum, tempered aluminum sheet with high-intensity reflective coating.

4188.10 ARROW BOARDS.

A. General.

Arrow Boards shall be approved per Materials I.M. 486.12.

B. Power System.

1. Solar power system shall charge and maintain batteries automatically without intervention, designed for year round deployment in Iowa assuming minimal solar charging during winter months.
2. No component shall create a shadow on any portion of solar panels.
3. Battery box shall be locked.

C. Display.

1. Minimum display size shall be 96 inches wide by 48 inches tall.
2. Minimum legibility distance is 1 mile.
3. Minimum number of elements (or pixels) is 15.
4. Elements shall be capable of at least 50% dimming from full brightness. Use dimmed mode for nighttime operation.
5. Color presented by elements shall be yellow.
6. Minimum element on-time shall be 50% for flashing mode, with equal intervals of 25% for each sequential phase. Flashing rate shall be not less than 25 or more than 40 flashes per minute.

D. Controls.

Use an LCD display, keyboard, Rotary switches, or other means to set and view operating modes.

E. Operating Modes.

Following 4 modes are the minimum required. Additional modes are allowed, but not required.

- Off. Except for charging system the entire unit is off. Solar panels will continue to charge batteries in this position.
- Sequential Chevron.
- Flashing Double Arrow.
- Alternating Diamond.

F. GPS and Remote Communications (When Required).

1. Arrow board shall have the ability to receive and transmit its GPS coordinates (latitude and longitude) within a 30 foot diameter of its true location.
2. Electronic communications between arrow board or arrow board's central server and the Department shall follow communication protocol defined in Materials I.M. 486.12.
3. Arrow boards shall transmit status and location as follows:
 - a. Mode change within 2 minutes.
 - b. Location (if moved more than 500 feet) within 2 minutes.
 - c. Health check every 30 minutes.

G. Portable Dynamic Message Signs as an Arrow Board.

A portable dynamic message sign may be used to simulate an arrow board if it meets the requirements in this section.

Section 4189

4189, Traffic Signal Equipment.

Replace the Article:

4189.01 UNDERGROUND.

A. Handhole.

1. General.

- a. **Cable Hooks:** Unless otherwise specified, provide four galvanized steel cable hooks with a minimum diameter of 3/8 inch and a minimum length of 5 inches.
- b. **Granular Base:** Comply with the following gradations; however, the Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.

Table 4189.01-1: Granular Base Gradation

| Sieve | Percent Passing |
|--------|-----------------|
| 2" | 100 |
| 1 1/2" | 80 to 90 |
| 1" | 15 to 20 |
| 3/4" | 0 to 0.5 |

- c. **Cover:** Include "TRAFFIC SIGNAL" as a message on the cover. Alternate messages may be required as specified in the contract documents.

2. Precast Concrete Handhole.

- a. **Pipe:** Use Class 2000D (Class III). Four, 8 inch knockouts (conduit entrance points) equally spaced around the handhole.
- b. **Casting:** Gray cast iron and certified according to requirements of AASHTO M 306 for a 16,000 pound proof-load (HS-20).

3. Composite Handhole and Cover: Composed of mortar consisting of sand, gravel, and polyester resin reinforced by a woven glass fiber mat or of resin mortar and fiberglass. Ensure the handhole and cover withstands a load of 20,000 pounds has a minimum ANSI/SCTE 77 2017 Tier 15 rating. Provide a skid resistant surface on the cover. Provide two 3/8-16 UNC stainless steel hex head bolts with washers.

4. HDPE Handhole and Cover.

- a. Size: Provide handhole and cover with minimum inside diameter of 24 inches and minimum 24 inches in depth. Handhole to be conical in shape with taper from bottom to top.
- b. Loading: Ensure handhole, extensions, and cover comply as a complete unit with ANSI 77 with a minimum 20,000 pound load Tier 15 rating.
- c. Resin: HDPE resin to comply with ASTM D790 for minimum flexural modulus of 142,000 psi and ASTM D638 for minimum yield strength of 3100 psi when using a Type IV specimen, 2 inch per minute test speed, and 0.075 inch thick molded sample.
- d. Cover: Ensure cover has skid resistant surface meeting PROWAG requirements with stainless steel bolts meeting manufacturer's requirements. Ensure cover fits handhole to meet PROWAG vertical surface discontinuity requirements when placed in pedestrian walkways.

B. Conduit.

1. General.

- a. Furnish weatherproof fittings of identical or compatible material to the conduit. Use standard factory elbows, couplings, and other fittings.
- b. Use a manufactured conduit sealing compound that is readily workable material at temperatures as low as 30°F and will not melt or run at temperatures as high as 300°F.
- c. Furnish flat polyester pull tape with a minimum pulling strength of 1250 pounds and permanent sequential footage markings.

2. Steel Conduit and Fittings.

- a. Comply with NEMA ANSI C80.1.
- b. Use 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. Provide steel bushings.

3. Plastic Conduit and Fittings.

- a. PVC.
 - 1) PVC Schedule 40 plastic conduit and fittings complying with NEMA TC-2 (pipe), NEMA TC-3 (fittings), and UL 651 for Schedule 40 heavy wall type.
 - 2) Solvent welded, socket type fittings, except where otherwise specified in the contract documents.
 - 3) Threaded adaptors for jointing plastic conduit to rigid metal ducts.
 - 4) Provide bell end fittings or bushings.
- b. HDPE.
 - 1) Comply with ASTM F 2160 (conduit) and ASTM D 3350 (HDPE material), SDR 13.5.
 - 2) Use orange colored conduit the color specified in the latest NEC or approved by the Contracting Authority.
 - 3) Continuous reel or straight pieces to minimize splicing.
 - 4) For dissimilar conduit connections, provide an adhesive compatible with both materials.

C. Wiring and Cable: Provide wire that is plainly marked on the outside of the sheath with the manufacturer's name and identification of the type of the cable.

1. **Power Cable:** Comply with Article 4185.11.
2. **Signal Cable:** Comply with IMSA Specifications 19-1 (PVC jacket) or 20-1 (PE jacket) for PE insulated, 600 volt, solid, multi-conductor copper wire, No. 14 AWG.
3. **Tracer Wire:** Comply with No. 10 AWG, single conductor, stranded copper, Type thermoplastic high-heat and water resistant, nylon-coated (THHN THWN), with UL approval, and an orange colored jacket.
4. **Communications Cable:** Comply with IMSA Specifications 39-2 or 40-2 for No. 19 AWG, solid copper conductor, twisted pairs. Use polyethylene insulated, aluminum shielded, complying with REA Specification PE-39 for paired communication cable with electrical shielding.
5. **Category 5E (Cat5E) Ethernet Cable:** Provide outdoor use rated cable. Provide either Category 5E (CAT5e) or Category 6 (CAT6) cable.
6. **Fiber Optic Cable and Accessories:**
 - a. Furnish fiber optic cable of the mode type, size, and number of fibers specified in the contract documents, and all associated accessories.
 - b. Meet the latest applicable standard specifications by ANSI, Electronics Industries Association (EIA), International Telecommunication Unit (ITU), and Telecommunications Industries Association (TIA).
 - c. **Multimode Fiber.**
 - Core Diameter: 62.5 $\mu\text{m} \pm 1.0 \mu\text{m}$
 - Cladding Diameter: 125.0 $\mu\text{m} \pm 1.0 \mu\text{m}$

- Core Concentricity: $\pm 1\%$
 - Max. Attenuation: 3.50 dB/km @ 850 nm
- d. Single-Mode Fiber:** Meet attributes of ITU-T G.652.D Table 2 and/or ITU-T G.657.A1 for low loss bend as specified in the contract documents.
- Typical Core Diameter: $8.3 \mu\text{m} \pm 1.0 \mu\text{m}$
 - Cladding Diameter: $125.0 \mu\text{m} \pm 1.0 \mu\text{m}$
 - Core Concentricity: $\pm 1\%$
 - Attenuation Uniformity: No point discontinuity greater than 0.1 dB at either 1310 nm or 1550 nm
 - Max. Attenuation: 0.25 dB/km @ 1550 nm, 0.35 dB/km @ 1310 nm
- e.** Dual layer UV cured acrylate coating applied by the fiber manufacturer, mechanically or chemically strip-able without damage to the fiber.
- f e.** Glass reinforced plastic rod central member designed to prevent the buckling of the cable. Cable core interstices filled with water blocking tape to prevent water infiltration. Dielectric fillers may be included in the cable core where needed to lend symmetry to the cable cross-section.
- g f.** Buffer tubes of dual layer construction with a polycarbonate inner layer and polyester outer layer. Each buffer tube filled with a water-swellable yarn or tape. Buffer tubes stranded around the central member using reverse oscillation or "SZ" stranding process. Gel-free cable and buffer tubes.
- h g.** Buffer tubes and fibers meeting TIA/EIA-598A, "Color coding of fiber optic cables," with 12 fibers per buffer tube.
- i h.** Cable tensile strength provided by a high tensile strength aramid yarn and/or fiber glass.
- j i.** All dielectric cables, without armoring, sheathed with medium density polyethylene (1.4 mm minimum nominal jacket thickness) or armored cables with corrugated steel tape armor as specified in the contract documents. Jacketing material Outer jacket of medium density polyethylene applied directly over the tensile strength members and flooding compound. Jacket or sheath marked in a contrasting color with the manufacturer's name and the words "Optical Cable," the year of manufacture, and sequential meter or feet marks. Additionally, provide a durable weather proof label on the cable jacket showing the actual attenuation of each fiber expressed in dB/km.
- k j.** Cable fabricated to withstand a maximum pulling tension of 600 pounds during installation (short term) and 135 pounds upon installation (long term).
- l k.** Shipping, storing, and operating temperature range of the cable: -40°F to 158°F . Installation temperature range of cable: 14 -22°F to 140 158°F .
- m l.** Each fiber of all fiber optic cable tested by manufacturer at the 100% level for the following tests:
- Proof tested at a minimum load of 50 kpsi
 - Attenuation
- n m.** Meet the appropriate standard Fiber Optic Test Procedure for the following measurements:
- Fluid Penetration
 - Compound Drip
 - Compressive Loading Resistance
 - Cyclic Flexing
 - Cyclic Impact
 - Tensile Loading and Bending
- o n.** Make cable ends available for testing. Seal cable ends to prevent moisture impregnation.
- p o. Fiber Distribution Panel:** Provide a fiber distribution panel capable of terminating a minimum the number of 24 fibers, or as specified in the contract documents.
- q p. Fiber Optic Connectors.**
- 1) ST type connectors of ceramic ferrule and physical contact end finish to terminate multi-mode fibers to equipment.
 - 2) SC type connectors of ceramic ferrule and physical contact end finish to terminate single-mode fibers to equipment.
 - 3) ST or mechanical connectors not allowed for cable splices.
 - 4) Maximum attenuation per connector: 0.75 dB.
- r q. Fiber Optic Jumpers/Patch Cords:** For connections in the cabinet, provide factory-assembled duplex pigtail jumpers with dielectric strength member, durable outer jacket and ST or SC compatible connectors. Provide adequate length for connections and 2 feet minimum slack.
- s r. Fiber Optic Breakout Kits:** Provide breakout kits for separation and protection of individual fibers, with buffering tube and jacketing materials suitable for termination of the fiber and fiber optic connector.
- t s. Splices/ Splice Enclosures:** Fusion splice continuous fiber runs or branch circuit connections in splice enclosures as allowed or specified in the contract documents. Provide environmentally protected outside plant splice enclosures with adequate number of trays to splice all fibers. Do not splice continuous fibers unless physical restraints require all fibers to be cut, unless approved by the Engineer. Maximum attenuation per splice: 0.3 dB.

D. Footings Foundations.

1. Use Class C structural concrete complying with Section 2403.

2. Use uncoated reinforcing steel complying with Section Article 4151.03. All reinforcing steel shall be Grade 60.
3. For drilled-shaft foundations, comply with Articles 2433.01, 2433.02, 2433.03,A and 2433.03, C through I.

E. Bonding and Grounding.

1. **Ground Rods:** Provide 5/8 inch by 8 foot copper clad, steel ground rod at each pole and controller footing.
2. **Bonding Jumper or Connecting Wire:** Provide No. 6 AWG bare conductor, copper wire.

4189.02 DETECTION.

A. Inductive Loop Vehicle Detector: A detector consists of a conductor loop or series of loops installed in the roadway, lead-in (feeder) cable, and a sensor (amplifier) unit with power supply installed in a traffic signal controller cabinet.

1. **Cables:** All cables must be UL approved.
 - a. **Tube Loop Detector Cable:** Comply with IMSA Specifications 51-5.
 - b. **Preformed Loop Detector Cable:** As approved by the Engineer.
 - c. **Loop Detector Lead-in Cable:** Comply with IMSA Specifications 50-2.
2. **Detector Loop Sealant:**
 - a. Use a rapid cure, high viscosity, liquid epoxy sealant formulated for use in sealing inductive wire loops and leads embedded in pavement. Ensure the cured sealer is unaffected by oils, gasoline, grease, acids, and most alkalis.
 - b. Use a sealant complying with Materials I.M. 491.18.
3. **Sensor (Amplifier) Unit:**
 - a. Use a sensor unit that is solid state, digital, providing detection channel(s) with an inductance range of 0 to 2000 micro-henries. Output circuits of the sensor unit will be provided by relays. Vehicle presence will result in a continuous call indication.
 - b. Provide a sensor unit with the following qualities:
 - 1) Sensitivity adjustment to allow as a minimum the selection of high, medium, or low sensitivity.
 - 2) Be capable of providing reliable detection of all licensed motor vehicles.
 - 3) Provide an indicator light for visual indication of each vehicle detection.
 - 4) Will not require external equipment for tuning or adjustment.
 - 5) Provide operation in the pulse mode or presence mode. Ensure mode switch is readily accessible.
 - 6) Provide a self tuning system that is activated automatically with each application of power. Provide automatic and continuous fine tuning to correct for environmental drift of loop impedance.
 - 7) Provide for fail-safe operation (continuous call) in the event of detector loop failure.
 - 8) Ensure each detector channel will respond to a frequency shift in an increasing or decreasing value as occurs with temperature shifts in the pavement without requiring a locked call.
 - 9) Use detector units with delay and extension timing. The delay feature is selected and adjusted externally on the sensor unit housing. Digitally derived timing is selectable in 1 second increments from 0 to 30 seconds. Ensure delay timing inhibits detector output until presence has been maintained for the time selected. Restart delay timer at each new detection.
 - 10) Use a sensor unit capable of normal operation without interference and false calls between sensor units ("crosstalk") when installed in the physical environment of the controller cabinet and the electrical environment of the associated electronic equipment installed therein, including other detectors.

B. Pedestrian Push Button Detectors.

1. **Assembly.**
 - a. Ensure the entire assembly is weather tight, secure against electrical shock, withstands continuous hard usage.
 - b. Provide a removable contact assembly mounted in a die cast aluminum case.
 - c. Ensure contacts are normally open with no current flowing except at the moment of actuation.
 - d. Ensure the contacts are entirely insulated from the housing and operating button with terminals for making connections.
 - e. Provide housing with one outlet for 1/2 inch pipe.
2. **Accessible Pedestrian Signals (APS) Push Button Stations.**
 - a. **Housing:** Die cast aluminum, weather tight, secure against electrical shock and withstands continuous hard usage.
 - b. **Audible and Vibrotactile Features:** Audible walk indication tone, vibrotactile arrow, and locator tone complying with MUTCD.
 - c. **Voice Messages:** As specified in the contract documents and per MUTCD.
 - d. **Speaker:** Weatherproof with automatic volume adjustment to 5 dBA over ambient sound. Maximum volume 100 dB at 3 feet.
 - e. **Push Button:** Nonrusting metal alloy, ADA compliant, 2 inch diameter with tactile arrow and 3 pounds maximum

- operational force.
- f. **Switch:** Solid state rated at 20 million operations minimum.
 - g. **Program and Audio File Updates:** USB or Ethernet.
 - h. **Operating Temperature:** -30°F to 165°F.
3. **Solid State Pedestrian Push Buttons (non-APS).**
 - a. **Housing:** Die cast aluminum, weather tight, secure against electrical shock and withstands continuous hard usage.
 - b. **Push Button:** Nonrusting metal alloy, ADA compliant, 2 inch diameter with 3 pounds maximum operational force, with momentary LED visual confirmation and audible tone confirmation.
 - c. **Switch:** Solid state piezo-driven, rated at 20 million operations minimum.
 - d. **Operating Temperature:** -30°F to 165°F.
 4. **Signs:** Furnish signs complying with MUTCD.
- C. **Video Detection Camera System:** Detects vehicles by processing video images and providing detection outputs to the traffic signal controller.
1. **Video Detection System and Processors.**
 - a. Processor to be card rack mounted, shelf mounted, or located within camera. Compatible with NEMA TS-1, TS-2, ITE ATC, and Type 170 and 2070 controllers and cabinets.
 - b. Shall be capable of the following:
 - 1) Shadow rejection without special hardware.
 - 2) Non-impaired operation under light intensity changes.
 - 3) Maintained operation during various weather conditions (e.g. rain, fog, snow).
 - 4) Anti-vibration, 5% rejection based on image change.
 - 5) Ability to select direction of flow parameters.
 - 6) Ability to properly detect directionally.
 - 7) Operate in presence mode with less than 4% error.
 - c. Provide user-defined detection zone programming via a graphical user interface (GUI) and any necessary equipment for future programming. Store detection zones in non-volatile memory.
 - d. Comply with NEMA TS-1 and TS-2 environmental and physical standards with an operating temperature of -29°F to 140°F, and 0% to 95% relative humidity.
 - e. Ensure a factory certified representative from the supplier provides on-site VDS programming and testing.
 2. **Video Cameras.**
 - a. ~~Provide a charge-coupled device (CCD) image sensor with variable focus color or black and white lens providing a minimum of 4 to at least a 40 degree horizontal field of view.~~
 - b. ~~Equipped with internal thermostatically controlled heater and external sunshield.~~
 - c. Meet NEMA-4 or NEMA-6P environmental standards.
 - d. Use camera cable(s) meeting the manufacturer's recommendations. Provide a continuous run, without splices, from the camera to the controller cabinet.
 - c. **Camera per Approach or Advance Detection Camera:**
 - 1) Provide a charge-coupled device (CCD) image sensor with variable focus color or black and white lens providing a minimum of 4 to at least a 40 degree horizontal field of view.
 - 2) Equipped with internal thermostatically controlled heater and external sunshield.
 - d. **Single Stop Line Detection Camera:**
 - 1) Provide a minimum 5 MP image sensor with power over ethernet and a fisheye lens capable of detecting multiple approaches from a single mounting location.
 - 2) Include the ability to count traffic.
 - 3) Provide necessary internal thermostatically controlled heater as needed.
- D. **Microwave/Radar Vehicle Detectors:** Detects all vehicles moving within the field of detection at speeds from 2 to 80 mph.
1. Must be capable of the following:
 - a. Minimum detection range from 3 to 200 feet for all vehicles.
 - b. Pattern spread of the detection field no more than 16 degrees.
 - c. Self-tuning and capable of continuous operation over a temperature range of -35°F to 165°F.
 - d. Side-fire mount or overhead mount.
 - e. Detecting directional traffic and the direction user selectable.
 2. Microprocessor based using Doppler microwave at an operating frequency of 10.525 GHz.
 3. FCC certification and tested to the applicable FCC specifications.
 4. Enclosure constructed of aluminum or stainless steel and water resistant.

5. All user operated controls and adjustments must be clearly marked and easily accessible.
 6. Relay detection output to the controller with a minimum 5 amp rating and designed to place a constant call to the controller in the event of any failure.
 7. Easily accessible indicator showing activation of detection relay.
 8. Required wiring as recommended by the manufacturer.
 9. Provide mounting hardware for the type of mounting specified in the contract documents and power supply equipment as recommended by the manufacturer.
- E. Wireless Magnetic Sensors (Pod/Puck):** Provide as specified in the contract documents in pavement sensors, access points, base stations, and repeaters, if necessary.

4189.03 COMMUNICATIONS.

- A. Traffic Monitoring System:** Provide as specified in the contract documents including, video camera in dome, dome mounting bracket and hardware, camera controller, cabling from camera to controller cabinet, and all accessories, software, and hardware necessary for a complete and operational system.
1. Pan/tilt/zoom (PTZ) color camera with automatic conversion to monochrome during low light levels, auto focus, auto-iris control, electronic image stabilization, privacy masking and high resolution 1/4 inch CCD imager progressive CMOS sensor. Minimum 1920 by 1080 maximum resolution. Minimum optical zoom: 25X. Minimum digital zoom: 12X.
 2. Camera system provided in a NEMA 4X or IP66 certified rugged weather-resistant package.
 3. Provide all required lightning protection for electronics control, power, and coax video outputs.
 4. Operating temperature range: -40°F to 122°F.
 5. Maximum cable length as specified by camera manufacturer.
 6. Provide full 360 degree endless pan and 220 degree tilt under PTZ control.
 7. Dome electronics capable of programming a minimum of 64 preset views and nine preprogrammed pattern sequences of preset views. All views selectable by the central office computer or a remote control device.
 8. Provide encoder and decoder devices as needed to transmit video over existing or proposed communication systems at 30 frames per second (or more).
 9. Provide all necessary rack support devices for video viewing and PTZ control.
 10. Provide ability to control PTZ and view video remotely. Includes installing necessary software/programming needed for agency to operate system.
- B. Fiber Optic Hub Cabinet:** As specified in the contract documents.
- C. Wireless Interconnect Network:** Provides two-way data communication between the on-street master controller system control software and local traffic signal controllers.
1. **Data Transceiver.**
 - a. Utilize a license-free spread spectrum radio frequency (902-928 MHZ) with frequency hopping technology.
 - b. Completely programmable by software. Furnish software to the Engineer.
 - c. Built-in diagnostics capabilities.
 - d. Configurable as master, slave, or repeater with store and forward capability.
 - e. Maintains user selectable power output levels between 0.1 and 1 watt.
 - f. Operates with input voltages between 6 VDC and 30 VDC.
 - g. RS-232 interface with 115.2 kbps capability.
 - h. Operating temperature of -40°F to 167°F.
 - i. Receiver sensitivity of -108 to -110 dBm at 10⁻⁶ BER.
 - j. Protected from power surges.
 - k. Rack or shelf mounted in controller cabinet and connections for antenna, power, and controller.
 2. **Antenna.**
 - a. Capable of transmitting and receiving data between intersections.

- b. Mount near the top of the signal pole nearest the controller cabinet or as specified in the contract documents. Provide engineer-approved mounting hardware.
- c. Connect to transceiver via appropriate cable from pole to signal cabinet in same conduit as traffic signal cable. Conceal cable within a watertight connection at antenna.

4189.04 CABINET AND CONTROLLER.

- A. NEMA Controller, Cabinet, and Auxiliary Equipment:** Comply with the latest edition of NEMA TS1 or TS2, CalTrans model 2070, or ITE advanced transportation controller (ATC) standards.
1. **Controller.**
 - a. Solid state modular design with digital timing and capable of accommodating at least eight phases.
 - b. Fully prompted, front panel keyboard with menu driven programmability.
 - c. Local time base scheduler including automatic accommodation for daylight savings time.
 - d. Local coordination control.
 - e. Local preemption control with at least four programmable internal preemption sequences.
 - f. Current software and documentation.
 - g. Data retained in a memory medium that does not require battery backup.
 2. **Cabinet.**
 - a. Unpainted aluminum cabinet according to NEMA standards.
 - b. Aluminum cabinet riser with same dimensions as cabinet and 12 to 18 inch height, as specified in the contract documents.
 - c. ATC cabinet voltage category as specified in the contract documents.
 - d. Police door with auto/flash switch and on/off power switch, manual/stop time switch, for signal heads only. Controller to remain in full operation regardless of switch positions.
 - e. Maintenance panel on inside of the main door containing the following test switches.
 - 1) Controller power switch.
 - 2) Detector test switches.
 - 3) Stop time switch.
 - 4) Signal flash switch.
 - f. Heavy-duty clear plastic envelope attached to inside wall of cabinet or cabinet door, for cabinet wiring diagrams, 12 inches by 18 inches minimum.
 - g. GFI electrical outlet and lamp in accessible location near the front of the cabinet. GFI outlet fused separately from main AC circuit breaker. Fluorescent or LED cabinet lamp connected and fused with GFI outlet.
 - h. Back panel positions to accommodate phasing and expansibility specified in the contract documents.
 - i. Power protection devices including AC power circuit breakers, radio interference suppressors, and lightning and surge protectors.
 - 1) AC field service single pole, nonadjustable, magnetic breaker rated for 117 VAC operation, NEC approved.
 - 2) Radio interference suppressors (RIS) as required to minimize interference in all broadcast transmission and aircraft frequency bands.
 - 3) Lightning arrestor/surge protector capable of withstanding repeated (minimum of 25) 30,000 ampere surges.
 - j. Neatly train wiring throughout the cabinet and riser. Bundle and attach wiring to interior panels using nonconductive clamps or tie-wraps.
 3. **Auxiliary Equipment:** Conflict monitor/malfunction management unit, flasher, load switches, terminals and facilities, and miscellaneous equipment and materials according to NEMA standards. For ATC cabinets, use serial interface unit, high density switch pack/flasher unit, cabinet monitor unit, cabinet power supply requirements, auxiliary display unit, sensor unit, and miscellaneous equipment materials meeting ITE standards.
- B. Uninterruptible Power Supply Battery Backup System:** Monitors 120VAC input from the electric utility source and automatically switches to/from a system consisting of batteries and electronics.
1. Include a maintenance bypass switch to allow operation of the traffic signal system while repairs are made to the battery backup system.
 2. Designed to provide a minimum of 4 hours of normal operation.
 3. Use cabinet equipment that is plug connected and shelf mounted.
 4. Designed to cover a temperature range from -30°F to 165°F and include a surge suppressor.
- C. Emergency Vehicle Preemption System:** As specified in the contract documents.

4189.05 POLES, HEADS, AND SIGNS.

- A. Vehicle Traffic Signal Head Assembly:** Comply with current MUTCD and ITE standards.

1. **Housing.**
 - a. Individual signal sections made of a durable polycarbonate. Use color specified in the contract documents. Color to be an integral part of the materials composition.
 - b. Self-contained unit capable of separate mounting or inclusion in a signal face containing two or more signal sections rigidly and securely fastened together.
 - c. Equipped with openings and positive locking devices in the top and bottom so that it may be rotated between waterproof supporting brackets capable of being directed and secured at any angle in the horizontal plane.
 - d. Doors and lenses with suitable watertight gaskets and doors that are suitably hinged and held securely to the body of the housing by simple locking devices of non-corrosive material. Doors are to be easily removed and reinstalled without use of special tools.
 2. **Optical System:** Designed to prevent any objectionable reflection of sun rays even at times of the day when the sun may shine directly into the lens.
 3. **Lenses:** 12 inch diameter polycarbonate. Do not use glass lenses.
 4. **Visors.**
 - a. **Standard Installation.**
 - 1) Each signal lens is to have a visor with the bottom 25% open.
 - 2) Minimum 0.1 inch in thickness and black in color.
 - 3) Fits tightly against the housing door with no filtration of light between the visor and door.
 - 4) Minimum length of 9 1/2 inches. Ensure the visor angle is slightly downward.
 - b. **Optically Programmed Sections:** Make sure the optical unit and visor are designed as a whole to eliminate the return of outside rays entering the unit from above the horizontal.
 5. **Terminal Block.**
 - a. Three-section signal equipped with a six position terminal block.
 - b. Four- and five-section signal equipped with an eight position terminal block.
 6. **Backplate.**
 - a. Manufactured one-piece, durable, black plastic or aluminum capable of withstanding a 100 mph wind.
 - b. Provides 5 inches of black field around the assembly.
 - c. If specified, provide high visibility reflective tape with a minimum width of 1 inch.
 7. **Mounting Hardware.**
 - a. **Fixed Rigid:** 1 1/2 inch aluminum pipe and fittings, natural aluminum finish for galvanized poles or match the pole color if specified in the contract documents. Secure to pole with a minimum 5/8 inch wide stainless steel banding material.
 - b. **Universally Adjustable:** Rigid mounted, consisting of both top and bottom brackets and easily adjustable in both horizontal and vertical planes. Provide galvanized steel cable material per manufacturer's recommendation.
 8. **LED Modules:** Comply with current ITE standards and consistent with cabinet voltage requirements.
- B. Pedestrian Traffic Signal Head Assembly:** Comply with current MUTCD and ITE standards.
1. **Housing.**
 - a. Made of a durable polycarbonate. Use color specified in the contract documents. Color to be an integral part of the materials composition.
 - b. Self-contained unit capable of separate mounting or inclusion in a signal face containing one or more signal sections rigidly and securely fastened together.
 - c. Equipped with openings and positive locking devices in the top and bottom so that it may be rotated between waterproof supporting brackets capable of being directed and secured at any angle in the horizontal plane.
 - d. Doors and lenses with suitable watertight gaskets and doors that are suitably hinged and held securely to the body of the housing by simple locking devices of non-corrosive material. Doors are to be easily removed and reinstalled without use of special tools.
 2. **Visor.**
 - a. Egg crate or Tunnel type visor, as specified in the contract documents, attached to the housing door by stainless steel screws or according to manufacturer's requirements.
 - b. Fit tightly against the housing door to prevent any filtration of light between the door and the visor.
 - c. Ensure the visor angle is slightly downward.
 3. **LED Module.**
 - a. Provide a LED unit(s) for the filled upraised hand symbol, walking person symbol, and countdown timer.
 - b. Ensure immediate blank out of the countdown timer display upon recognizing a shortened "Walk" or a shortened "Flashing Don't Walk" interval.
 - c. Comply with current ITE standards and consistent with cabinet voltage requirements.

A C. Traffic Signal Poles and Mast Arms.

1. General.

- a. Use Mast arm length and vertical pole height as specified in the contract documents.
- b. Ensure the mast arms, poles, and supporting bases are galvanized inside and out on both interior and exterior surfaces according to ASTM A 123.
- c. Use Continuously tapered, round, steel poles of the transformer base type for poles with mast arms 60 feet or less. Fabricate poles from low carbon (maximum carbon 0.30%) steel of U.S. standard gauge.
- d. For poles with mast arms greater than 60 feet or ~~When~~ a transformer base is not specified, provide a 6 inch by 16 inch handhole in the pole shaft for cable access. Provide a cover for the handhole. Secure the cover to the base with simple tools. ~~Hardware to be~~ Use corrosion resistant hardware.
- e. Ensure minimum yield strength of 48,000 psi after manufacture. Supply base and flange plates of structural steel complying with ~~AASHTO M-183~~ ASTM A 36 and cast steel complying with ASTM A 27, Grade 65-35 or better.
- f. Where a combination street lighting/signal pole is specified in the contract documents, ensure the luminaire arm is ~~to be~~ mounted in the same vertical plane as the signal arm unless otherwise specified. Use a luminaire arm of the single member tapered type ~~arm for the luminaire arm type.~~ Equip Fabricate the pole with a minimum 4 inch by 6 inch handhole and cover located opposite the signal mast arm.
- g. If allowed by the Engineer, poles and mast arms may be fabricated by shop welding two sections together, resulting in a smooth joint and ~~factory weld~~ as follows:
 - 1) Ensure a minimum of 60% penetration for longitudinal butt welds in plates 3/8 inch and less in thickness for longitudinal butt welds, except within 1 foot of a transverse butt-welded joint. Ensure a minimum of 80% penetration for longitudinal butt welds in plates over 3/8 inch in thickness.
 - 2) Ensure 100% penetration for longitudinal butt welds on in poles and arms within 1 foot of a transverse butt-welded joint.
 - 3) Ensure 100% penetration, achieved by for transverse butt welds by using a back-up ring or bar, for transverse butt welds for connecting to connect the sections.
 - 4) Examine 100% the full length of all transverse butt welds and 100% penetration longitudinal butt welds by ultrasonic inspection according to the requirements of ANSI/AWS D1.1-80.AH.
 - 5) Comply with Structural Welding Code AWS D1-180, as modified by AASHTO 1981 Standard Specifications for Welding of Structural Steel Highway Bridges and by Supplemental Specifications No. 969 ANSI/AWS D1.1 except as modified by Article 2408.03, B.
- h. For mast arms over 50 feet length, two-piece mast arms with a slip-fit and bolt connection are allowed.
- ~~h i.~~ Provide non-shrink grout (complying with Materials I.M. 491.13) or a rodent guard (complying with Materials I.M. 443.01) for placement between the pole base and the foundation per the manufacturer's requirements.

2. Pole Design.

- a. Comply with AASHTO 1994 2013 Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Use a 90 mph basic wind speed (3 second gust) with a 50 year mean recurrence interval for strength design. Use Category II for fatigue design. Apply only natural wind gust loads (i.e., do not apply galloping loads, vortex shedding loads, or truck-induced gust loads) for fatigue design. Install vibration mitigation devices on all traffic signal pole mast arms over 60 feet in length as shown in the standard details.
- b. ~~Designed to support the loading necessary for all traffic control equipment. Capable of withstanding winds up to 80 mph with a 1.3 gust factor without failure.~~

3. Hardware.

- a. Equipped poles and mast arms with all necessary hardware and anchor bolts to provide for a complete installation without additional parts.
- b. ~~Use Anchor bolts complying with ASTM F 1554 Grade 105 S5 Class 2A,; hot dip galvanized, and threaded to a minimum of 6 inches at one end; and having a 4 inch long, 90-degree bend at the other end.~~
- c. ~~Use Washers complying with ASTM F 436 Type 1.~~
- d. ~~Use Heavy hex nuts complying with ASTM A 563 Grade DH Class 2B.~~
- e. ~~Ensure All hardware is made of steel, and is hot dipped galvanized complying with according to ASTM F 2329, with a zinc bath temperature limited to 850°F or mechanically galvanized according to ASTM B 695, Class 50 55, Type 1, or electrodeposited coated of the same coating thickness and designed for this purpose.~~

4. Anchor Bolts, Nuts, and Washers.

Furnish each anchor bolt with one leveling nut, one anchoring nut, and one jam nut (if required) on the exposed end and one of the following on the embedded end: nut, nut and plate, or nut and anchor bolt assembly ring plate. Use anchor bolts, nuts, and washers that comply with Materials I.M. 453.08. Meet the following requirements:

- a. **Anchor Bolts.**
 - 1) Use straight full-length galvanized bolts.
 - 2) Comply with ASTM F 1554, Grade 105, S4 (-20oF).
 - 3) Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A tolerance.
 - 4) The end of each anchor bolt intended to project from the concrete is to be color coded to identify the grade.
 - 5) Do not bend or weld anchor bolts.
- b. **Nuts.**
 - 1) Comply with ASTM A 563, Grade DH or ASTM A 194, Grade 2H.

- 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.
- 5) Refer to Articles 2522.03, H, 2, b through h for tightening procedure and requirements.
- c. **Washers.**
Comply with ASTM F 436 Type 1.
- d. **Galvanizing.**
Galvanize entire anchor bolt assembly consisting of anchor bolts, nuts, and washers (and plates or anchor bolt assembly ring plate, if used) according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F. Galvanize entire assembly by the same zinc-coating process, with no mixed processes in a lot of fastener assemblies.

B D. Traffic Signal Pedestal Poles.

- 1. **Materials.**
 - a. **Pedestal:** The height from the bottom of the base to the top of the shaft as specified in the contract documents.
 - b. **Pedestal Shaft:** Schedule 80 with satin brush or spun finish aluminum tubing. Top of the shaft outer diameter to be 4 1/2 inches and provided with a pole cap. Supply base collar for poles with shaft lengths greater than 10 feet. Provide brackets to mount pedestrian signal on side of pole.
 - c. **Pedestal Base:** Cast aluminum, square in shape, with a handhole.
 - 1) **Handhole:** Minimum of 6 3 1/2 inches by 6 5 1/2 inches and equipped with a cast aluminum cover that can be securely fastened to the base with the use of simple tools.
 - 2) **Base:** Minimum weight of 20 pounds with a four bolt pattern uniformly spaced on a 12 1/2 inch diameter bolt circle. A breakaway base with a four bolt pattern uniformly spaced on a minimum of 6 inch diameter bolt circle. Meet or exceed AASHTO breakaway requirements.
- 2. **Anchor Bolts:** Four 3/4 5/8 inch by 15 7 1/2 inch steel (minimum), hot dip galvanized anchor bolts complying with ASTM F 1554, Grade 36, with right angle bend at the bottom end meeting pole manufacturer requirements for installation, complete with all hardware required for installation. For pedestal pole sidewalk mounting, provide anchor bolts and hardware per pole manufacturer requirements.

E. Pedestrian Push Button Post.

- 1. **Post:** Standard weight (Schedule 40) pipe complying with ASTM F 1083, galvanized inside and out; 2 1/2 inches in diameter.
- 2. **Cap:** Waterproof cap complying with ASTM F 626.
- 3. **Anchor Bolts:** Four 1/2 inch by 24 inch steel, hot dip galvanized anchor bolts complete with all hardware required for installation.
- 4. **Non-shrink Grout:** Comply with Materials I.M. 491.13 or a rodent guard (complying with Materials I.M. 443.01) for placement between the post base and the foundation.
- 5. **Base Plate:** Provide a 5 inch square, 1/2 inch thick galvanized steel base plate with a 4 1/2 inch bolt circle.

F E. Traffic Signs.

- 1. Comply Sheet aluminum and retroreflective sheeting complying with Section 4186.
- 2. Use a universally adjustable mast arm mounted sign bracket.
- 3. Comply with MUTCD and the contract documents for the street name sign dimensions, letter height, and font, and sheeting.

Section 4195

4195.02, A.

Replace Table 4195.02-1:

Table 4195.02-1: Maximum Dimension Variations

| | Nonlaminated | Laminated |
|------------------|------------------------------|----------------------------|
| Thickness | - 0 inch, + 1/16 0.1181 inch | - 0 inch, + 1/8 0.125 inch |

| | | |
|---------------|-----------------------------------|-----------------------------------|
| Width | - 1/8 0.125 inch, + 1/4 0.25 inch | - 1/8 0.125 inch, + 1/4 0.25 inch |
| Length | - 1/8 0.125 inch, + 1/4 0.25 inch | - 1/8 0.125 inch, + 1/4 0.25 inch |

Section 4196

4196.01, B, 2, Subsurface Drainage.

Replace Table 4196.01-2:

Table 4196.01-2: Fabric for use in Subsurface Drains

| Property | Value | Test Method |
|---|---------------------------------|-------------|
| Grab strength, dry, minimum average value in either principal direction | 90 lbs. | ASTM D 4632 |
| Elongation, dry, minimum average value in either principal direction | 20% | ASTM D 4632 |
| Permittivity, minimum | 0.02–0.30 0.1 sec ⁻¹ | ASTM D 4491 |
| Apparent Opening Size, maximum | US Sieve No. 40 | ASTM D 4751 |

4196.01, B, 3, Embankment Erosion Control.

Replace Table 4196.01-3:

Table 4196.01-3: Fabric for use as Embankment Erosion Control

| Property | Value | Test Method |
|---|---------------------------------|-------------|
| Grab strength, dry, minimum average value in either principal direction | 150 lbs. | ASTM D 4632 |
| Elongation, dry, minimum average value in either principal direction | 20% | ASTM D 4632 |
| Permittivity, minimum | 0.02–0.30 0.1 sec ⁻¹ | ASTM D 4491 |
| Apparent Opening Size, maximum | US Sieve No. 40 | ASTM D 4751 |

4196.01, B, 5, a.

Replace Article:

To stabilize subgrade under pavement or pavement patches, use material that:

- Is capable of withstanding installation stresses, and
- Has the properties listed in Table 4196.01-5a or 4196.01-5b for the type specified for use in the contract documents.

Table 4196.01-5a: Fabric for use as Subgrade Stabilization (Biaxial Polymer Grid)

| Property | Value | Test Method |
|---|------------------|--|
| Minimum tensile strength at 2% strain. Both directions. | 250 lbs./ft. | GRI Test Method GG1-87 ASTM D 6637 |
| Maximum aperture Aperture size. Both directions. | 0.5 to 2 in. | Internal Dimension Measuring Calipers |
| Minimum aperture. Both directions. | 0.5 in. | Internal Dimension Measuring Calipers |
| Minimum Ultimate junction strength. Both directions. | 800 790 lbs./ft. | GRI Test Method GG2-87 or ASTM D 7737 |

Table 4196.01-5b: Fabric for use as Subgrade Stabilization (Triaxial Polymer Grid)

| Property | Value | Test Method |
|---|--|-------------|
| Minimum radial stiffness at 0.5% strain or Minimum tensile modulus at | 13,700 lbs./ft. or 12,000 lbs./ft. | ASTM D 6637 |

| | | |
|---|--------------|---------------------------------------|
| 2% strain | | |
| Minimum isotropic stiffness ratio | 0.60 | ASTM D 6637 ^(a) |
| Aperture size. | 0.5 to 2 in. | Internal Dimension Measuring Calipers |
| Minimum junction efficiency | 90% | ASTM D 6637/D 7737 |
| (a) Ratio between minimum and maximum values of radial stiffness at 0.5% strain, measured on rib and midway between rib directions. | | |

4196.01, B, 6, Bridge Abutment Backfill Fabric.

Replace Table 4196.01-6:

Table 4196.01-6: Fabric for use in Bridge Abutment Backfill

| Property | Value | Test Method |
|--|------------------------------------|-------------|
| Tensile Strength (at 5% Strain), minimum | 1356 lbs/ft | ASTM D 4595 |
| Apparent opening size (AOS), maximum | US Sieve #40 | ASTM D 4751 |
| UV resistance (at 500 hours) | 70% retained strength | ASTM D 4355 |
| Flow Rate, maximum minimum | 18 20 10 gal./min./ft ² | ASTM D 4491 |

Appendix.

Appendix.

Replace the Aggregate Gradation Table:

| Grad. No. | Section No. | Std. Sieve Sz. | TABLE 4109.02-1: AGGREGATE GRADATION TABLE | | | | | | | | | | | Notes | | | |
|-----------|--|---------------------------------|---|--------|--------|--------|------|--------|--------|-------|-------|-------|-------|-------|--|-------|-----------|
| | | | 1 1/2" | 1.00" | 3/4" | 1/2" | 3/8" | 4 | 8 | 30 | 50 | 100 | 200 | | | | |
| | | Intended Use | Percent Passing | | | | | | | | | | | | | | |
| 1 | 4110, 4125, 4133, 4134 | PCC FA, Cover Agg. | | | | | | | 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 | | | 0-5 | | | | | | | 0-1.5 | 2, 10 |
| 4 | 4115 (2-8) | PCC CA | 100 | 50-100 | 30-100 | 20-75 | | | 0-5 | | | | | | | 0-1.5 | 10 |
| 5 | 4115 (67, 2-8) | PCC CA | | 100 | 90-100 | | | | 0-5 | | | | | | | 0-1.5 | 10 |
| 6 | 4115-06 4115.05 (Repair & Overlay) | PCC CA | | | 100 | 90-100 | | | 0-30 | | | | | | | 0-1.5 | 10 |
| 7 | 4117 (Class V) | PCC FA & CA | 100 | | | | | | 80-92 | 20-40 | | | | | | | |
| 8 | 4117.03 (Class V) | Fine Limestone | | | | | | 100 | 90-100 | | | | | | | 0-30 | |
| 9 | 2556 | Grout Aggregate | | | | 100 | | 85-100 | | | | | | | | 0-1.5 | |
| 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 |
| 13a | 4122.02 (Cr. St.) | Macadam St. Base | 3" nominal maximum size screened over 3/4" or 1.00" screen. | | | | | | | | | | | | | | |
| 13b | 4122.02 | Macadam Choke St. | 100 | | | | | | | | | | | | | 6-16 | 11 |
| 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 | | | 0-30 | | | | | | | 0-1.5 | 11 |
| 20 | 4125 (1/2" Scr. Gr.) | Cover Aggregate | | | 100 | 95-100 | | | 0-15 | 0-7 | | | | | | 0-1.5 | 11 |
| 21 | 4125 (3/8") | Cover Aggregate | | | | 100 | | | 10-55 | 0-20 | 0-7 | | | | | 0-1.5 | 11 |
| 22 | 4124 | Fine Slurry Mixture | | | | | | | 85-100 | 40-95 | 20-60 | 14-35 | 10-25 | | | 5-25 | 9, 11 |
| 23 | 4124 (Cr. St.) | Coarse Slurry Mixture | | | | | | | 70-90 | 40-70 | 19-42 | | | | | 5-15 | 11 |
| 29 | 4131 | Porous Backfill | | | 100 | 95-100 | | | 0-50 | 0-8 | | | | | | | 11 |
| 30 | 4132.02 (Cr. St.) | Special Backfill | 100 | | | | | | | 10-40 | | | | | | 0-10 | 5, 11, 14 |
| 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 | | | | | | | | | | | | | | |
| 35 | 4134 (Natural Sand/Gr.) | Floodable Backfill | 100 | | | | | | | 20-90 | | | | | | 0-4 | 11 |
| 36 | 4134 (Natural Sand) | Floodable Backfill | | | | | | | 100 | | | | | | | 0-2 | 11 |
| 37 | 2320 (Quartzite/Granite/Slag) | Polymer-Modified Microsurfacing | | | | | | 100 | 90-100 | 65-90 | 30-50 | 18-30 | 10-21 | | | 5-15 | 12, 13 |
| 38 | 2320 (limestone/Dolomite) | Polymer-Modified Microsurfacing | | | | | | 100 | 70-90 | 45-70 | 15-35 | 10-25 | 5-20 | | | 5-15 | 12, 13 |

Notes: (Gradations No. 9, 15, 16, 17, 18, 24, 25, 26, 27, 28, 33, and 34 have been deleted)

1. 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.
2. 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.
3. When compaction of material is a specification requirement, the minimum percent passing the No. 200 sieve is 6%.
4. See specifications for combination of gravel and limestone.
5. 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.
6. The gradation requirement for the No. 8 sieve shall be 5% to 20% when recycled material is supplied.
7. 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.
8. Crushed stone shall have 100% passing the 1½" sieve.
9. 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.
10. Maximum of 2.5% passing the No. 200 sieve allowed if for crushed limestone or dolomite when documented production is 1% or less.
11. 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.
12. For Quartzite/Granite/Slag: 45% to 70% passing No. 16 Sieve; for Dolomite/Limestone: 25% to 50% passing No. 16 Sieve.
13. Percent passing shall not go from the high end to the low end of the range for any two consecutive screen.
14. If the material meets the quality requirements of Article 4120.04, a maximum of 14% passing the No. 200 sieve will be allowed.