MINUTES
OF
IOWA DOT SPECIFICATION COMMITTEE MEETING

November 14, 2024

Members Present:	Christy Vanbuskirk	Fairfield RCE
	Mark Dunn	Contracts & Specifications Bureau
	Daniel Harness	Design Bureau
	Eric Johnsen, Chair	Contracts & Specifications Bureau
	Wes Musgrove	Construction & Materials Bureau
	Dillon Feldmann	Local Systems Bureau
	Scott Nixon	District 1 – DCE
	Kimball Olson	Bridges & Structures Bureau
	Willy Sorenson	Traffic & Safety Bureau
Members Not Present:	Charlie Purcell	Project Delivery Division
	Bob Welper	District 2 – Materials
Advisory Members Present:	Darwin Bishop	FHWA
	Josh Stott	FHWA
	Ryan Weidemann	Hamilton County
	Bryan Horesowsky	Muscatine County
	Ben Hucker	Maintenance Bureau
	Cedric Wilkinson	Construction & Materials Bureau
	Danny Wegener	Civil Rights Bureau
	Matthew Gordy	Bridges & Structures Bureau

The Specification Committee met on Thursday, November 14, 2024, at 9:00 a.m. Eric Johnsen, Specifications Engineer, opened the meeting. The items were discussed in accordance with the revised agenda dated November 6, 2024.

1. Article 1102.17, E, 2, Proposals with Established DBE Goals.

The Civil Rights and Contracts and Specifications Bureaus requested to add the DBE distributor designation and clarify the submittal of the DBE commitment form.

2. Article 1105.03, A, Working Drawings.

The Construction and Materials Bureau requested to add language from the BSB shop drawing review stamp so that it can be shortened and more easily placed on each sheet.

3. Article 1107.08, Public Convenience and Safety.
Article 1108.02, K, 3, Accelerated Work Schedule.

The Specifications Section requested to clarify that a standard work day starts 30 minutes after sunrise and ends 30 minutes before sunset and also that any incentive is grounds for an accelerated schedule.

4. **Article 2303.03, D, 3, b, 1, Production Control.**

The Construction and Materials Bureau requests to revise a couple incorrect references.

5. **Article 2301.03, H, 4, a, 1.**
Article 2303.03, D, 6, e, Smoothness (Flexible Pavement).
Article 2428.04, A, 2.
Article 2428.04, B, 3.

The Local Systems and Construction and Materials Bureaus requested to update the smoothness criteria for PCC pavement, flexible pavement, and bridge decks.

6. **Article 2303.03, E, 4, b, Lab Voids (Flexible Pavement).**

The Construction and Materials Bureau requested to make the article easier to read and clarify that PWL will not apply for lab voids for small quantities.

7. **Article 2405.03, H, 2, a, Bridge Bearings.**

The Construction and Materials Bureau requested to specify grout manufacturers recommendations since they can vary.

8. **Section 4160, Wood Preservatives.**
Section 4161, Preservative Treatment.
Article 4163.02, A, Treated Timber and Lumber.
Article 4165.04, D, Preservative Treatment (Timber Piles).

The Construction and Materials; and Contracts and Specifications Bureaus requested to update the preservative treatment specifications to stay current.

9. **SS-23004, Project Management.**

The Construction and Materials Bureau requested approval of updates to the Supplemental Specifications for Project Management.

10. **DS-23026, Alternate Acceptance of HMA for Local Systems Projects.**

The Construction and Materials Bureau requested approval of updates to the Developmental Specifications for Alternate Acceptance of HMA for Local Systems Projects.

11. **DS-23027, Quality Management Concrete (QM-C).**

The Construction and Materials Bureau requested approval of updates to the Developmental Specifications for Quality Management Concrete (QM-C).

12. **DS-23054, Multicomponent Liquid Pavement Markings.**

The Construction and Materials and Maintenance Bureaus requested approval of updates to the Developmental Specifications for Multicomponent Liquid Pavement Markings.

13. **DS-XXXXX, Pavement Marking Installation Record.**

The Construction and Materials and Maintenance Bureaus requested approval of Developmental Specifications for Pavement Marking Installation Record.

14. DS-XXXXX, Mobile Reflectometer Measurements.

The Construction and Materials and Maintenance Bureaus requested approval of Developmental Specifications for Mobile Reflectometer Measurements.

15. DS-XXXXX, Integral Thin Veneer Brick for Structural Concrete.

The Bridges and Structures Bureau requested approval of Developmental Specifications for Integral Thin Veneer Brick for Structural Concrete.

16. DS-XXXXX, Intermediate Foundation Improvements.

The Specifications Section requested approval of Developmental Specifications for Intermediate Foundation Improvements.

17. DS-23058, Intelligent Transportation Systems.

The Specifications Section requested approval of updates to the Developmental Specifications for Intelligent Transportation Systems.

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SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Mark Dunn/Eric Johnsen	**Bureau/Office:** Contracts & Specifications	**Item 1**
Submittal Date: 10/17/2024	**Proposed Effective Date:** April 2025	
Article No.: 1102.17, E, 2 **Title:** Proposals with Established DBE Goals	**Other:**	

Specification Committee Action: Approved as recommended.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 4/15/2025

Specification Committee Approved Text: See Specification Section Recommended Text.

Comments: None.

Specification Section Recommended Text:

1102.17, E, 2, b.

Replace Article 7, add the Article, and **renumber** subsequent Article:

7) If the DBE firm is being used as a supplier (in which case, only 60% of the dollars paid to the DBE firm will count toward the DBE commitment), ~~and~~

8) If the DBE firm is being used as a distributor (in which case, only 40% of the dollars paid to the DBE firm will count toward the DBE commitment), and

~~8~~ **9)** The "DBE Commitment" of each DBE firm which will be counted towards the total DBE commitment for the contract.

1102.17, E, 2, d.

Replace the first sentence:

On contracts let through the Department, the form shall be submitted with the electronic bidding software authorized by the Department. On other contracts, ~~T~~the completed form shall be computer generated and submitted with the bidding documents.

Comments:

Member's Requested Change: (Do not use '**Track Changes**', or '**Mark-Up**'. Use ~~**Strikeout**~~ and **Highlight**.)

Reason for Revision: Clarify the submittal of DBE commitments and add "distributor" as a DBE function that will count towards the goal.

New Bid Item Required (X one)	**Yes**	**No** X
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X

Comments:

County or City Comments:
Industry Comments:

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SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove/Kyle Frame	**Bureau/Office:** Construction and Materials	**Item 2**
Submittal Date: 10/22/2024	**Proposed Effective Date:** April 2025	
Article No.: 1105.03, A **Title:** Working Drawings	**Other:**	

Specification Committee Action: Approved as recommended.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 4/15/2025

Specification Committee Approved Text: See Specification Section Recommended Text.

Comments: None.

Specification Section Recommended Text:

1105.03, A.

Replace the Article:

The plans shall be supplemented by such working drawings as are necessary to adequately control the work. Working drawings shall be furnished by the Contractor, as required by the contract documents. When required, the working drawings shall be accompanied by engineering calculations furnished by the Contractor, that substantiate the details of the working drawings. When certification by a Professional Engineer licensed in the State of Iowa is required, the certification shall be in the appropriate branch of engineering, for the work specified in the contract documents. Working drawings may include shop drawings of fabricated materials, erection plans, falsework plans, cofferdam plans, or other supplemental plans or data. The Contracting Authority's review of working drawings shall not constitute validation or endorsement of the Contractor's means or methods of construction. The Contracting Authority's review of shop drawings covers only requirements for strength and arrangement of component parts as relevant to the permanent works. Any deviation from the plans or specifications not clearly noted by the Contractor has not been reviewed. Review by the Contracting Authority shall not serve to relieve the Contractor of the contractual responsibility or any error, omission, or deviation from the contract requirements. The Contracting Authority ~~assumes no responsibility for errors or omissions in the Contractor's working drawings and~~ assumes the Contractor will use material complying with requirements of the contract documents or, where not specified, those of sound and reasonable quality, and will construct the subjects of such working drawings in accordance with recognized standards of first quality work or, when specified, in accordance with standards of the contract documents. If unanticipated and either unusual or complex construction procedures or site conditions occur, the Engineer may require the Contractor to submit such working drawings as, in the judgment of the Engineer, are necessary to satisfactorily control or complete the proposed construction. Prior to the Engineer's written acceptance of required working drawings, any work done or material ordered shall be at the Contractor's risk.

Comments:

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)**

1105.03 WORKING DRAWINGS.

A. The plans shall be supplemented by such working drawings as are necessary to adequately control the work. Working drawings shall be furnished by the Contractor, as required by the contract documents. When required, the working drawings shall be accompanied by engineering calculations furnished by the Contractor, that substantiate the details of the working drawings. When certification by a Professional Engineer licensed in the State of Iowa is required, the certification shall be in the appropriate branch of engineering, for the work specified in the contract documents. Working drawings may include shop drawings of fabricated materials, erection plans, falsework plans, cofferdam plans, or other supplemental plans or data. The Contracting Authority's review of working drawings shall not constitute validation or endorsement of the Contractor's means or methods of construction. The Contracting Authority's review of shop drawings covers only requirements for strength and arrangement of component parts as relevant to the permanent works. Any deviation from the plans or specifications not clearly noted by the Contractor has not been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility or any error, omission or deviation from the contract requirements. The Contracting Authority ~~assumes no responsibility for errors or omissions in the Contractor's working drawings and~~ assumes the Contractor will use material complying with requirements of the contract documents or, where not specified, those of sound and reasonable quality, and will construct the subjects of such working drawings in accordance with recognized standards of first quality work or, when specified, in accordance with standards of the contract documents. If unanticipated and either unusual or complex construction procedures or site conditions occur, the Engineer may require the Contractor to submit such working drawings as, in the judgment of the Engineer, are necessary to satisfactorily control or complete the proposed construction. Prior to the Engineer's written acceptance of required working drawings, any work done or material ordered shall be at the Contractor's risk.

Reason for Revision: Language was removed from the Bridge and Structures Bureau (BSB) shop drawing review stamp and added to the specification language to make the BSB review stamp smaller. This will allow the stamp to more easily be placed on each page of the shop drawing instead of just the cover sheet. This helps field staff when the shop drawing sheets are separated from the lager submittal.

New Bid Item Required (X one)	**Yes**	**No** X
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X
Comments:		
County or City Comments:		
Industry Comments:		

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SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Eric Johnsen	**Bureau/Office:** Specifications	**Item 3**
Submittal Date: 10/29/2024	**Proposed Effective Date:** April 2025	
Article No.: 1107.08 **Title:** Public Convenience and Safety **Article No.:** 1108.02, K, 3 **Title:** Accelerated Work Schedule	**Other:**	

Specification Committee Action: Approved with changes.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 4/15/2025

Specification Committee Approved Text:

1107.08, Public Convenience and Safety.

Replace Article D and **renumber** the following Articles:

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 provide instructions for handling traffic through the work area.

E. Unless otherwise stated in the contract documents or allowed by the Engineer, all work shall be performed by the Contractor between the hours of 30 minutes after sunrise to 30 minutes before sunset.

~~**E**~~ **F.**
~~**F**~~ **G.**
~~**G**~~ **H.**
~~**H**~~ **I.**
~~**I**~~ **J.**
~~**J**~~ **K.**
~~**K**~~ **L.**
~~**L**~~ **M.**
~~**M**~~ **N.**
~~**N**~~ **O.**

1108.02, K, 3.

Replace the Article:

The proposal form may specify a completion bonus or incentive for early completion. An accelerated work schedule, as provided in this article, is allowed for work necessary to earn the bonus or incentive.

Comments:

Specification Section Recommended Text:
1107.08, Public Convenience and Safety.

Replace Article D and **renumber** the following Articles:

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 provide instructions for handling traffic through the work area.

E. 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**~~ **F.**
~~**F**~~ **G.**
~~**G**~~ **H.**
~~**H**~~ **I.**
~~**I**~~ **J.**
~~**J**~~ **K.**
~~**K**~~ **L.**
~~**L**~~ **M.**
~~**M**~~ **N.**
~~**N**~~ **O.**

1108.02, K, 3.

Replace the Article:

The proposal form may specify a completion bonus or incentive for early completion. An accelerated work schedule, as provided in this article, is allowed for work necessary to earn the bonus or incentive.

Comments:

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)**

Reason for Revision: To clarify that all work is to be performed from 30 minutes after sunrise to 30 minutes before sunset, even if there are no affects to traffic.
Also, to clarify that an incentive is also grounds for an accelerated schedule.

New Bid Item Required (X one)	**Yes**	**No** X
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X
Comments:		
County or City Comments:		
Industry Comments:		

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SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove / John Hart	**Office:** Construction and Materials	**Item 4**
Submittal Date: October 2024	**Proposed Effective Date:** April 2025	
Article No.: 2303.03 D. 3. b. 1 **Title:** Production Control	**Other:**	

Specification Committee Action: Approved as recommended.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 4/15/2025

Specification Committee Approved Text: See Specification Section Recommended Text.

Comments: None.

Specification Section Recommended Text:

2303.03, D, 3, b, 1.

Replace the Article:

After the JMF is established, the combined aggregate gradation furnished for the project, asphalt binder content, asphalt film thickness, and lab~~oratory 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~~ Lab 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.

Comments:

Member's Requested Change: (Do not use **'Track Changes'**, or **'Mark-Up'**. Use ~~**Strikeout**~~ and **Highlight**.)

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~~ lab 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~~ Lab 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.

Reason for Revision: Incorrect reference to laboratory voids and field laboratory air voids when consistent and common terminology of lab voids should be used.

New Bid Item Required (X one)	**Yes**	**No**
Bid Item Modification Required (X one)	**Yes**	**No**
Bid Item Obsoletion Required (X one)	**Yes**	**No**

Comments:

County or City Comments: Not submitted to local agencies as clerical changes only.

Industry Comments: Not submitted to industry as clerical changes only.

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SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Dillon Feldmann	**Office:** Local Systems	**Item 5**
Submittal Date: 10/23/2024	**Proposed Effective Date:** April 2025	
Article No.: 2301.03, H, 4, a, 1 **Title:** Smoothness (PCC Pavement) **Article No.:** 2303.03, D, 6, e **Title:** Smoothness (Flexible Pavement) **Article No.:** 2428.04, A, 2 **Title:** Bumps (Smoothness of Bridge Decks and Bridge Deck Overlays) **Article No.:** 2428.04, B, 3 **Title:** Dips (Smoothness of Bridge Decks and Bridge Deck Overlays)	**Other:**	

Specification Committee Action: Approved as recommended.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 4/15/2025

Specification Committee Approved Text: See Specification Section Recommended Text.

Comments: A county engineer asked how the Engineer is supposed to check the 1/2 inch in 25 feet. The Construction and Materials Bureau indicated that if the Contractor is not willing to check, that the District may be able to assist in check the smoothness.

Specification Section Recommended Text:

2301.03, H, 4, a, 1.

Replace the Article:

Periodically check the pavement longitudinally with a ~~10 foot~~ straightedge. ~~The surface is not to deviate from a straight line by more than 1/8 inch in 10 feet.~~

a. The Engineer may determine and identify irregularities of 1/2 inch or more in 25 feet longitudinally.

b. Correct the irregularities identified by the Engineer.

2303.03, D, 6, e, Smoothness.

Replace the Article:

1) Apply Section 2317 to HMA surface mixture bid items of a Primary project or when specifically required for other projects.

2) On all projects, the Engineer may determine and identify irregularities of 1/2 inch or more in 25 feet longitudinally. Correct the irregularities identified by the Engineer in accordance with Section 2317.

2428.04, A, 2.

Replace the Article:

Corrected bumps will be considered satisfactory when profilograph measurement shows that the bumps were ~~0.3~~ 0.5 inch or less in a 25 foot span.

2428.04, B, 3.

Replace the Article:

Corrected dips will be considered satisfactory when the profilogram shows the dips are less than ~~0.3~~ 0.5 inch in a 25 foot span.

Comments:

Member's Requested Change: (Do not use '**Track Changes**', or '**Mark-Up**'. Use ~~**Strikeout**~~ and **Highlight**.)

2301.03, H

4. Smoothness.

a. Construct the pavement to have a smooth riding surface within the following tolerances:

1) Periodically check the pavement longitudinally with a ~~10 foot~~ straightedge. ~~The surface is not to deviate from a straight line by more than 1/8 inch in 10 feet.~~

a. The Engineer may determine and identify irregularities of 1/2 inch or more in 25 feet longitudinally.

b. The contractor shall correct areas over 1/2 inch in 25 feet identified by the Engineer.

2) If slip form methods are used, the 6 inches nearest the edge may exceed the 1/8 inch tolerance, but is not to exceed 1/2 inch deviation in 10 feet.

3) Where abutting pavement is to be placed adjacent to the pavement being checked, the surface is not to deviate by more than 1/4 inch when checked 1 inch from the edge with:
A 3 foot straightedge used transversely, and
A 10 foot straightedge used longitudinally.

b. Apply Section 2317 to all PCC Pavement bid items of a Primary project or when specifically required for other projects.

2303.03, D, 6

e. Smoothness.

1) Apply Section 2317 to HMA surface mixture bid items of a Primary project or when specifically required for other projects.

2) When Section 2317 is not 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 2317.04, F, 2, or apply a price adjustment.

2428.04 BUMPS AND DIPS.

Bumps and dips, including those at headers, on all surfaces for which smoothness is designated will be evaluated.

A. Bumps.

1. Correct all bumps exceeding 0.5 inch within a 25 foot span, as indicated on the profilogram, except as stated in Article 2428.04, C.

2. Corrected bumps will be considered satisfactory when profilograph measurement shows that the bumps were 0.~~3~~5 inch or less in a 25 foot span.

B. Dips.

1. 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 $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.

2. A dip in both wheel paths at a lane location will be considered a single dip when assessing a price adjustment.

3. Corrected dips will be considered satisfactory when the profilogram shows the dips are less than 0.~~35~~ inch in a 25 foot span.

Reason for Revision: Recent conversations with industry led this office to believe that the 1/8” in 10’ could be too difficult to obtain.
In the Jan. 2024 meeting we revised 2303.03, D, 6, e to remove references to 2316 and to delete a reference that was stated to be redundant as it was already in 2317. I assume that I missed this as 2317 is automatically applied on Primary projects, but it is not on Local projects.

With the removal of manual trace reduction, if the bump is less than 0.5” it should be acceptable.

New Bid Item Required (X one)	**Yes**	**No**
Bid Item Modification Required (X one)	**Yes**	**No**
Bid Item Obsoletion Required (X one)	**Yes**	**No**
Comments:		
County or City Comments:		
Industry Comments:		

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SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove/ Brian Johnson	**Bureau/Office:** CMB	**Item 6**
Submittal Date: 10/25/2024	**Proposed Effective Date:** April 2025	
Article No.: 2303.03, E, 4, b **Title:** Lab Voids (Flexible Pavement)	**Other:**	

Specification Committee Action: Approved as recommended.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 4/15/2025

Specification Committee Approved Text: See Specification Section Recommended Text.

Comments: None.

Specification Section Recommended Text:
2303.03, E, 4, b, Lab Voids.

Replace the Article:

1) 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.

2) 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.

3) PWL for lab voids will not apply to small quantities.

Comments:

Member's Requested Change: (Do not use '**Track Changes**', or '**Mark-Up**'. Use ~~**Strikeout**~~ and **Highlight**.)

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.~~

1) 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.

2) 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. **3)** PWL for lab voids will not apply to small quantities.		
Reason for Revision: The old version was hard to read. It did not clearly state that PWL will not apply for lab voids for small quantities.		
New Bid Item Required (X one)	**Yes**	**No** x
Bid Item Modification Required (X one)	**Yes**	**No** x
Bid Item Obsoletion Required (X one)	**Yes**	**No** x
Comments:		
County or City Comments:		
Industry Comments:		

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SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove/Kyle Frame	**Bureau/Office:** Construction and Materials	**Item 7**
Submittal Date: 10/22/2024	**Proposed Effective Date:** April 2025	
Article No.: 2405.03, H, 2, a **Title:** Bridge Bearings	**Other:**	

Specification Committee Action: Approved as recommended.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 4/15/2025

Specification Committee Approved Text: See Specification Section Recommended Text.

Comments: None.

Specification Section Recommended Text:

2405.03, H, 2, a, Anchor Bolts Set in Drilled Holes.

Replace Articles 2 and 3 and add the Article:

2) When hydraulic cement grout is used, use one that meets the requirements of Materials I.M. 491.13. ~~Make the diameter of the hole 1/2 inch larger than the bolt diameter. Slightly overfill the annular space with grout.~~

3) When polymer grout is used, use one meeting the requirements of Materials I.M. 491.11. ~~Make the diameter of the hole 1/8 inch larger than the bolt diameter. Fill the annular space with the grout according to the manufacturer's recommendations and limitations, as approved by the Engineer.~~

4) Use a concrete hole diameter and hole filling procedure according to the grout manufacturer's recommendations.

Comments:

Member's Requested Change: (Do not use '**Track Changes**', or '**Mark-Up**'. Use ~~**Strikeout**~~ and **Highlight**.)

2. Bridge Bearings.

Unless otherwise specified in the contract documents, set anchor bolts to be embedded in concrete in drilled holes. Set them prior to the time the concrete is placed, when specified in the contract documents.

a. Anchor Bolts Set in Drilled Holes.

1) In clean, dry holes accurately set anchor bolts for bridge bearings perpendicular to the plane of the bridge seat. Vary the locations of anchor bolts in relation to slotted holes in expansion shoes to compensate for the temperature of the structure. Adjust the nuts on anchor bolts at the expansion bearings of spans to permit movement of the span with changes in temperature. Set anchor bolts with a hydraulic cement or polymer grout.

2) When hydraulic cement grout is used, use one that meets the requirements of Materials I.M. 491.13. ~~Make the diameter of the hole 1/2 inch larger than the bolt diameter. Slightly overfill the annular space with grout.~~

3) When polymer grout is used, use one meeting the requirements of Materials I.M. 491.11. ~~Make the diameter of the hole 1/8 inch larger than the bolt diameter. Fill the annular space with the grout according to the manufacturer's recommendations and limitations, as approved by the Engineer.~~

4) Use a concrete hole diameter and hole filling procedure according to the approved grout manufacturer's recommendations.		
Reason for Revision: Different grout manufacturers recommend different hole diameters for their products.		
New Bid Item Required (X one)	**Yes**	**No** X
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X
Comments:		
County or City Comments:		
Industry Comments:		

Form 510130 (07-24)

IOWA | DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Jeff Devries/Eric Johnsen	**Bureau/Office:** CMB and CSB	**Item 8**
Submittal Date: 10/17/2024	**Proposed Effective Date:** April 2025	
Section No.: 4160 **Title:** Wood Preservatives **Section No.:** 4161 **Title:** Preservative Treatment **Article No.:** 4163.02, A **Title:** Treated Timber and Lumber **Article No.:** 4165.04, D **Title:** Preservative Treatment (Timber Piles)	**Other:**	

Specification Committee Action: Approved as recommended.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 4/15/2025

Specification Committee Approved Text: See Specification Section Recommended Text.

Comments: None.

Specification Section Recommended Text:
4160, Wood Preservatives.

Delete the Article:

~~**Section 4160. Wood Preservatives**~~

~~**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).~~

4161, Preservative Treatment.

Replace the Section:

4161.01 GENERAL REQUIREMENTS.
Meet the requirements of applicable sections within these specifications for preservative treatment of timber, lumber, piling and posts. Unless specified otherwise, meet the requirements of this section for treatment process and results.

4161.02 PRESERVATIVES.
Meet the requirements ~~of Section 4160~~ for the material specified and all Federal, State, and local regulations. Unless specified otherwise, treatment may be with any of the preservatives listed.

A. Creosote.
Meet the requirements of AASHTO M 133 (AWPA P1/P13, P2, and P3).

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 P34 and 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 and P62).

G. Other EPA-Registered and AWPA-Standardized Wood Preservative Pesticides.
Meet the requirements of AASHTO M 133. Including but not limited to: inorganic boron/borates (AWPA P25, P51 and P60), alkaline copper quat (AWPA P26, P27, P28 and P29), copper azole (AWPA P32 and P48), copper HDO (AWPA P33), oxine copper (AWPA P37), 4,5-dichloro-2-N-octyl-4-isothiazolin-3-one (DCOI) (AWPA P39), tebuconazole (AWPA P41), propiconazole (AWPA P42) and propiconazole tebuconazole imidacloprid (AWPA P45 and P47).

4161.03 TREATMENT.

A. Except as provided herein, follow the requirements and recommendations of AWPA Standards U1 and T1 and the applicable AWPA Commodity Specifications listed in Tables 4161.03-1 and 4161.03-2 for various materials and usages~~:~~. All preservatives covered in Article 4161.02, G, but not specifically listed in Table 4161.03-1 or 4161.03-2, shall be treated according to the Minimum Preservative Retention Requirements in AWPA U1.

Table 4161.03-1: Minimum Preservative Retention Requirements (lb./cu. ft. of wood)

	Retention

Material and Usage	Creosote[a]	PCP-A[a]	CuN[a,b]	ACZA[b]	CCA[b,c]	MCA[b,c]	AWPA UC-Section-Special Req.
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	0.5	0.06	0.4	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.

Table 4161.03-2: Minimum Preservative Retention Requirements
~~**inches of wood and/or % of sapwood penetration**~~

	Penetration[4](inches of wood and/or % of sapwood penetration)		
Material and Usage	**Southern Pine**	**Douglas Fir**	**AWPA Material Standard Section**
Lumber and Timber for Structures[a]	AWPA U1, T1	AWPA U1, T1	AWPA U1, T1
Piles for Foundation:	3.0 in. or 90%	0.75 in. and 85% up to 1.6 in. and 85%	T1-8.5
Guardrail Posts and Spacer Blocks:			
Sawed Four Sides	2.5 in. or 85%	**Under 5 in. thick:** 0.4 in. and 90% **5 in. and thicker:** 0.5 in. and 90%	T1-8.1
Fence, Guide, and Sign Posts:			
Round	2.0 in. or 85%	3/8 in. and 100% up to 1 in. or 85%	T1-8.2
Sawed Four Sides	2.5 in. or 85%	**Under 5 in. thick:** 0.4 in. and 90% **5 in. and thicker:** 0.5 in. and 90%	T1-8.1

[a] Penetrations based on AWPA Use Category and Commodity Specifications for different applications.

B. Meet the following requirements for other aspects of the treatment process:

1. Incising.
Incise Coastal Douglas Fir lumber.

2. Seasoning.
a. ~~When sawed material is treated with waterborne preservatives (ACZA, CCA), ensure the moisture content prior to treatment, as determined by resistance type moisture meter, is no more than 20% if kiln dried or no more than 23% if air dried.~~

~~b. Measure moisture content at a depth equivalent to the required penetration up to a maximum of 1.5 inches.~~

~~c.~~ After treatment, unless specified otherwise, dry all lumber that is 2 inches or less in nominal thickness and is treated with a waterborne preservative. Dry the lumber to a moisture content of no more than 20% if kiln dried or no more than 23% if air dried.

~~3. Special Treatment for Guardrail and Sign Posts Treated With Oil Type Preservative.~~ ~~Before removing sign and guardrail posts from the treatment cylinder, further subject them to live steam at a maximum pressure of 13 psi. Following that, subject the posts to an additional period of vacuum to ensure that the surface of the wood is free from accumulation of oil type preservative.~~

~~4~~ 3. **Method of Treatment.**

~~a.~~ Use same preservative for all of the product furnished for each contract item or order.

~~b. Unless specified otherwise, use the empty cell process with initial air pressure for creosote, pentachlorophenol, or copper naphthenate treatments.~~

~~c. Use the full cell process for ACZA and CCA treatments.~~

~~5~~ 4. **Results of Treatment.**

a. Ensure retention and penetration of preservatives complies with Tables 4161.03-1 and 4161.03-2, unless specified otherwise.

b. Use the assay method to determine preservative retentions.

c. Ensure other treatment requirements are in accordance with AWPA Standards U1 and T1 and the applicable AWPA Specifications listed in Tables 4161.03-1 and 4161.03-2.

~~6~~ 5. **Handling Treated Products.**

Follow AWPA Standard M4 regarding care and handling of preservative treated wood products. 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.

~~7~~ 6. **Product Marking.**

a. Ensure individual pieces of inspected, treated material bear a legible identification mark that is either hammer or heat branded, die stamped, or metal tagged. For material treated with waterborne preservatives, the identification mark may be ink stamped provided the information is clearly visible and legible. Ensure the identification mark, as a minimum, indicates the treater, the species of wood, the preservative treatment type, and the retention level. Acceptable brands or marks are to be similar to the general guidelines for brands listed in AWPA M1 and M6.

b. Ensure all treated wood material that requires a grade, with the exception of 45 inch Terminal Posts[1], displays a quality grade mark of an accredited grade monitoring and inspection agency approved under the American Lumber Standards Committee (ALSC).

[1] In the event that Terminal Posts 45 inches in length to be used for Guardrails cannot be stamped with a quality grade mark due to sizing of material, ensure Terminal Posts are instead stamped "MFG No. 1" to indicate that the Terminal Posts were cut from an original piece graded as a No. 1. Wane requirements will be waived.

c. Material less than 3 feet in length does not require a grade mark; however, ensure a statement from the mill/processor certifying the grade of the material is provided. See Documentation Section of Materials I.M. 462. Round wood posts, round wood piles, and round wood poles do not require a grade, since the grading rules apply only to sawn material.

d. Ensure each bundle of treated wood products has at least one plastic tag identifying the charge number for the bundle.

~~8~~ 7. **Inspection.**
Furnish white and treatment inspections, certifications, and test reports for each shipment according to Materials I.M. 462.

4163.02, A.

Replace the Article:

Unless specified otherwise, treat only Douglas Fir (coast region)~~, Northern Pine,~~ and Southern Pine.

4165.04, D, Preservative Treatment.

Replace the first sentence:

~~Creosote, pentachlorophenol, or copper naphthenate t~~Treatment complying with Section 4161.

Comments:

Member's Requested Change: (Do not use **'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.**)

Reason for Revision: Review was done by the Treated Wood Council for any inconsistencies or updates needed.

New Bid Item Required (X one)	**Yes**	**No** X
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X
Comments:		
County or City Comments:		
Industry Comments: Revisions came from an industry group.		

Form 510130 (02-24)

IOWA | DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove/ Cedric Wilkinson	**Bureau/Office:** Construction and Materials Bureau	**Item 9**
Submittal Date: Tues Oct 29, 2024	**Proposed Effective Date:** 2/18/2025	
Article No.:	**Other:** SS-23004, Project Management	

Specification Committee Action: Approved with changes.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 2/18/2025

Specification Committee Approved Text: See attached Developmental Specifications for Project Management.

Comments: The Construction and Materials Bureau requested to add a certification statement to the SS.

Specification Section Recommended Text: See attached Draft Developmental Specifications for Project Management.

Comments:

Member's Requested Change: (Do not use '**Track Changes**', or '**Mark-Up**'. Use ~~**Strikeout**~~ and **Highlight**.)

23004.01 DESCRIPTION.
The Contractor shall provide a Project Manager to perform project management responsibilities as described in this Supplemental Specification.

23004.02 COORDINATION OF SUBCONTRACTORS.
The Project Manager shall be on the project at the beginning of each phase of work to be performed by a subcontractor. The Project Manager shall coordinate the work of each subcontractor working on the project and shall ensure that the subcontractor understands the scope of work required by the contract documents.

23004.03 COMMUNICATION WITH THE ENGINEER.
The Project Manager shall be responsible for communicating requests for information regarding details of the contract with the Engineer.

23004.04 DOCUMENTATION OF ITEM PROGRESS.

A. The Project Manager, or designated representative, shall take and record item measurements and perform calculations to determine pay quantities for invoicing work performed. A second person shall check these calculations to verify they are correct. The items shall be measured as defined in the Method of Measurement specified for each item. The measurements shall be accurate to the nearest 0.1 unit unless otherwise specified in the contract documents.

B. As a minimum, the following information shall be included for all item quantity records and measurements:

Information needed for all measurement methods –
- Project Number.
- Proposal Line No Item Code, and Division.

- Date the work was performed.
- Name of contractor/subcontractor performing the work.
- Location of the work.
- Measured quantity.
- ~~Calculations made to arrive at the quantity~~

~~Remarks and/ or supporting sketch as needed to clearly define the work performed and quantity measured~~

- ~~Names of persons measuring the work and person double checking records~~
- Name of person doing the measurements
- Name of person that completed the calculations and initial check.
- Name of person that checked the calculations.
- Drawing/Map of area measured.
- Identification of whether the measurement is interim or final.
- Signed certification statement by the persons taking the measurements, performing the calculations, and submitting them for payment that the measurement and calculations are correct.

Information needed for mechanical measurements – (Measuring Wheel, Tape, etc.)

- Calculations (Show your work, e-sheet if applicable that have formulas)
- If first put into a paper field book, the field book needs to be with the project records.
- Calculations made to arrive at the quantity

Information needed for GPS measurements –

- GPS needs to be accurate within 0.1'; this does not include a Phone or Tablet without an external GPS device.
- ASCII comma delineated file of the coordinates formatted as (Point Number, Northing, Easting, Elevation, Point Description, Feature Code).
- Identify coordinate system used.

Information needed for UAS (Drone) measurements –

- Name of Drone Pilot registered with the FAA -
- If applicable Name of Visual Observer
- Drone Software used to create the Model
- Drones make and model
- Provide the raw data export Lidar Aerial Survey (LAS)
- Physical location on the ground with known measurement using other methods.
- Minimum one independent check per flight and Maximum of one every 3,000' per independent check

C. The Contracting Authority will make available the item forms that shall be used for recording item progress. The Contractor may submit alternative forms to the Engineer for approval.

D. When the method of measurement requires weighing or volume measurement in the hauling vehicle, the Project Manager, or designated representative, shall collect the scale tickets and record the location and placement of the material. The Project Manager shall furnish the original truck scale tickets and a signed, written summary of the delivery of the material to the Engineer at the end of each working day.

E. For lump sum items, the records shall support invoiced progress payments for pay estimates.

F. Unless otherwise specified, the item measurement shall be made when the work is in place and complete. When the work is not complete, the item measurement records shall be submitted as interim measurements.

G. The quantities submitted for payment by the Project Manager shall not include measurements for quantities of work performed outside the scope of work included in the contract without written authorization from the Engineer. The Project Manager shall not submit quantities of work performed to establish or remove plant sites, storage areas, or temporary areas used for Contractor operations.

H. Project Manager shall submit item measurement records to the Engineer on a weekly basis, or before subsequent work prevents verification of completed quantities, whichever occurs first.

I. When the quantity of work required for an item exceeds the contract quantity, the Project Manager shall notify the Engineer, in writing, that extra work is being performed. The notification shall include the location and an estimate of the quantity of extra work.

J. When extra work, as defined in Article 1109.03, B, of the Standard Specifications, is required, the Project Manager shall notify the Engineer, in writing, of the project number, quantity, contractor that will perform the work, and proposed cost settlement of extra work prior to beginning work. Project Manager and Engineer must agree on quantity and cost before extra work is performed. For unusual circumstances, Contractor may proceed with work upon verbal agreement. The Engineer will issue a change order within 7 working days of the agreement. Contractor shall promptly return the signed change order to ensure prompt payment for extra work.

K. The Project Manager and Engineer shall agree on a tracking system that will ensure mutual agreement on the status of all change orders.

L. The Engineer will randomly select quantities for verification. If discrepancies between quantities furnished by the Project Manager and verified by the Engineer occur, Project Manager and Engineer must reconcile differences before payment is processed. The Project Manager shall arrange to have the items in question remeasured and resubmitted if it is determined the original measurement included unacceptable or incomplete quantities of work. In the event the Project Manager, or designated representative, repeatedly fails to perform measurements as required, the Engineer will measure all quantities, and reduce final payment for the item, Project Management.

M. If the Engineer withholds quantities for payment, the Project Manager will be provided the details, quantity, and reason for withholding payment. The Project Manager shall correct all deficiencies that have resulted in the withholding of payment within 2 weeks.

23004.05 SUBMISSION OF MATERIAL APPROVAL DOCUMENTATION.
Project Manager shall maintain a Material Approval Record. This record shall include all material approval documentation as required for the basis of acceptance by Materials I.M. 204 except for material approved by visual inspection or tests performed by the Engineer. This includes certification statements for all certified materials incorporated in the project. For materials approved by brand name from an approved source, the Project Manager, or designated representative, shall document the brand name, producer, quantity, and appropriate Materials I.M. for the material incorporated. Copies of these documents shall be provided to the Engineer when reporting item progress for progress payments.

23004.06 FALSE STATEMENTS.

The Contractor shall inform all personnel performing project management activities of the following provisions regarding the falsification of reports and certifications:

- FHWA 1273, IX False Statements;
- Iowa Code 714.8, Subsection 3, Fraudulent Practices; and
- Article 1102.03, C, 5, of the Standard Specifications; Imposition of Increase in Bidder Qualification Requirements, Suspension, and Disqualification.

23004.07 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.

A. The Lump Sum price for Project Management shall be full compensation for coordinating, communicating, measuring, recording, and submitting the required documentation for all projects on the contract. Final payment may be reduced for failure to perform these requirements.

B. Progress payments for this item will be made at the same rate as the percent of work completed.

Reason for Revision: Updating the items needed for quantity records and measurements. This is needed to clarify what type of measurement tool, Tape Measure, measuring wheel, Survey Grade GPS and Drones. This will help both the contractor and RCE staff establish a clear understanding of what is needed when submitting measured items for payment.

New Bid Item Required (X one)	**Yes**	**No** X
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X
Comments:		
County or City Comments:		
Industry Comments:		

SS- 23007
(Replaces SS-23004)

SUPPLEMENTAL SPECIFICATIONS
FOR
PROJECT MANAGEMENT

Effective Date
February 18, 2025

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SUPPLEMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23007.01 DESCRIPTION.
The Contractor shall provide a Project Manager to perform project management responsibilities as described in this Supplemental Specification.

23007.02 COORDINATION OF SUBCONTRACTORS.
The Project Manager shall be on the project at the beginning of each phase of work to be performed by a subcontractor. The Project Manager shall coordinate the work of each subcontractor working on the project and shall ensure that the subcontractor understands the scope of work required by the contract documents.

23007.03 COMMUNICATION WITH THE ENGINEER.
The Project Manager shall be responsible for communicating requests for information regarding details of the contract with the Engineer.

23007.04 DOCUMENTATION OF ITEM PROGRESS.

A. The Project Manager, or designated representative, shall take and record item measurements and perform calculations to determine pay quantities for invoicing work performed. A second person shall check these calculations to verify they are correct. The items shall be measured as defined in the Method of Measurement specified for each item. The measurements shall be accurate to the nearest 0.1 unit unless otherwise specified in the contract documents.

B. As a minimum, the following information shall be included for all item quantity records and measurements~~:~~.

1. Information needed for all measurement methods:
- Project number.
- Proposal line ~~no~~ item code~~,~~ and division.
- Date the work was performed.
- Name of contractor~~/subcontractor~~ performing the work.
- Location of the work.
- Measured quantity.

- ~~Calculations made to arrive at the quantity~~
- ~~Remarks and/ or supporting sketch as needed to clearly define the work performed and quantity measured~~
- ~~Names of persons measuring the work and person double checking records~~
- Name of person doing the measurements.
- Name of person that completed the calculations and initial check.
- Name of person that checked the calculations.
- Drawing/map of area measured.
- Identification of whether the measurement is interim or final.
- Signed certification statement ~~by the persons taking the~~ to be placed with measurements~~, performing the calculations, and submitting them for payment that the measurement and calculations are correct~~.

_____,	_____,
(Name)	*(Name)*
_____ *of*	_____ *of*
(Title)	*(Title)*
_____	_____
(Company)	*(Company)*

I hereby certify that the measurements, calculations, checks, and verifications made herein are, to the best of my knowledge and belief, a true representation of field work completed according to the contract documents, and all documentation with measurements, calculations, and supporting files is attached.

Dated _____ */s/* _____

Dated _____ */s/* _____

2. Information needed for mechanical measurements (measuring wheel, tape, etc.):
- Calculations (show your work, e-sheet if applicable that have formulas).
- If first put into a paper field book, the field book needs to be with the project records.
- Calculations made to arrive at the quantity.

3. Information needed for GPS measurements:
- GPS needs to be accurate within 0.1 feet; this does not include a phone or tablet without an external GPS device.
- ASCII comma delineated file of the coordinates formatted as (point number, northing, easting, elevation, point description, feature code).
- Identify coordinate system used.

4. Information needed for drone (UAS) measurements:
- Name of UAS pilot registered with the FAA.
- If applicable name of visual observer.
- Drone Software used to create the model.
- Drones make and model.
- Provide the raw data export lidar aerial survey (LAS).
- Physical location on the ground with known measurement using other methods.
- Minimum one independent check per flight with a maximum of 3000 feet per independent check.

C. The Contracting Authority will make available the item forms that shall be used for recording item progress. The Contractor may submit alternative forms to the Engineer for approval.

D. When the method of measurement requires weighing or volume measurement in the hauling vehicle, the Project Manager, or designated representative, shall collect the scale tickets and record the location and placement of the material. The Project Manager shall furnish the original truck scale tickets and a signed, written summary of the delivery of the material to the Engineer at the end of each working day.

E. For lump sum items, the records shall support invoiced progress payments for pay estimates.

F. Unless otherwise specified, the item measurement shall be made when the work is in place and complete. When the work is not complete, the item measurement records shall be submitted as interim measurements.

G. The quantities submitted for payment by the Project Manager shall not include measurements for quantities of work performed outside the scope of work included in the contract without written authorization from the Engineer. The Project Manager shall not submit quantities of work performed to establish or remove plant sites, storage areas, or temporary areas used for Contractor operations.

H. Project Manager shall submit item measurement records to the Engineer on a weekly basis, or before subsequent work prevents verification of completed quantities, whichever occurs first.

I. When the quantity of work required for an item exceeds the contract quantity, the Project Manager shall notify the Engineer, in writing, that extra work is being performed. The notification shall include the location and an estimate of the quantity of extra work.

J. When extra work, as defined in Article 1109.03, B, of the Standard Specifications, is required, the Project Manager shall notify the Engineer, in writing, of the project number, quantity, contractor that will perform the work, and proposed cost settlement of extra work prior to beginning work. Project Manager and Engineer must agree on quantity and cost before extra work is performed. For unusual circumstances, Contractor may proceed with work upon verbal agreement. The Engineer will issue a change order within 7 working days of the agreement. Contractor shall promptly return the signed change order to ensure prompt payment for extra work.

K. The Project Manager and Engineer shall agree on a tracking system that will ensure mutual agreement on the status of all change orders.

L. The Engineer will randomly select quantities for verification. If discrepancies between quantities furnished by the Project Manager and verified by the Engineer occur, Project Manager and Engineer must reconcile differences before payment is processed. The Project Manager shall arrange to have the items in question remeasured and resubmitted if it is determined the original measurement included unacceptable or incomplete quantities of work. In the event the Project Manager, or designated representative, repeatedly fails to perform measurements as required, the Engineer will measure all quantities, and reduce final payment for the item, Project Management.

M. If the Engineer withholds quantities for payment, the Project Manager will be provided the details, quantity, and reason for withholding payment. The Project Manager shall correct all deficiencies that have resulted in the withholding of payment within 2 weeks.

23007.05 SUBMISSION OF MATERIAL APPROVAL DOCUMENTATION.
Project Manager shall maintain a Material Approval Record. This record shall include all material approval documentation as required for the basis of acceptance by Materials I.M. 204 except for material approved by visual inspection or tests performed by the Engineer. This includes certification statements

for all certified materials incorporated in the project. For materials approved by brand name from an approved source, the Project Manager, or designated representative, shall document the brand name, producer, quantity, and appropriate Materials I.M. for the material incorporated. Copies of these documents shall be provided to the Engineer when reporting item progress for progress payments.

23007.06 FALSE STATEMENTS.

The Contractor shall inform all personnel performing project management activities of the following provisions regarding the falsification of reports and certifications:

- FHWA 1273, IX False Statements;
- Iowa Code 714.8, Subsection 3, Fraudulent Practices; and
- Article 1102.03, C, 5, of the Standard Specifications; Imposition of Increase in Bidder Qualification Requirements, Suspension, and Disqualification.

23007.07 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.

A. The Lump Sum price for Project Management shall be full compensation for coordinating, communicating, measuring, recording, and submitting the required documentation for all projects on the contract. Final payment may be reduced for failure to perform these requirements.

B. Progress payments for this item will be made at the same rate as the percent of work completed.

Form 510130 (08-15)

IOWA DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove/Brian Johnson	**Office:** CMB	**Item 10**
Submittal Date: 9/30/2024	**Proposed Effective Date:** January 2025	
Article No.: **Title:**	**Other:** DS-23026, Alternate Acceptance of HMA for Local Systems Projects.	

Specification Committee Action: Approved as recommended.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 2/18/2025

Specification Committee Approved Text: See attached Developmental Specifications for Alternate Acceptance of HMA for Local Systems Projects

Comments:

Specification Section Recommended Text: See attached Draft Developmental Specifications for Alternate Acceptance of HMA for Local Systems Projects

Comments:

Member's Requested Change: (Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)
See Attachment

Reason for Revision: Not needed and incorrect table referenced.

New Bid Item Required (X one)	**Yes**	**No** X
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X

Comments:

County or City Comments:

Industry Comments:

DS-23067
(Replaces DS-23026)

DEVELOPMENTAL SPECIFICATIONS
FOR
ALTERNATE ACCEPTANCE OF HMA FOR LOCAL SYSTEMS PROJECTS

Effective Date
February 18, 2025

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

This Specification becomes void on federal aid contracts. Apply requirements of Article 2303 of the Standard Specifications unless otherwise stated.

2303.03, D, 6, a, Lab Voids.

Replace the Article:

~~Use the following method of acceptance for laboratory voids:~~

~~a)~~ For mixture bid items not defined as small quantities in Article 2303.03, A, 2, b, 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.

~~For mixture bid items not defined as small quantities in Article 2303.03, A, 2, b, of the Standard Specifications, acceptance for laboratory voids will be based on a moving absolute average deviation (AAD) from target as defined in Materials I.M. 501. Use the production tolerance in Table 2303.03-5.~~

2303.03, D, 6, b 1, d, 2.

Replace the first paragraph of the Article:

For all other areas of Class I compaction, determine PWL as defined in Materials I.M. 501. The PWL upper limit shall be 91.5% of G_{mm} (8.5% voids). Use maximum specific gravity (G_{mm}) results in field voids calculations as follows:

2303.05, A, 3, b, 1.

Replace the Article:

Payment when PWL is used for acceptance:

PWL	Pay Factor
80.0 –100.0	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.

Form 510130 (08-15)

IOWA DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove/ Todd Hanson	**Office:** Construction & Materials	**Item 11**
Submittal Date: October 2, 2024	**Proposed Effective Date:** January 2025	
Article No.: **Title:**	**Other:** DS-230027, Quality Management Concrete (QM-C)	

Specification Committee Action: Approved as recommended.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:**

Specification Committee Approved Text: See attached Developmental Specifications for Quality Management Concrete (QM-C).

Comments:

Specification Section Recommended Text: See attached Draft Developmental Specifications for Quality Management Concrete (QM-C).

Comments:

Member's Requested Change: (Do not use '**Track Changes**', or '**Mark-Up**'. Use ~~**Strikeout**~~ and **Highlight**.)

See attached DS. Change max w/c ratio to 0.435.

Reason for Revision: The new Type IL and IT cements tend to have a slightly higher water demand. Contractors expressed concerns bumping up against the max water to cement ratio of 0.42. This increase to 0.435 max w/c ratio is similar to changes made to HPC-D mixes for the same reason.

New Bid Item Required (X one)	**Yes**	**No** X
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X

Comments:

County or City Comments:

Industry Comments: Discussion item at CQI meeting with ICPA on October 1, 2024

DS- 23068
(Replaces DS-23027)

DEVELOPMENTAL SPECIFICATIONS FOR QUALITY MANAGEMENT CONCRETE (QM-C)

Effective Date
January 22, 2025

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23068.01 DESCRIPTION.

A. This specification identifies a concrete mixture design with an optimum combined aggregate gradation, and the Contractor's testing and quality control responsibilities. Optimization of the aggregates should produce concrete with low water requirement as well as improved workability and finishing characteristics. While concrete strength is important and is measured, it is not the basis for optimization of the concrete mixture design.

B. Testing and quality control apply to all Contractor produced concrete using the Concrete Design Mixture (CDM). The CDM applies to mainline slip form pavement. At the Contractor's option, the CDM may apply to any other slip form paving.

23068.02 MATERIALS.

For all materials, meet the quality requirements for the respective items in Division 41 of the Standard Specifications. Compatibility of all material combinations is the Contractor's responsibility based on acquired field experience with proposed materials.

23068.03 CONCRETE DESIGN MIXTURE.

A. An Iowa DOT PCC Level III Certified Technician is responsible for the development of the CDM. Develop a CDM based on a unit volume of 1.000 according to industry standard practice, and containing proportions of materials, including admixtures. Base the proportions upon saturated surface dry aggregates to produce a workable concrete mixture meeting the constraints of Table DS-23068.03-1:

Table DS-23068.03-1: Concrete Mixture Constraints

Nominal Maximum Coarse Aggregate Size	Greater than or equal to 1 inch
Gradation	Materials I.M. 532
Cementitious Content	Minimum, 560 pounds per cubic yard*
Fly Ash Substitution Rate	See Article 2301.02, B, 6
Water/Cementitious Ratio	Maximum, ~~0.42~~ 0.435
Air Content	6% ± 1%, Design Absolute Volume = 0.060

	28 Day Flexural Strength, Third Point	Minimum, 640 pounds per square inch
*	The minimum cement content assumes the use of Type I/II cement with a specific gravity of 3.14 for an absolute volume of 0.106. If cement other than Type I/II is used, use an absolute volume of 0.106 and determine the weight of cement from the specific gravity of the cement. Cement content may need to be increased to maintain the water to cementitious ratio during hot weather conditions.	

B. Develop a target combined gradation in Zone II for each CDM based on normal production gradations and the relative percentages of each individual aggregate. Submit Form 955QMC to aggregate producer(s) to ensure individual gradations used are acceptable. Limit the percent passing the No. 200 sieve to no more than 1.5% for the combined aggregate gradation. When the coarse aggregate used meets the increase in percent passing the No. 200 sieve, according to Section 4109, Aggregate Gradation Table, Note 10 of the Standard Specifications, limit the percent passing the No. 200 sieve to no more than 2.0% for the combined aggregate gradation.

C. Contractor may use water reducing admixture, Type A, or water reducing and retarding admixture, Type D, in the CDM.

23068.04 MIX DESIGN DOCUMENTATION.
At least 7 calendar days prior to the start of paving, submit a CDM report to the District Materials Engineer for approval on Iowa DOT form. Contract extensions will not be allowed due to inadequate or additional CDMs.

23068.05 QUALITY CONTROL.

A. General.

1. The Contractor is responsible for quality control of the concrete. An Iowa DOT PCC Level II Certified Technician is required to oversee quality control operations. The individual conducting the testing on grade is required to be an Iowa DOT PCC Level I Certified Technician. Calibrate and correlate testing equipment prior to and during paving operations.

2. At least 7 calendar days prior to the preconstruction conference, submit to the Engineer a Quality Control Plan complying with Materials I.M. 530. Include the proposed mix design(s) with the Quality Control Plan. Do not begin paving until the plan is reviewed for compliance with the contract documents. Maintain equipment and qualified personnel to direct and perform all field quality control sampling and testing necessary to:
- Determine the various properties of the concrete governed by the contract documents, and
- Maintain the properties described in this specification.

B. Quality Control Testing.

1. Perform all quality control tests necessary to control the production and construction processes applicable to this specification and as set forth in the Quality Control Plan. Take samples for quality control testing in a random manner according to the prescribed sampling rate. Perform the tests listed in Table DS-23068.05-1:

Table DS-23068.05-1: Quality Control Table

	Limits	Testing Frequency	Test Methods
Unit Weight (Mass) of Plastic Concrete	Monitor for changes, ± 3%	Twice/day	AASHTO T 121
Gradation Combined % Passing	See Paragraph 2 below	1/1500 cubic yard	Materials I.M. 216, 301, 302, 531

Aggregate Moisture Contents	See Materials I.M. 527	1/1500 cubic yard	Materials I.M. 308
Air Content Plastic Concrete In Front of Paver	See Article 2301.02, B, 4	1/350 cubic yard 1/100 cubic yard (ready mix)	Materials I.M. 318
Air Content Plastic Concrete In Back of Paver	May be used by Project Engineer to adjust target air in front of paver	2/day for first 3 days and 1/week thereafter (for each paver used)	Materials I.M. 318
Water/Cementitious Ratio	0.42 maximum	Twice/day	Materials I.M. 527
Vibrator Frequency	See Article 2301.03, A, 3, a, 6, a	With Electronic Vibration Monitoring: Twice/day Without Electronic Vibration Monitoring: Twice/Vibrator/Day	Materials I.M. 384

2. Maintain the running average of three combined aggregate gradation tests within the limits established by the CDM target gradation and the working ranges of Table DS-23068.05-2:

Table DS-23068.05-2: CDM Target Gradations

Sieve Size	Working Range
No. 4 or greater	± 5%
No. 8 to No. 30	± 4%
No. 50	± 3%
No. 100	± 2%
minus No. 200	See Article DS-23068.03

C. Corrective Action.

For QM-C mixes only, plot all process control test results on control charts as described in Materials I.M. 530.

1. Aggregate Tests.

Take corrective action when the running average approaches the working range limits. When a combined gradation test result for a sieve exceeds the working range limits, adjust the target and notify the Engineer. If the verification test result for the minus No. 200 exceeds the limits in Article DS-23068.03 for the combined gradation, the material represented by that test for this sieve will be considered non-complying. Price adjustments will be assessed based on Coarseness/Workability Factors as described in Article DS-23068.07, E.

2. Concrete Tests.

Take corrective action when an individual test result approaches the control limits. Notify the Engineer whenever an individual test result exceeds the control limits.

D. Acceptable Field Adjustments.

1. All mix changes must be mutually agreed upon between the Contractor and Engineer. Document all mix changes on the QM-C Mix Adjustment form. Determine batch weights using a basic water cement ratio of 0.40. When the water cement ratio varies more than

±0.03 from the basic water cement ratio, adjust the mix design to unit volume of 1.000. A change in the source of materials or an addition of admixtures or additives requires a new CDM. The following are small adjustments that may be made without a new CDM being required:

- Increase cementitious content.
- Decrease fly ash substitution rate.
- Aggregate proportions may be adjusted from CDM proportions by a maximum of ± 4% for each aggregate.
- Change water reducer to water reducer retarder.
- Adjustment in water reducer or water reducer retarder admixture dosage.
- Change in source of fly ash.
- Change in source of sand, provided target gradation limits are met.

2. When circumstances arise, such as a cement plant breakdown, that create cement supply problems, a change in cement source may be allowed with the Engineer's approval. Consult the District Materials Engineer for approval of other changes to the mix design. A set of three beams for 28 day flexural strength testing may be required to document the changes.

3. Should conditions beyond the Contractor's control prevent completion of the work with the CDM, a Class C mix, or a mix based on Class C mix proportions using project materials, will be allowed, at no additional cost to the Contracting Authority. Mutual agreement between the Contractor and Engineer is required. When Class C mix, or mix based on Class C mix proportions using project materials is allowed it will not be considered in the coarseness and workability lot evaluation.

E. Hand Finished Pavement.
Use project materials based on Class C or Class M concrete mix proportions. With approval of the Engineer, the Contractor's CDM may be used for hand finished pavement. Quality control, as required in this specification, will not apply to hand finished pavement.

23068.06 METHOD OF MEASUREMENT.
Measurement will be as follows:

A. Standard or Slip-Form Portland Cement Concrete Pavement, QM-C.
Square yards shown in the contract documents.

B. Portland Cement Concrete Overlay, QM-C, Furnish Only.
Article 2310.04, A, of the Standard Specifications applies.

C. Portland Cement Concrete Overlay, QM-C, Placement Only.
Article 2310.04, B, of the Standard Specifications applies.

D. Hand Finished Pavement.
Square yards of Standard or Slip-Form Portland Cement Concrete Pavement, QM-C, constructed using Class C or Class M mixtures. For overlays, the Engineer will compute the number of:

- Square yards of Portland Cement Concrete Overlay, QM-C, Placement Only, constructed using Class C or Class M mixtures, and
- Cubic yards of Class C and Class M mixtures used.

23068.07 BASIS OF PAYMENT.
The cost for furnishing labor, equipment, and materials for the work required by the Contractor to design, test, and provide process control for production of QM-C shall be included in the contract unit price for QM-C bid items. Payment will be the contract unit prices as follows:

A. Standard or Slip Form Portland Cement Concrete Pavement, QM-C.
Contract unit price for Standard or Slip-Form Portland Cement Concrete Pavement, QM-C, per square yard.

B. Portland Cement Concrete Overlay, QM-C, Furnish Only.
Article 2310.05, A, of the Standard Specifications applies. Average coarseness and workability factor for each lot will be determined according to Materials I.M. 530.

C. Portland Cement Concrete Overlay, QM-C, Placement Only.
Article 2310.05, B, of the Standard Specifications applies. Average coarseness and workability factor for each lot will be determined according to Materials I.M. 530.

D. Hand Finished Pavement.

1. Standard or Slip-Form Portland Cement Concrete Pavement, QM-C: per square yard.

2. Portland Cement Concrete Overlay, QM-C, Placement Only: per square yard.

3. Portland Cement Concrete Overlay, QM-C, Furnish Only: per cubic yard.

E. Price Adjustment
Failure to provide an optimized gradation within Zone II, when required, will result in the following price adjustments.

Table DS-23068.07-1: Price Adjustments

Gradation Zone (Materials I.M. 532)	Price Adjustment Per Lot
IV	2%
I	5%

Form 510130 (02-24)

IOWA | DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove / Ben Hucker	**Office:** Construction & Materials / Maintenance	**Item 12**
Submittal Date: 11/14/2024	**Proposed Effective Date:** 1/22/2025	
Article No.: **Title:**	**Other:** DS-23054, Multicomponent Liquid Pavement Markings	

Specification Committee Action: Approved as recommended.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:**

Specification Committee Approved Text: See attached Developmental Specifications for Multicomponent Liquid Pavement Markings.

Comments: Ben Hucker will remain the controller of this DS.

Specification Section Recommended Text: See attached draft Developmental Specifications for Multicomponent Liquid Pavement Markings.

Comments:

Member's Requested Change: (Do not use '**Track Changes**', or '**Mark-Up**'. Use ~~**Strikeout**~~ and **Highlight**.)

See gray highlights on the following pages.

Reason for Revision:

23043.03, A.5.: Our earliest multicomponent pavement markings need to be replaced next year and this section is needed to better define our expectations for that operation.

23043.03, A.6.: Added to ensure the quality of all markings, ensure operations are conducted in a safe manner, and provide direction for when field conditions do not match the contract documents.

23043.03, B.1.: Added to better define our expectations for the grooving operation and provide direction for when field conditions do not match the contract documents.

23043.03, C.1.: Added to ensure clarity regarding the type of traffic control required for this work.

New Bid Item Required (X one)	**Yes**	**No** X
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X

Comments:

County or City Comments:

Industry Comments: Presented on October 24, 2024, at the ATSSA Iowa Chapter meeting and industry comments were incorporated into this revision.

DS-23069
(Replaces DS-23054)

DEVELOPMENTAL SPECIFICATIONS
FOR
MULTI-COMPONENT LIQUID PAVEMENT MARKINGS

Effective Date
January 22, 2025

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23069.01 DESCRIPTION.

Provide reflectorized white and yellow multi-component, 100% solids ~~multi-component~~ liquid pavement markings that are free of toxic heavy metals for installation on asphalt and PCC pavement surfaces.

23069.02 MATERIALS.

A. General.

1. Apply multi-component liquid pavement markings in accordance with Article 2527.01 of the Standard Specifications.

2. Use materials capable of producing pavement markings with a wet-film thickness (WFT) of at least 20 mils. Apply at a greater WFT as recommended by the material manufacturer based on pavement type, pavement composition, environmental conditions, placement within a rumble, and other relevant factors. Approved products are listed in Materials I.M. 483.04, Appendix B. The Contractor may propose an equivalent product meeting all requirements of this specification, but the Engineer reserves the right to approve or deny the proposal. Multi-component Polyurea products will not be considered for usage.

3. Provide materials in accordance with the retro reflectivity requirements below.

Table 23069.02-1: Minimum Initial Retroreflectivity Requirements

Minimum Coefficient of Retroreflected Luminance	
White lines~~, Symbols, and Legends~~	400 mcd/sq. m/lux
Yellow lines	250 mcd/sq. m/lux

4. Provide yellow markings distinguishable from white markings in the dark.

5. Mix individual components before use if stored for more than 12 months.

B. Multi-Component Liquid Material.

1. Provide multi-component liquid material meeting the following requirements and

characteristics:

a. Composed only of multi-component liquids and pigments,
b. Does not emit or leach solvents into the environment upon application to a pavement surface,
c. The infrared spectrum for all components shall match the reference sample provided by the manufacturer for the product tested and approved by the Department,
d. Free of lead, cadmium, mercury, hexavalent chromium, and other toxic heavy metals as defined by the EPA,
e. White material no darker than or no yellower than 17778 of Federal Standard Number 595C Colors,
f. Daytime color of the yellow epoxy meeting the following CIE chromaticity limits using illuminant "D65/2":

Table 23069.02-2: Daytime Chromaticity Coordinates

Daytime Chromaticity Coordinates (Corner Points) - Yellow				
	1	**2**	**3**	**4**
x	0.470	0.485	0.520	0.480
y	0.440	0.460	0.450	0.420

g. White daylight directional reflectance (Y) of least 83%,
h. Yellow daylight directional reflectance (Y) of at least 50%,
i. Nighttime color of yellow meeting the following chromaticity limits in ASTM D 6628:

Table 23069.02-3: Nighttime Chromaticity Coordinates

Nighttime Chromaticity Coordinates (Corner Points) - Yellow				
	1	**2**	**3**	**4**
x	0.575	0.508	0.473	0.510
y	0.425	0.415	0.453	0.490

j. Contrast ratio of 0.98 or greater when measured on a black/white drawdown card at 15 mils WFT application rate.

2. Provide shadow lane line markings (legend BLC6) according to Standard Road Plans PM-110 and PM-320. Black epoxy should satisfy color chip 37038 of Federal Standard 595B and have similar quality as the white and yellow multi-component pavement markings. An anti-skid material shall be incorporated with the shadow line marking at a minimum rate of 15 pounds per gallon.

3. Adhesion Capabilities.
Provide material meeting the adhesion requirements of the ACI Committee 403 when tested on PCC. Apply multi-component ~~l~~iquid pavement markings during the test to concrete pavements with a tensile strength of at least 300 psi and ensure the failure of the system occurs in the concrete during testing.

4. Abrasion Resistance.
Provide material with an abrasion resistance wear index no greater than 82 when tested in accordance with ASTM C 501 with a CS 17 wheel under a load of 1000 g for 1000 cycles. The Department defines the wear index as the weight in milligrams of material abraded from the sample under the test conditions.

5. Hardness.
Provide material with a Type D durometer hardness from 75 to 90 when tested in accordance with ASTM D 2240 after curing for 72 hours at 73°F ±4°F.

6. Tensile Strength.
For epoxy-amine based multicomponent systems, including variations of this base chemistry, provide material with a tensile strength of at least 6000 psi when tested in accordance with ASTM D 638 after curing for 72 hours at 73°F ±4°F.

7. Compressive Strength.
For epoxy-amine based multicomponent systems, including variations of this base chemistry, provide material with a compressive strength of at least 12,000 psi when tested in accordance with ASTM D 695 after curing for 72 hours at 73°F ±4°F.

C. Retroreflective Media.

1. Provide first drop wet media per the minimum rate shown for each product below. Use one of the following products for all grooved: edge lines, white broken lines, ramp edge lines, and lane drop lines:
- 3M Connected Roads All Weather Elements Series 70E or 50E: Minimum rate 5 pounds per gallon
- Potters VisiUltra 455: Minimum rate 8 pounds per gallon

2. Provide second drop glass spheres with the following gradation on all lines except for black broken lane lines:

Table 23069.02-4: Utah Blend Gradation

Sieve Size	% Passing
No. 18	65-80
No. 30	30-50
No. 50	0-5

a. Glass spheres shall be dual coated.
b. Apply glass spheres at a minimum rate of 15 pounds per gallon. Application rate shall provide required minimum levels of retro reflectivity in accordance with Table 23069.02-1.

3. Provide beads packaged in moisture-proof, multi-wall shipping bags, and in containers marked with the following information:
a. Manufacturer name,
b. Manufacturer address,
c. Type of treatment,
d. Batch number, and
e. Date of manufacture.

D. Sampling and Testing.

1. Test daylight directional reflectance and color meeting the requirements of ASTM E 1349.

2. Provide 1 pint samples of each manufacturer's lot or batch of material when manufactured to an independent lab for this testing. NTPEP data may be substituted if the product has not changed from initial submittal to NTPEP for evaluation of these products.
3. Submit to the Engineer a manufacturer's Certificate of Compliance for all components of the multi-component liquid pavement marking system.

4. Mark containers with the following information:
a. Name of manufacturer,
b. Product identification number,
c. Lot or batch number,

d. Date of manufacture,
e. Color, and
f. Net weight of contents.

23069.03 CONSTRUCTION.

A. General.

1. The contract documents will specify quantity, locations, and type of pavement markings required.

2. Allowable painting dates will be from April 8th to October 22nd. Minimum pavement surface temperatures for application of pavement markings shall be 40°F and rising.

3. For all pavement markings, ensure pavement surface is dry and free from dirt, dust, oil, curing compound, and other contaminates which may interfere with markings properly bonding to the surface. Ensure the clean surface is at least 1 inch wider than anticipated marking. Shoot an air blast on the pavement surface immediately prior to placing new marking. Air blast is not intended to remove large amounts of dust, but only a very small amount of residue that might be left from removal and cleaning operation.

4. For pavement markings placed on a new asphalt surface, install any necessary temporary pavement markings, and wait a minimum of 2 weeks from the day the surface is completed before installing permanent markings.

5. Remove existing multi-component pavement markings prior to new pavement marking placement by vacuum blasting, vacuum dry grinding, wet grinding, shot blasting, or high-pressure water blasting. Containment is required if open abrasive blasting or dry grinding is utilized. Do not utilize chemical removal methods for removal of the existing marking. It is the intent that existing markings be approximately 90% removed while not creating a groove deeper than 0.080 inches +/- 0.010 inches. Confirm with Engineer that proper removal is achieved prior to new pavement marking placement. If consensus on removal is not confirmed or achieved, consult with manufacturer of the pavement marking to be placed and verify they concur with adequate existing marking removal. Provide this concurrence info to the Engineer prior to beginning new pavement marking placement.

6. Limitations.
a. Complete grooving, existing pavement marking removal, and pavement marking placement in the same direction of travel as traffic is intended to utilize the lanes being worked on. On multi-lane roadways with adjacent lanes open to traffic, do not operate equipment against the flow of traffic.
b. When grooves are present, match existing cycle lengths for all non-continuous lines unless otherwise noted in the plans. If existing cycle lengths are found to differ from those specified in the contract documents by more than 10%, immediately cease work and consult the Engineer for direction.

~~5~~ **7.** Ensure the following for all painted pavement markings:
- Uniform thickness
- Uniform distribution of glass beads throughout the line width,
- Line widths as specified, with a tolerance of ± 1/2 inch for all lines,
- Markings have sharp edges and cutoffs at the ends.

B. Grooving.
1. Perform grooving according to Section 2527.03, H of the Standard Specifications and

Standard Road Plan PM-115.

2. Grooving is intended to provide a recessed surface for placement of the new pavement marking. Grooving is also intended to remove any existing markings where the new installation of pavement markings is to occur. If existing cycle lengths are found to differ from those specified in the contract documents such that the grooving operation does not remove at least 75% of each line segment, immediately cease work and consult the Engineer for direction. Failure to notify the Engineer will result in the removal of excess existing markings being considered incidental to the grooving operation.

C. Traffic Control.
Apply the provisions of Section 2528 of the Standard Specifications to traffic control for removing and placing painted and taped pavement markings, along with the following additional requirements:

1. All work shall take place under static lane closures. Place traffic control devices on the roadway before removal operations have commenced. Leave traffic control devices in place through the completed curing time of the newly applied pavement markings.

2. Do not close any longer length of lane than can be adequately removed and replace in a single working day.

3. For painted pavement markings, do not remove traffic control devices until the newly applied pavement markings are tack free.

D. Final Inspection
Provide an acceptable, calibrated 30-meter geometry (100 feet), retro reflectometer to use on the project which will remain the property of the Contractor. In the presence of the Engineer, measure the retro-reflectivity of the pavement markings. Take a minimum of five randomly spaced readings per line type every 1 mile. The average minimum retro-reflectivity per mile shall be as per table 1 from Article 23069.02, A, 3.

E. Defective Pavement Markings.

1. Markings that are low on initial retro reflectivity up to 20% may, at the discretion of the Engineer, be accepted with a price adjustment.

2. Repair, at no additional cost to the Contracting Authority, all pavement markings which, after application and curing, the Engineer determines to be defective and not in conformance with these specifications. Remove the defective markings completely and clean to the underlying pavement surface according to the requirements of Article 2527.03, C of the Standard Specifications. Remove the defective area plus all adjacent marking material extending 1 foot in any direction. After surface preparation work is complete, finish the repair by reapplying new marking material over the cleaned pavement surface according to the requirements of these specifications.

23069.04 METHOD OF MEASUREMENT.

A. Measurement for pavement markings, pavement markings removed, and grooves cut, satisfactorily placed, removed, or approved, will be as follows:

1. **Painted Pavement Markings, Multi-Component Liquid.**
Stations placed.

2. **Pavement Markings Removed.**
Stations Removed.

~~2~~ 3. Grooves Cut for Pavement Markings.
Stations. This quantity will be equivalent to the number of stations measured for the pavement markings. Additional width and transition length will be incidental.

B. The Engineer will measure the number of stations, based on a single 6 inch width of line. The length of markings will be determined using beginning and ending points, and adjusting for breaks at ramps, station equations, or other locations shown in the contract documents. The measurement for dashed and dotted lines will be adjusted to exclude skips. Measurement of lines wider than 6 inches will be adjusted by the quantity factor to a 6 inch line.

23069.05 BASIS OF PAYMENT.
Painted Pavement Markings, Multi-Component Liquid; Pavement Markings Removed, and Grooves Cut for Pavement Markings will be paid for per Article 2527.05 of the Standard Specifications.

Form 510130 (02-24)

IOWA | DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove / Ben Hucker	**Office:** Construction & Materials	**Item 13**
Submittal Date: 11/14/2024	**Proposed Effective Date:** 1/22/2025	
Article No.: **Title:**	**Other:** DS-XXXXX, Pavement Marking Installation Record	

Specification Committee Action: Approved with changes.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 2/18/2025

Specification Committee Approved Text: See attached Developmental Specifications for Pavement Marking Installation Record.

Comments: The committee decided that paying for this item when it is a mostly automated function of the pavement marking machine would be having two items with the same unit of measure with no discernible separate work involved, which could lead to odd bidding. The bid item was removed and the work will be incidental to the pavement marking being placed.

This DS will be used on multi-component liquid pavement marking projects at first and then expanded to other types of pavement marking work.

Ben Hucker will be the controller of this DS.

Specification Section Recommended Text: See attached draft Developmental Specifications for Pavement Marking Installation Record.

Comments:

Member's Requested Change: (Do not use '**Track Changes**', or '**Mark-Up**'. Use ~~**Strikeout**~~ and **Highlight**.)

See attached new Developmental Specifications for Pavement Marking Installation Record.
Request that Ben Hucker be the controller of this DS.

Reason for Revision: New DS to allow agency review of various pavement marking application data for quality. It will also allow us to begin populating an inventory of our pavement markings in order to better manage this roadway safety feature and meet Federal requirements.

New Bid Item Required (X one)	**Yes** X	**No**
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X

Comments:

County or City Comments:

Industry Comments: Most recently presented on October 24, 2024, at the ATSSA Iowa Chapter meeting and industry comments were incorporated into this revision. The industry has been notified this DS would be coming since at least January of 2024 and has been given the opportunity to review it multiple times. Industry stated they would be ready to begin using this technology within 6 months of the October ATSSA meeting (April 2025), which allows use of this DS during the 2025 construction season.

DS- 23070
(New)

DEVELOPMENTAL SPECIFICATIONS
FOR
PAVEMENT MARKING INSTALLATION RECORD

Effective Date
February 18, 2025

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23070.01 DESCRIPTION.

It is the intent of this specification to gather data on the various pavement markings placed and use this data to make decisions on future pavement marking projects. It is further intended to help Contractors understand what processes and or operations need to be adjusted to assure minimum specification requirements are being met for the various pavement marking types being placed. As marking operations proceed and as quality control of the marking is being checked, the Contractor shall make any adjustments and any tweaks to operations as they deem necessary to assure every reasonable effort is made to meet all minimum specification requirements including retro-reflective values, paint mil thickness, bead application rates and so on for each marking type placed.

23070.02 CONSTRUCTION.

A. General.

1. Under this specification, the Contractor shall provide a record of the pavement marking installation. A Striper Computerized Data Logging System (DLS) for liquid pavement marking material (such as paint or multi component) on projects with at least 1 centerline mile in length shall be utilized to provide the Engineer with a record of the pavement markings placed and pertinent information on material quantities utilized and conditions during placement of the markings. The DLS shall have an onboard monitoring system for the purpose of monitoring the amounts of striping materials being applied to the pavement surface. Collect data for any pavement marking application of 300 feet (driven length) or greater.

2. For all preformed materials (tape and thermoplastic) and liquid pavement markings on projects with less than 1 centerline mile of length, provide data to the Engineer in the format of the Contractors choosing.

B. Equipment.

The DLS Equipment shall be operational, calibrated, and in use during pavement marking operations. Prior to commencing work, provide to the Engineer the DLS manufacturer's recommendations for equipment calibration frequency and provide certification that the equipment meets manufacturer's recommended calibration. Verify that the physical and electronic measurement of distance travelled is consistent by travelling a minimum 100 foot distance prior to

the start of pavement marking operations and submit proof to the Engineer as well.

C. Reporting.

1. DLS files shall provide the following minimum information.
- **a.** Iowa DOT project number.
- **b.** The Highway class (Interstate, US, or IA) and number with the beginning and ending reference points of data collection rounded to the nearest 0.01 mile and the beginning and ending coordinates determined by a GPS receiver with nominal 3 meter accuracy, including the direction of travel in terms of increasing or decreasing reference points.
- **c.** Date and beginning and ending time of application.
- **d.** Product being placed for both marking and retroreflective materials (paint and beads).
- **e.** Lot numbers for products used (paint/multi-component and reflective material).
- **f.** Striping contractor information.
- **g.** The code for the line being read:
  - **1)** LEL – Left edge line
  - **2)** REL – Right edge line
  - **3)** CL – Centerline (yellow line separating traffic flowing in different directions)
  - **4)** XCL – Centerline for a roadway that has two centerlines due to a bidirectional center turn lane or painted median; LCL shall be used for the left centerline and RCL shall be used for the right centerline when facing in the direction of increasing reference points.
  - **5)** LL – Lane line skip
  - **6)** XLL – Lane line skip where X is the lane number for the lane on the left side of the measured line on a section with three or more mainline lanes in the same direction. Lane 1 shall be the left-most lane; the right-most mainline lane will not be used (auxiliary lanes, if present, will be identified as noted below).
  - **7)** AL – Auxiliary lane markings where there is only one auxiliary lane and the line on the left side of the auxiliary lane is the line being measured.
  - **8)** XAL - Auxiliary lane markings where X is the auxiliary lane number for the lane on the right side of the measured line on a section with two or more auxiliary lanes. Lane 1 shall be the left-most auxiliary lane; the right-most auxiliary lane number will not be used as the right line will be read as the right edge line for that segment of roadway.
- **h.** Width of marking applied.
- **i.** Indication of presence of rumble strip or contrast marking (report if majority of line is installed with each characteristic within the segment).
- **j.** Summary of total stations of each marking type placed.

2. The following data shall be reported as an average for each driven mile (or other Engineer approved segment) installed:
- **a.** Application vehicle speed to the nearest 0.1 mph.
- **b.** Weight (pounds) and / or volume (gallons) as measured through a positive displacement pump (mechanism or flow meter) of liquid materials used by color.
- **c.** Weight (pounds) of reflective material used.
- **d.** Ratio of reflective material used (weight) per liquid material used (volume) reported as pounds per gallon.
- **e.** Ambient air temperature (in °F).
- **f.** Road surface temperature (in °F).
- **g.** Humidity (%).
- **h.** Dew point (in °F).
- **i.** The system shall record the average material application rates and film thickness calculated over the section striped.

3. Provide a sample format of the electronic data and summary for Engineer approval at least 2 weeks prior to beginning work on the project.

4. Provide the measurement report in the form of an electronic database file, or delimited text

file, containing all raw data collected. Submit the data to the Maintenance Bureau: Benjamin.hucker@iowadot.us and copy the Engineer. Submit a summary of the report to the Engineer.

23070.03 METHOD OF MEASUREMENT.

None.

23070.04 BASIS OF PAYMENT.

Providing the pavement marking installation record is incidental to the pavement marking being placed and no separate payment will be made.

Form 510130 (02-24)

IOWA | DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove / Ben Hucker	**Office:** Construction & Materials	**Item 14**
Submittal Date: 11/14/2024	**Proposed Effective Date:** 1/22/2025	
Article No.: **Title:**	**Other:** DS-XXXXX, Mobile Reflectometer Measurements (MRM)	

Specification Committee Action: Approved with changes.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 2/18/2025

Specification Committee Approved Text: See attached draft Developmental Specifications for Mobile Reflectometer Measurements.

Comments: The recommended text missed including submission of the raw test results to the Maintenance Bureau.

As originally submitted, the specification required an independent contractor to do the testing. This requirement was removed, as even though a subcontractor may be doing the testing, the only way to make the testing company independent would be for them to be hired by the Contracting Authority. We rely on the Contractor's to provide smoothness testing that they are completing or subbing and still pay based on these numbers, so we believe this should work.

At this time, the testing is for information purposes. We may pay incentive/disincentive based on the testing results in the future.

This DS will be used on multi-component liquid pavement marking projects at first and then expanded to other types of pavement marking work.

Ben Hucker will be the controller of this DS.

Specification Section Recommended Text: See attached draft Developmental Specifications for Mobile Reflectometer Measurements.

Comments:

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)**

See attached new Developmental Specifications for Mobile Reflectometer Measurements.
Request that Ben Hucker be the controller of this DS.

Reason for Revision: New DS to define measurement processes, allow qualitative evaluation of contractor-installed pavement marking products, and allow us to meet new Federal retroreflectivity requirements as required in the 11th Edition of the MUTCD.

New Bid Item Required (X one)	**Yes** X	**No**
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X

Comments:

County or City Comments:

Industry Comments: Most recently presented on October 24, 2024, at the ATSSA Iowa Chapter meeting and industry comments were incorporated into this revision. The industry has been notified this DS would be coming since at least January of 2024 and has been given the opportunity to review it

multiple times.

DS-23071
(New)

DEVELOPMENTAL SPECIFICATIONS
FOR
MOBILE RELECTOMETER MEASUREMENTS

Effective Date
February 18, 2025

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23071.01 DESCRIPTION.

Provide dry retro-reflectivity measurements of longitudinal markings using a vehicle-mounted mobile retro-reflectometer utilizing 30-meter CEN geometry. Retroreflectivity readings shall comply with the requirements of this specification and shall meet the applicable minimum standards established by the FHWA, in addition to the following standards:

- U.S. DOT Retroreflectivity Standards
- MUTCD
- ASTM E 1710 Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
- ASTM E 3320 Standard Test Method for Measurement of Retroreflective Pavement Marking Materials Using a Mobile Retroreflectometer Unit (MRU)

23071.02 CONSTRUCTION.

A. Equipment.

1. The retro-reflectometer shall be calibrated in accordance with the operating manual and calibration guide for each specific machine and vehicle configuration. Measurement shall consist of the average retroreflective readings and standard deviations, as well as contrast ratios, over 0.1-mile intervals (or over the length of the line if shorter than 0.1 mile) for each type of pavement marking placed.

2. Verify the accuracy of traveled distance prior to performing measurements by traveling a known distance and comparing to the systems recorded distance. Provide proof of calibration and distance confirmation to the Engineer, including values and information.

B. Testing.

1. Conduct the evaluation of retro-reflectivity between 14 Calendar Days and 45 Calendar Days after pavement marking installation, prior to snow and ice maintenance operations if possible.

2. Excess beads or reflective elements must not be visible before the retro-reflectivity testing is conducted.

3. Collect the data when pavement and markings are dry, clean and no visible moisture is on the road surface.

4. Measure centerline markings in both directions, except in areas of painted medians or bidirectional turn lanes. Measure centerlines in painted medians and bidirectional turn lanes; and other longitudinal markings in the direction of intended vehicular travel for the adjacent mainline lane.

5. Notify the Engineer at least 1 business day prior to collecting data.

6. Evaluate any replaced or repaired markings per this specification at no additional cost to the Contracting Authority.

C. Reporting.

1. Provide a measurement report that includes:
   - **a.** Iowa DOT project number.
   - **b.** Data collection software name and version.
   - **c.** Date and time of data collection.
   - **d.** The Highway class (Interstate, US, or IA) and number with the beginning and ending reference points of data collection rounded to the nearest 0.01 mile and the beginning and ending coordinates determined by a GPS receiver with nominal 3 meter accuracy, including the direction of travel in terms of increasing or decreasing reference points.
   - **e.** The code for the line being read:
     - **1)** LEL – Left edge line
     - **2)** REL – Right edge line
     - **3)** CL – Centerline (yellow line separating traffic flowing in different directions)
     - **4)** XCL – Centerline for a roadway that has two centerlines due to a bidirectional center turn lane or painted median; LCL shall be used for the left centerline and RCL shall be used for the right centerline when facing in the direction of increasing reference points.
     - **5)** LL – Lane line skip
     - **6)** XLL – Lane line skip where X is the lane number for the lane on the left side of the measured line on a section with three or more mainline lanes in the same direction. Lane 1 shall be the left-most lane; the right-most mainline lane will not be used (auxiliary lanes, if present, will be identified as noted below).
     - **7)** AL – Auxiliary lane markings where there is only one auxiliary lane and the line on the left side of the auxiliary lane is the line being measured.
     - **8)** XAL - Auxiliary lane markings where X is the auxiliary lane number for the lane on the right side of the measured line on a section with two or more auxiliary lanes. Lane 1 shall be the left-most auxiliary lane; the right-most auxiliary lane number will not be used as the right line will be read as the right edge line for that segment of roadway.
   - **f.** The 0.1 mile interval retroreflective reading averages and standard deviations.
   - **g.** The 0.1 mile interval contrast ratio average.
   - **h.** An explanation for any intervals that are marked invalid.
   - **i.** A summary of the average retroreflective readings for each individual run file.
   - **j.** A summary of the average retroreflective readings in 1 mile intervals.
   - **k.** A summary of average retroreflective readings based on 0.1 mile intervals.
   - **l.** A summary of the total distance traveled by the vehicle in feet while taking retroreflective readings.

2. Provide the measurement report in the form of an electronic database file, or delimited text file, containing all raw data collected. Submit the data to the Maintenance Bureau: Benjamin.hucker@iowadot.us and copy the Engineer. Submit a summary in the form of a PDF to the Engineer.

3. Note in the report any areas where the pavement markings are obscured and why they are obscured.

23071.02 METHOD OF MEASUREMENT.

Mobile Reflectometer Measurements will be measured by the length in feet. The linear foot will be measured for the distance travelled by the mobile reflectometer while measuring the retro-reflectivity of the pavement markings. One pass per measured line will be paid except for centerlines which are allotted one pass in each direction for a given line. Deadhead travel or additional distance required to prepare for measurement shall be incidental to the measured line length.

23071.03 BASIS OF PAYMENT.

The contract unit price per foot for the Mobile Reflectometer Measurements includes all costs incurred in materials, equipment, labor, traffic control, and time as required by the Contractor doing the MRM work. Submission of all summaries and measurement reports is included in the contract unit price.

Form 510130 (07-24)

IOWA | DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Michael Nop (Kimball Olson)	**Bureau/Office:** BSB	**Item 15**
Submittal Date: 10-26-2024	**Proposed Effective Date:** 2/18/2025	
Article No.: **Title:**	**Other:** Developmental Specifications for Integral Thin Veneer Brick for Structural Concrete	

Specification Committee Action: Approved as recommended.

Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 2/18/2025

Specification Committee Approved Text: See attached Developmental Specifications for Integral Thin Veneer Brick for Structural Concrete.

Comments: Kimball Olson will be the controller of this DS.

Specification Section Recommended Text: See attached draft Developmental Specifications for Integral Thin Veneer Brick for Structural Concrete.

Comments:

Member's Requested Change: (Do not use '**Track Changes**', or '**Mark-Up**'. Use ~~**Strikeout**~~ and **Highlight**.)
Convert Special Provision to Developmental Specification.

Reason for Revision: The standard template for this work has not substantially changed in the last few years over many affected projects. The qualified product manufacturers listed in the Materials section of the SP have not changed since this SP was first used 14 years ago [SP-090081, Proj. No. BRFN-065-6(42)--39-42]. Preference is to keep the materials listed in a DS rather than creating a new Materials I.M. and MAPLE listing. Typically the only adjustments made to the SP language have been relative to descriptions of mockups, which has been made generic in the attached version. Mockup descriptions are easily shifted to plan notes since that brings them closer to the details.

New Bid Item Required (X one)	**Yes** X	**No**
Bid Item Modification Required (X one)	**Yes**	**No** X
Bid Item Obsoletion Required (X one)	**Yes**	**No** X

Comments: Bid item has been a generic bid item so far, so we will need a standard item.

County or City Comments:

Industry Comments:

DS- 23072
(New)

DEVELOPMENTAL SPECIFICATIONS
FOR
INTEGRAL THIN VENEER BRICK FOR STRUCTURAL CONCRETE

Effective Date
February 18, 2025

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23072.01 Description.
This specification describes the requirements for using integral thin veneer brick and a compatible form liner gasket system for installation within forms for vertical cast-in-place structural concrete and for precast retaining wall panels.

23072.02 MATERIALS.

A. Manufacturers.

1. Thin Veneer Brick Form Liner Gasket System Manufacturers.
Subject to compliance with requirements, provide products by one of the following:
- **a.** Scott System, Inc.
- **b.** Architectural Polymers
- **c.** United Wall Systems
- **d.** Other manufacturers submitted to the Iowa DOT, Bridges and Structures Bureau for review and approval.

2. Thin Veneer Brick Unit Manufacturers.
Subject to compliance with requirements, provide products by one of the following:
- **a.** Metro Brick by Ironrock Capital
- **b.** Summitville Tile Co.
- **c.** Feldhaus Thin Brick
- **d.** Endicott Clay Products Co.
- **e.** Röben Tonbaustoffe
- **f.** Other manufacturers submitted to the Iowa DOT, Bridges and Structures Bureau for review and approval.

B. Thin Veneer Brick Form Liner Gasket Materials.

1. General.
Single or multi-use template system for vertical poured concrete walls and corners. Modular templates formed of styrene plastic or polyurethane to securely surround individual thin veneer brick units, having factory-applied face wax or other bond breaker.

2. Maximum variation from indicated nominal dimensions of brick cavities:
   a. Length: ±1/32 inch.
   b. Height: ±1/32 inch.
   c. Depth: ±1/32 inch.

3. Maximum variation from square, measured diagonally across non-adjacent corners: ±1/16 inch.

4. Coursing: Running bond, stack bond, soldier course, or other coursing as indicated in the plans.

C. Thin Veneer Brick Units.

1. **General.**
   Exterior grade thin brick shall meet the requirements of ASTM C 1088, Type TBX (Select). When the allowable thin brick unit tolerance values indicated by the thin veneer brick form liner gasket system manufacturer's recommendations are different than those specified for Type TBX, the more stringent of the two tolerance requirements shall apply.

2. **Size.**
   Normal (modular) 2 1/4 inches high by 7 5/8 inches wide by 9/16 to 3/4 inch thick. Corner bricks (modular) long side 2 1/4 inches high by 7 5/8 inches wide, short side 2 1/4 inches high by .3 5/8 inches wide. Both sides of corner bricks shall be 9/16 to 3/4 inch thick.

3. **Color and Texture.**
   As indicated in the plans, and subject to approval of submitted samples. All thin veneer brick used in the project shall be from a single production run to ensure color and texture uniformity. Corner bricks (if used) shall match normal bricks in both color and texture.

4. **Back Side Bonding Surface.**
   Back surface to be embedded in concrete shall exhibit ribs or dovetail striations with minimum relief of 5/64 inch.

5. **Bond Breaker.**
   Thin veneer brick units shall have factory-applied face wax or other bond breaker to prevent grout staining of the exposed brick faces. Bond breaker shall be approved for use with the form liner gasket system by the form liner manufacturer.

D. Accessories.

1. Plastic or foam bricks for tie hole locations (if needed), sized to securely fit form liner gasket and to create voids of appropriate dimensions for installation of grouted patch brick units following stripping of forms.

2. Epoxy grout in accordance with manufacturer's recommendations for the setting of patch bricks into defects and tie hole voids. Epoxy grout shall be non-leaching.

3. Other accessories as recommended by the manufacturer.

E. Quality Assurance.

1. **Manufacturer Qualifications.**
   Firm(s) experienced in manufacturing thin veneer brick form liner gaskets and thin veneer brick units similar to those indicated for this project and with a record of successful in-service performance, as well as sufficient production capacity to manufacture required units.
2. **Source Limitations for Form Liner Gaskets.**

Obtain form liner gaskets through one source from a single manufacturer.

3. **Source Limitations for Thin Veneer Brick Materials.**
Obtain thin veneer brick units through one source from a single manufacturer, and from a single production run for the entire Project to ensure color and texture uniformity.

F. Product Delivery, Storage and Handling.

1. Do not use damaged products. Do not install products not bearing product trade name and manufacturer's name.

2. Store all installation materials in manufacturer's unopened packaging in a dry storage area, with ambient temperature between 30˚F and 120˚F until installation. Protect all materials from exposure to sun, rain, dirt and dust until installation.

3. Do not top load or otherwise crush form liners in their packages.

23072.03 CONSTRUCTION.

A. Submittals.
The following shall be submitted to the Engineer for approval.

1. **Product Data.**
Manufacturer's data sheets on each product to be used including:
a. Preparation instructions and recommendations.
b. Storage and handling requirements and recommendations.
c. Installation methods.
d. Cleaning methods following form removal.
e. Patching methods.

2. **Shop Drawings.**
Submit elevation drawings and details that indicate:
a. Horizontal and vertical brick coursing.
b. Alignment of brick coursing to adjacent construction.
c. Corner details (if required).
d. Construction joints.
e. Brick color and texture.
f. Special conditions.

3. **Selection Samples.**
For each finish product specified, one complete set of samples, representative of full range of color and finish for each brick type. Include a written submittal document with the manufacturer and supplier names, brick color name(s) or number(s), and brick finish type(s) listed.

4. **Verification Samples.**
For each finish product specified, two samples, representative of selected range of color and finish for each brick type. Include form liner sample and bond breaker sample applied to full size thin veneer brick, representing bond breaker to be used. Include a written submittal document with the manufacturer and supplier names, brick color name(s) or number(s), and brick finish type(s) listed.

B. Mockups.
Construct mockups meeting the following requirements.

1. **General.**

Construct a concrete mockup panel with the dimensions and features shown in the plans. Mockup is to be located near the jobsite, but shall not become part of the final construction. Use construction methods identical to those intended for final production concrete work. Demonstrate brick void epoxy grout patching method on the mockup. No production integral thin veneer brick work shall proceed until approval of the mockup by the Engineer. Rebuild mockup as required to produce acceptable work.

2. **Additional Requirements.**
   If the first constructed mockup is deemed to be unacceptable by the Engineer, a qualified technical representative of the thin veneer brick form liner gasket system manufacturer or a supplier with at least three years of system installation experience shall be on site during additional mockup construction and review. At the Engineer's request, a qualified technical representative shall also be on site for at least one complete production work cycle of form setup, concrete pouring, stripping, cleaning, and finish patching operations associated with the integral thin veneer.

3. **Mockup Removal.**
   Upon completion of the project, the mockup(s) shall become the property of the Contractor and shall be removed from the site. Precast retaining wall panel mockup(s), if approved for use by the Engineer, may be incorporated into the Project.

C. Forming.

1. Do not begin installation until concrete forms have been properly prepared.

2. No grouted patch brick units are allowed in brick-faced outside surfaces of traffic barriers or any other project element located above traffic lanes. Forms must withstand fluid pressures without the use of ties through the brick surfaces of the barrier.

3. If form ties are necessary within the brick zones indicated in the plans, coordinate location of ties with the form liner gasket system. Ties shall be located only within brick cavities of liner. Adjust position of ties, not form liner, as necessary to avoid conflicts with liner.

4. Coordinate installation of form liner gasket system with installation of required form inserts, rustication strips, construction joints, etc. as shown in the plans.

D. Installation of Form Liner Gasket System.

1. Thoroughly clean form surfaces prior to installation.

2. Prepare, install, and finish form liner gasket system in accordance with manufacturer's recommendations or with guidance from the manufacturer's on-site representative.

E. Installation of Thin Veneer Brick Units.

1. Clean brick pockets free of all foreign material prior to setting thin bricks. Take special care not to damage the form liner gasket system during cleaning.

2. Install thin brick units in accordance with form liner gasket system manufacturers written instructions or with guidance from manufacturer's on-site representative.

3. When more than one color or texture brick is used to create a single-color brick field with variations, mix the different thin brick units prior to installing into gaskets so that color or texture differences are randomly patterned in the finished surface.

4. Ensure that all thin brick units are securely held in form liner gasket system.

5. Remove and replace any individual form liner gasket module that does not securely hold the thin veneer brick. Remove and replace any individual form liner gasket module if the thin brick unit falls out of it for any reason. Remove and replace any individual form liner gasket module if the thin brick is purposely removed from it for any reason.

6. If allowed by the manufacturer, glue may be used to aid in securing thin veneer bricks in place within the form liner gasket system. Use only approved glue as recommended by the manufacturer. Glue is not intended to be a replacement for well-fitting gaskets and properly sized bricks. If glue is used, all residues must be completely removed from finished brick faces during stripping and cleaning operations.

F. Installation Tolerances.

1. Maximum variation in alignment of horizontal or vertical mortar joints: 1/4 inch in 10 feet, non-cumulative.

2. Maximum offset in plane of adjacent form liner units: 1/16 inch.

3. Maximum misalignment between adjacent form liner units: 3/64 inch.

G. Loading of Forms.

Load forms with concrete according to the Standard Specifications and the following:

1. Do not drop concrete directly upon thin veneer brick during loading of vertical concrete forms.

2. Do not touch thin veneer brick with internal vibrators (stingers).

3. Do not externally vibrate forms or strike the outside of forms with heavy objects. Precast panel forms may be externally vibrated if panels are cast horizontally and provided that the thin veneer bricks will not be dislodged from the form liner gasket by the vibratory process used.

4. Take particular care to ensure consolidation of concrete into all joint spaces between thin bricks.

H. Stripping and Cleaning.

1. Remove the form liner gaskets immediately following stripping of the concrete forms. If approved by the form liner gasket system manufacturer, power washing may be used to aid removal of the gaskets from the brick surfaces.

2. Immediately following form stripping and form liner removal, commence power washing of brick surfaces in accordance with the manufacturer's recommendations or with guidance from the manufacturer's on-site representative. Use water pressure and temperature recommended by the manufacturer. Washing operations shall remove all concrete mortar leakage, thin veneer brick face wax or bond breaker, glue, and any remaining form liner gasket components.

3. Do not re-use single-use brick gaskets on the project. Do not re-use any multi-use brick gaskets that are warped, cracked, torn, folded, crushed, or show other signs of damage. Replace any gaskets as directed by the Engineer.

I. Patching (at Abutment and Pier Surfaces Only).

1. Clean and prepare defects, including form tie voids and lost brick zones, if any, in accordance with manufacturer's recommendations or with guidance from the manufacturer's on-site representative. Concrete in any areas from which brick dropped out of form liner gasket prior to or during concrete pour must be carefully chipped out to create a pocket similar to an intentional block-out, and prepared for patch brick installation. Do not damage surrounding brick or concrete during preparation of brick pocket.

2. Securely grout thin veneer bricks into voids using epoxy grout in accordance with manufacturer's recommendations or with guidance from the manufacturer's on-site representative. Tool and finish patched brick grout to blend with surrounding grout lines. Immediately clean any mortar from brick faces before staining can occur.

3. No grouted patch brick units are allowed in brick-faced outside surfaces of traffic barriers or any other project elements located above traffic lanes.

4. **Patch Brick Installation Tolerances.**
   - **a.** Maximum offset of patch brick face to plane of adjacent brick faces: 1/16 inch.
   - **b.** Maximum misalignment of patch brick relative to adjacent bricks: 1/16 inch.
   - **c.** Maximum variation in mortar joints surrounding patch brick: 1/16 inch.

23072.04 METHOD OF MEASUREMENT.
The work of furnishing and installing Integral Thin Veneer Brick will be based on plan quantities in square feet and will not be measured.

23072.05 BASIS OF PAYMENT.
For the number of square feet of Integral Thin Veneer Brick shown in the plans, the Contractor will be paid the contract unit price per square foot. Payment for Integral Thin Veneer Brick shall be full compensation for all materials, labor, tools, equipment, testing, inspection, services, accessories, and incidentals necessary to perform the work of this section. Payment for Integral Thin Veneer Brick shall also include the furnishing of additional thin brick units (if required) for future patching operations.

Form 510130 (07-24)

IOWA | DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Eric Johnsen		**Bureau/Office:** Specifications	Item 16
Submittal Date: 10/28/2024		**Proposed Effective Date:** 2/18/2025	
Article No.: **Title:**		**Other:** DS for Intermediate Foundation Improvements	
Specification Committee Action: Approved as recommended.			
Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 2/18/2025
Specification Committee Approved Text: See attached Developmental Specifications for Intermediate Foundation Improvements.			
Comments: Mark Dell will be the controller of this DS.			
Specification Section Recommended Text: See attached draft Developmental Specifications for Intermediate Foundation Improvements.			
Comments:			
Member's Requested Change: (Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)			
Reason for Revision: To move these specifications from an SP to a DS.			
New Bid Item Required (X one)	**Yes**	**No** X	
Bid Item Modification Required (X one)	**Yes**	**No** X	
Bid Item Obsoletion Required (X one)	**Yes**	**No** X	
Comments: We already have bid items for this work.			
County or City Comments:			
Industry Comments:			

DS- 23073
(New)

DEVELOPMENTAL SPECIFICATIONS
FOR
INTERMEDIATE FOUNDATION IMPROVEMENTS

Effective Date
February 18, 2025

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23073.01 GENERAL.

A. Description.

1. This work includes furnishing the material for and installation of either stone columns or aggregate piers, hereafter collectively denoted as intermediate foundations. The design of the proposed intermediate foundations shall be the responsibility of the Contractor.

2. The primary purposes of the intermediate foundations on this project are to improve global slope stability, improve the underlying soils' bearing capacity, reduce post-construction settlement, and/or increase the time-rate of settlement of the underlying compressible layer(s).

3. The final location and extent of the intermediate foundations shall be determined by the Contractor but shall generally be located under the influence area of the new roadway embankment and MSE walls, as shown in the contract documents (Q sheets), to satisfy the design requirements listed in Article DS-23073.01, B.

B. Design Requirements.

1. The intermediate foundations shall extend through the compressible native soils, hereafter denoted as "soil to be improved". The soils to be improved include, but are not necessarily limited to, soft to medium stiff clays and loose sands.

2. The intermediate foundations shall extend into the underlying soils, hereafter denoted as "foundation soil", which includes stiff to very stiff clays or shale bedrock. Each individual intermediate foundation element shall penetrate a minimum of 2 feet into the foundation soil. Any other material encountered will be classified by the Engineer.

3. It should be noted that subsurface conditions can change abruptly across the site. The Contractor is required to obtain additional subsurface information, including soil borings and water table information, as part of their design of the intermediate foundations, as required to meet the requirements of this section. It is imperative that the surface of the foundation soil is delineated either before or during installation to ensure the intermediate foundations penetrates to the foundation soil layer.

4. After installation of the intermediate foundations, the minimum design criteria for MSE walls, bridge berms, and roadway embankments are:
   a. Bearing capacity: a capacity to demand ratio greater than or equal to 1.0 (i.e., the ratio of strength limit state bearing resistance to the maximum factored load). The estimated minimum required strength limit state bearing resistance for MSE walls is provided in the contract documents (Q Sheets). Final determination of the required strength limit state bearing resistance should be developed in consultation with the MSE wall designer.
   b. Settlement: Settlement criteria applies to areas within the intermediate foundation zones and to the transitions between improved areas and unimproved areas. In areas where more than one criterion applies, the more restrictive settlement tolerance shall control.
      - Settlement of up to 1 inch is tolerable adjacent to bridge structures
      - Settlement of up to 3.6 inches is tolerable below MSE walls
      - Settlement of up to 4.8 inches is tolerable below roadways
      - Differential settlement is limited to 1 inch over 120 feet (i.e., parallel to and perpendicular to the proposed roadway centerline)
   c. Global slope stability: short-term minimum factor of safety of 1.3, long-term minimum factor of safety of 1.5.

C. Method.

1. The Contractor may elect to use either a stone column or aggregate pier intermediate foundation system, based on the soil information provided in the contract documents, additional borings conducted by the Contractor, the Contractor's expertise, and other factors. The Contractor shall be responsible for the design of the intermediate foundation system selected and meeting the performance requirements specified herein. The Contractor shall follow the Specified Construction Sequences listed in the contract documents (Q Sheets).

2. If the Contractor does not possess the capability or expertise to design and/or install the intermediate foundations or they select a system that is considered proprietary, they shall make arrangements to contract the services of a licensed Contractor or other qualified personnel to perform the necessary design and/or installation. All intermediate foundation design documents shall be signed and sealed by a Professional Engineer licensed in the State of Iowa. The procurement of any permits required for the installation of the intermediate foundations, including the disposal of any water or spoils, shall be the sole responsibility of the Contractor.

D. Submittals.

1. Submit the following documents to the Engineer a minimum of 30 days prior to the installation of the intermediate foundation system they have selected, pursuant to Article 1105.03, E of the Standard Specifications:
   a. Evidence of successful installation of the selected intermediate foundation system in the United States on five or more projects under similar conditions using the same proposed installation technique within the last 3 years. The documentation to be submitted includes references for the specific projects. The references consist of the Contracting Authority and Engineer, including names, addresses, and telephone numbers.
   b. Construction drawings showing intermediate foundation locations, depths, and identification numbers. The construction drawings shall follow the Specified Construction Sequences listed in the contract documents (Q Sheets). Construction drawings shall be signed and sealed by a Professional Engineer licensed in the State of Iowa.
   c. A description of the equipment and construction procedures to be used, including a plan to dispose of any water or spoils if applicable.
   d. A proposed verification program, including proposed independent testing agency to be used (see Article DS-23073.01, D, 2).
   e. Certification that the project superintendent possesses a minimum of five years of method specific experience.
   f. The source of the proposed intermediate foundation backfill material(s) and the gradation

and bandwidths the Contractor proposes to use. Upon approval of the backfill source and gradation, the Contractor shall maintain this gradation throughout the intermediate foundation installation.

g. A proposed plan for quality control throughout the installation procedure. This shall address issues such as control and measurement of column or pier diameter, lift thickness, and any other pertinent information. The roles of the Contractor and Engineer shall be defined in the contract documents.

h. Results of overall stability analysis, bearing capacity, anticipated settlements, and other calculations relating to performance of the intermediate foundations. Also include the results of any additional soil borings.

2. Verification Program.

A verification program designed, accomplished, and reported by the Contractor is required to measure the quality of the installed intermediate foundations. The proposed verification program is subject to approval by the Engineer. As a minimum, the verification program shall include the following:

a. Proposed means and methods for verification that design and performance criteria as stated in Article DS-23073.01, B have been satisfied. This may include, but shall not be limited to, modulus or load tests on individual elements and/or groups, soil borings, and other methods as required by the intermediate foundation designer and approved by the Engineer.

b. Quality control program to verify that intermediate foundation elements are installed in accordance with the designer's specifications and the requirements as outlined in this Special Provision. The quality control program shall include testing and/or observations by an independent testing laboratory.

c. Program to monitor performance of the intermediate foundations during and after construction of the bridge berms and roadway embankment. This procedure may include installation of settlement plates, inclinometers, or other instrumentation. Instrumentation installed to monitor performance may also be used to aid in verification that design and performance criteria have been satisfied.

3. Daily Reports.

During construction, submit daily progress reports electronically to the Engineer detailing the following:

a. Stone Columns.

1) Stone column identified by location number.
2) Date constructed.
3) Elevation of top and bottom of each stone column.
4) Average lift thickness.
5) Estimate of ground heave or subsidence.
6) Vibrator power consumption during penetration and compaction of each increment of stone column constructed.
7) Jetting pressure (air or water).
8) Description of soil and groundwater conditions.
9) Details of obstructions, delays, and any unusual ground conditions.
10) Quantity of aggregate placed in each stone column.
11) Amount of water used per column (if applicable).
12) Results of quality control testing.

b. Aggregate Piers.

1) Aggregate pier identified by location number.
2) Date constructed.
3) Elevation of top and bottom of each aggregate pier.
4) Average lift thickness.
5) Description of soil and groundwater conditions.
6) Details of obstructions, delays, and any unusual ground conditions.
7) Quantity of aggregate placed in each aggregate pier.

8) Results of quality control testing.

4. Final Report.
At the completion of the installation of the intermediate foundations, submit a report to the Engineer detailing the equipment and methods used, production rates, the performance of the site during treatment, and that the site meets the criteria established for this project. This report shall include a summary of all verification testing performed.

E. Pre-Construction Conference.

1. A pre-construction conference shall be held at least 5 working days prior to beginning intermediate foundation installation work at the site to discuss construction procedures, personnel, verification program, quality control, and equipment to be used. Those attending shall include:
a. The superintendent, on-site supervisors, independent testing agency representative, and all foremen in charge of intermediate foundation installation operations.
b. The Engineer, key inspection personnel, and representatives of the Contracting Authority.

2. If the Contractor's key personnel change or if the Contractor proposes a significant revision of the approved intermediate foundation installation plan, an additional conference shall be held before any additional work is performed.

F. Basis of Acceptance.
The basis of acceptance for the intermediate foundations will include visual inspection by the Engineer, who will consider results of all verification tests as well as consistent use of procedures, methods, and construction performance rates.

23073.02 MATERIALS.

A. Intermediate foundation system backfill material shall be furnished by the Contractor. Aggregate used for the construction of both stone columns and aggregate piers shall be relatively clean crushed stone, meeting the requirements of Section 4115 of the Standard Specifications for abrasion loss, freeze-thaw durability, and deleterious material content.

B. Gradation for stone columns shall be in accordance with Section 4109, Gradation No. 4 of the Standard Specifications. Gradation for aggregate piers shall be in accordance with Section 4120 and with Section 4109, Gradation No. 11 of the Standard Specifications. However, in the case that the drilled cavity is partially filled with water, the Contractor may furnish a crushed granular material that meets the requirements of Section 4115 and Section 4109, Gradation No. 3 of the Standard Specifications. This Gradation No. 3 material shall be placed to a thickness of approximately two feet above the water level. Gradation for aggregate piers using a displacement or non-drilled system shall meet the requirements of Section 4115 and Section 4109, Gradation No. 3 or No. 5 of the Standard Specifications. Alternative gradations may be considered as part of the submittal process (Article DS-23073.01, D, 1, f).

23073.03 CONSTRUCTION.

A. Procedures.

1. General.
a. The actual construction procedures shall be determined by the Contractor (Article DS-23073.01, D, 1, c). The following are minimum requirements and should be referenced when preparing submittals. The submittal shall include the manufacturer's specifications for the proposed equipment to ensure that it has sufficient capacity to perform the intended function.
b. Grade and level the site as needed for proper installation of the intermediate foundation

system selected, which may include cutting benches into the existing roadway embankment slopes. This work shall be incidental to intermediate foundation installation.

2. **Stone Columns.**
Construct the stone columns in accordance with the contract documents, the Contractor's design plans and the following requirements. Install the stone columns with a down-hole vibrator capable of densifying the aggregate by forcing it radially into the surrounding soil. The vibrator shall be of sufficient size and capacity appropriate to constructing stone columns to the Contractor's design plan diameters and lengths.
   - **a.** The probe and follower tubes shall be of sufficient length to reach the elevations shown on the design plans and approved shop drawings. The probe, used in conjunction with the available pressure to the tip jet, shall be capable of penetrating to the required tip elevation. Pre-boring of silt lenses, layers, or strata, if encountered is permitted.
   - **b.** The probe and follower tubes shall have visible markings at regular increments to enable measurement of penetration and re-penetration depths.
   - **c.** Provide methods for supplying to the tip of the probe a sufficient quantity of air or water to widen the probe hole to allow adequate space for stone backfill placement around the probe. Maintain the flow of air or water from the bottom jet at all times during backfilling to prevent caving or collapse of the hole and to form a clean stone column.
   - **d.** The probe shall penetrate into the foundation soil layer to the minimum depths required in the Contractor's design plans or 2 feet, whichever is deeper.
   - **e.** Lift thickness shall not exceed 4 feet. After penetration to the treatment depth, slowly retrieve the vibrator in 1 foot to 1 1/2 foot increments to allow backfill placement.
   - **f.** Compact the backfill in each lift by re-penetrating it at least twice with the horizontally vibrating probe so as to densify and force the stone radially into the surrounding soil. Re-penetrate the stone in each increment a sufficient number of times to develop an ammeter reading on the motor significantly higher than the freestanding (unloaded) ampere draw on the motor.
   - **g.** Install stone columns so that each completed column is continuous throughout its length.
   - **h.** Removal of subsurface obstructions, if directed by the Engineer, shall be incidental to the intermediate foundation system. Additional elements or replacement elements required due to obstructions shall also be incidental to the intermediate foundation system. Obstructions include but are not limited to boulders, timbers, concrete and utility lines which shall prevent placing the elements to the required depth or shall cause the element to drift from the required location.
   - **i.** Rework and compact any ground heave that is observed prior to retaining wall foundation construction. The depth of soil to be reworked and the degree of compaction required will be determined by the Engineer. Rework and compaction of heaved ground shall be incidental to stone column installation.
   - **j.** Provide a full-time quality control representative to verify all installation procedures.

3. **Aggregate Piers, Drilled System.**
Construct the aggregate piers in accordance with the contract documents, the Contractor's design plans and the following requirements.
   - **a.** The drilled cavity excavation shall be in reasonably close conformity to the limits and construction stages shown on the plans. If temporary casing is needed to limit the sloughing of subsurface soils, insert the casing to at least 2 feet beyond any sloughing strata. Casing of sufficient length should be available on-site during drilling operations. Upon extraction, maintain the bottom of the casing at not more than 1 foot to 2 feet above of level of the backfill.
   - **b.** Removal of subsurface obstructions, if directed by the Engineer, shall be incidental to the intermediate foundation system. Additional elements or replacement elements required due to obstructions shall also be incidental to the intermediate foundation system. Obstructions include but are not limited to boulders, timbers, concrete and utility lines which shall prevent placing the elements to the required depth or shall cause the element to drift from the required location.

c. Backfill placement shall closely follow the excavation of each cavity. Place the backfill in 2 feet thick lifts loose measure. Compact each lift with a high-energy impact tamper to the satisfaction of the Engineer and as recommended in the Contractor's design plans.
d. Provide a full-time quality control representative to verify all installation procedures.

4. Aggregate Piers, Displacement or Non-Drilled System.
Construct the aggregate piers in accordance with the contract documents, the Contractor's design plans and the following requirements.
a. The installed aggregate pier shall be in reasonably close conformity to the limits and construction stages shown on the plans.
b. Removal of subsurface obstructions, if directed by the Engineer, shall be incidental to the intermediate foundation system. Additional elements or replacement elements required due to obstructions shall also be incidental to the intermediate foundation system. Obstructions include but are not limited to boulders, timbers, concrete and utility lines which shall prevent placing the elements to the required depth or shall cause the element to drift from the required location.
c. Place the aggregate pier in 1 foot or 2 foot thick lifts compacted measure, or lift thickness as designed and scheduled in Contractor's design plans. Compact each lift with a high-energy impact tamper to the satisfaction of the Engineer and as recommended in the Contractor's design plans.
d. Provide a full-time quality control representative to verify all installation procedures.

B. Tolerances.

1. Horizontal Control: The center of the completed pier or column shall be within 4 inches of the plan location.

2. Vertical Control: The completed pier or column shall not deviate from the vertical by more than 2 inches in 10 feet.

3. Diameter: The completed pier or column diameter shall not be more than 10% below the plan diameter.
a. If any pier or column falls outside these tolerances, an additional pier or column may be required to be installed at the Contractor's expense.
b. The Engineer may require additional aggregate piers or stone columns at the Contractor's expense if the average effective diameter of any group of 50 consecutively installed piers or columns is less than the plan diameter.

4. Finish top of stone column or aggregate pier to within 3 inches of the proposed foundation subgrade elevation.

23073.04 METHOD OF MEASUREMENT.

A. Intermediate Foundation Improvements will be the lump sum for completed and accepted aggregate piers or stone columns in locations as shown in the contract documents. Backfill and temporary casing will not be measured.

B. Intermediate Foundation Improvements Verification Testing will be the lump sum.

C. For the purpose of subcontracting, Intermediate Foundation Improvements and Intermediate Foundation Improvements Verification Testing will be considered specialty items.

23073.05 BASIS OF PAYMENT.

A. The Contractor will be paid the contract lump sum price for Intermediate Foundation Improvements. This payment shall be full compensation for design, field staking for the location of elements;

drilling, furnishing, transporting, placing and compacting intermediate foundation system backfill and associated work; and full-time quality control. Backfill and temporary casing will not be paid for directly but shall be considered incidental to the intermediate foundation improvements, as per plan.

B. The Contractor will be paid the contract lump sum price for Intermediate Foundation Improvements Verification Testing. This payment shall be full compensation for furnishing all of the labor and equipment and installing additional intermediate foundation members to comply with the procedures as outlined in Article DS-23073.01, D, 2.

Form 510130 (07-24)

IOWA | DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Eric Johnsen		**Bureau/Office:** Specifications	**Item 17**
Submittal Date: 10/28/2024		**Proposed Effective Date:** 1/22/2025	
Article No.: **Title:**		**Other:** DS-23058, Intelligent Transportation Systems	
Specification Committee Action: Approved as recommended.			
Deferred:	**Not Approved:**	**Approved Date:** 11/14/2024	**Effective Date:** 1/22/2025
Specification Committee Approved Text: See attached draft Developmental Specifications for Intelligent Transportation Systems.			
Comments: None.			
Specification Section Recommended Text: See attached draft Developmental Specifications for Intelligent Transportation Systems.			
Comments:			
Member's Requested Change: (Do not use '<u>Track Changes</u>', or '<u>Mark-Up</u>'. Use ~~Strikeout~~ and Highlight.)			
Reason for Revision: To add the note that ITS work will be considered a specialty item for the purpose of subcontracting.			
New Bid Item Required (X one)	**Yes**	**No** X	
Bid Item Modification Required (X one)	**Yes**	**No** X	
Bid Item Obsoletion Required (X one)	**Yes**	**No** X	
Comments:			
County or City Comments:			
Industry Comments:			

DS- 23074
(Replaces DS-23058)

DEVELOPMENTAL SPECIFICATIONS
FOR
INTELLIGENT TRANSPORTATION SYSTEMS

Effective Date
January 22, 2025

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23074.01 DESCRIPTION.

A. This section includes furnishing all work, apparatus, and materials to construct, install, and place in operation, to the Engineer's satisfaction, a complete ITS as shown in the contract documents.

B. Definition of Abbreviations.

AC – Alternating Current
AMP - Ampere
AWG – American Wire Gauge
CSR – Combined Stress Ratio
EMT – Electric Metallic Tube
GFCI – Ground Fault Circuit Interrupter
IP – Internet Protocol
ITU-T - International Telecommunications Union – Telecommunications Standardization Sector
LED – Light Emitting Diode
MVDS - Microwave Vehicle Detection System
NOC – Network Operations Center
OSP – Outside Plant
PDF – Portable Document File
RJ – Registered Jack
RMS – Root Mean Square
SC – Subscriber Connector
SCTE - Society of Cable Telecommunications Engineers
TMC – Traffic Management Center
UPC - Ultra-Physical Contact
UV – Ultraviolet
VAC - Volts Alternating Current
XHHW - Cross-linked Polyethylene, High Heat and Water Resistant

C. Special Requirements.

1. Comply with NEC, latest edition adopted by the State of Iowa.

2. Comply with TIA latest editions.

3. EIA latest editions.

4. IEEE Standards and Practices.

5. ANSI Standards and Practices.

6. NEMA Standards.

7. UL Standards.

D. Submittals.

1. **Material List.**
   Complete and submit one electronic PDF file of the materials list to the project Engineer within 14 calendar days after award of the project contract. Include the name of the materials, supplier and catalog number of each item listed.

2. **Construction Schedule.**
   a. Fourteen calendar days before the preconstruction conference, submit to the Engineer one electronic PDF file of the detailed construction schedule including dates of commencement for each major work item, duration of each major work item and completion of each major work item on each segment of the proposed construction.
   b. Major items of work to be included on the schedule shall include, but are not limited to the following:
   - Duration of material procurement,
   - Installation of conduit, handholes, building entrances, and fiber optic cable,
   - Bridge attachments,
   - Installation of device cabinets, foundations, and poles,
   - Installation and energizing of power,
   - Splicing and termination of fiber optic cables, and
   - Duration of fiber testing and submission of test reports.

   c. The construction schedule shall comply with Section 1108 of the Standard Specifications. In addition to limitations of operations in Article 1108.03 of the Standard Specifications, work shall not be performed that may result in an unplanned network disruption during an ICN moratorium date.
   d. Coordinate with the Engineer to schedule all splicing work.
   e. Upon acceptance of the schedule, the Contractor will be expected to adhere to these dates as proposed unless modified with the approval of the Engineer.
   f. Submittal and approval of the proposed construction schedule by the Engineer is required before the Contractor can commence construction activities.
   g. The cost of preparing and revising the construction schedule shall be included in the bid item for Mobilization.

3. **Shop Drawings.**
   a. Before any items are ordered or installation is started, submit the following list of shop drawings for approval according to Article 1105.03 of the Standard Specifications:
   - Power Installed Foundation.
   - Pole.
   - Breakaway Transformer Base.
   - Pole Mount Cabinet Mounting Assemblies.
   - Cabinet Foundation.

- Cabinet.
- HDPE Conduit.
- Schedule 80 HDPE Conduit.
- Conduit Splice Kit.
- Rigid Steel Conduit and Fittings.
- Duct Plugs.
- Duct Seal.
- Handholes.
- Test Stations.
- Fiber Markers.
- Ground Rods.
- Exothermic Welding Kit.
- Copper Cable (Power).
- Copper Cable (Ground).
- Tracer Wire.
- Tracer Wire Splice Kit.
- Fiber Optic Cable.
- NEMA 3R 240/120 1.0 kVA Transformer.
- Meter Pedestal.
- Circuit Breaker.
- OTDR Meter with Calibration Certificate from Manufacturer within last year.
- Fusion Splicer with Calibration Certificate from Manufacturer within last year.
- Fiber Optic Splice Closure.
- Fiber Optic Splice Tray.
- Module Connector Housing Splice Cassettes.
- Connector Adaptor Panel.
- Single Panel Housing.
- Fiber Connector and Pigtails.
- One Rack Unit Connector Housing.
- Four Rack Unit Connector Housing.
- Additional drawings may be required on a project specific basis in accordance with the contract documents.

b. Submittal for power installed foundation shall include all structural calculations and be accompanied by a shop drawing that at a minimum illustrates a schematic of the foundation with a summary of the design criteria, material data, foundation data and orientation details. Design calculations and shop drawing for power installed foundation shall be sealed by a Professional Engineer licensed in the State of Iowa.

c. Submittal for poles shall include all structural calculations and be accompanied by a shop drawing that at a minimum illustrates a schematic of the proposed pole and transformer base with a summary of the design criteria, material data, pole data and details of handholes, pole top, pole base and pole orientation. Design calculations for poles and transformer bases shall be sealed by a Professional Engineer licensed in the State of Iowa.

d. The Engineer will review the shop drawings/catalog cuts for the purpose of assuring general conformance with the project design concept and contract documents.

e. The Engineer will provide approval or rejection of shop drawings within 14 calendar days of the Contractor’s submission. Re-submit the shop drawings for approval within 7 calendar days of the Engineer’s rejection.

f. Provide written notice of any deviations from the requirements of the contract documents or Special Provisions.

g. Engineer's approval of shop drawings/catalog cuts does not relieve the Contractor of responsibility for providing satisfactory materials complying with the contract documents. Errors not detected during review do not authorize the Contractor to proceed in error.

h. Order all materials requiring production lead time greater than 4 weeks within 7 calendar days of receiving the approved shop drawing(s).

i. Submit to the Engineer proof of material purchase order in electronic PDF format.

4. Warranty.

a. Transfer all required standard materials warranties on the date of final acceptance to the Contracting Authority.

b. Warranty periods shall not commence prior to final acceptance of the work and shall remain in effect until at least 1 year after the final acceptance for all cables and equipment furnished and installed for the project.

E. As-Built Documentation.

1. General.

a. Maintain written records of daily construction progress, areas worked, and quantities installed to aid in the completeness of as-constructed documentation.

b. Provide as-built documentation package with the following:

1) Documentation of fiber cable sequentials at building entrances, cabinets, and in/out of handholes.

2) Master record set of plans (maintained throughout construction) documenting any deviations from the design shown in the original contract documents.

3) Confirmation that splicing was completed as planned or redline corrections on how it was spliced.

2. GPS Data Recording Staking Assistance.

a. Unless otherwise specified in the contract documents, ~~T~~the Engineer will be responsible for collecting GPS data of all installations including, but not limited to, conduit and/or cable routing and installation depth and handhole locations.

b. Coordinate and assist the Engineer in this effort by staking, flagging or otherwise locating all installed features until such time that the GPS data can be collected. Mark the conduit alignment at least every 50 feet.

c. For any segments that are bored, provide bore logs to the Engineer that include the bore depth and location if the boring equipment is capable of producing these records.

d. The cost of GPS data recording staking assistance shall be included in the bid item for Mobilization.

F. Aerial photography shown on the plans is for reference only and may not match existing conditions.

23074.02 MATERIALS.

A. General.

1. Provide any items, equipment, or materials not specifically addressed in the contract documents but required to provide a complete and functional installation. The level of quality shall be consistent with other specified items. All miscellaneous electrical equipment and materials shall be listed for its specific application.

2. Material requirements apply to new construction, relocation, and maintenance of the Intelligent Transportation System.

B. ITS Construction Survey.

1. General.

ITS construction survey includes equipment and supplies required for fiber optic conduit path and ITS construction surveying and staking necessary for construction of the project as shown in the contract documents.

2. Lath.

Provide wood lath that is approximately 3/8 inch thick by 1 1/2 inches wide by 48 inches long.

3. Survey Equipment.
Utilize survey equipment with a level of accuracy that will result in less than 6 inches of error horizontally.

C. Power Installed Foundation.

1. General.

a. This specification is for a power installed foundation compatible for use with, and support of, 45 foot steel breakaway poles.
b. Foundations and baseplate should be of steel construction.
c. Ensure the foundation and baseplate are hot dip galvanized inside and out according to ASTM A153.
d. After galvanizing, the manufacturer identification and fabrication date shall be permanently stamped to the baseplate in minimum 1/2 inch letters.
e. The manufacturer shall utilize industry recognized written quality control for materials and manufacturing processes.

2. Fabrication Specifications.

a. All foundations shall be designed in accordance with the AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, First Edition.
b. Mill certifications shall be supplied as proof of compliance with the specifications. The Fabricator shall be certified under Category I, "Conventional Steel Structures" as set forth by the AISC Quality Certification Program. All welding shall be in accordance with Article 2408.03, B of the Standard Specifications. Tackers and welders shall be qualified in accordance with the code. Tube longitudinal seam welds shall be free of cracks and excessive undercut, performed with automatic processes, and be visually inspected. Longitudinal welds suspected to contain defects shall be magnetic particle inspected. All circumferential butt-welded pole and arm splices shall be ultrasonically or radiographically inspected.
c. The baseplate shall be perpendicular to the shaft axis (± 1 degree) and hole and concentric (± 0.188 inches) to shaft axis.
d. Pilot point and shaft axis to be concentric (± 0.125 FIM) and in line (± 2 degrees)
e. Preheat, tumbleblast, handgrind, and clean baseplate on all welded areas prior to galvanizing.
f. All material is to be new, unused and mill traceable meeting the following specifications:

Baseplate:	ASTM A36 (Latest Revision) Structural Steel (Conform to AASHTO Tech. Bul. No. 270)
Shaft:	ASTM 252 (Latest Revision) Grade 2, steel pipe piles. Alternate material: ASTM A53 (Latest Revision) Type E or S, Grade B, steel pipe OR ASTM A500 (Latest Revision), Grade B, structural steel tubing
Helix:	ASTM A635 (Latest Revision) 1/2 inch thick hot rolled steel plate or coil.
Pilot Point:	ASTM A575 (Latest Revision) 1 1/4 inch diameter hot rolled steel bar.

g. Two slots with minimum dimensions of 2.5 inches in width and 12 inches in length shall be cut into the shaft of the foundation, perpendicular to the base plate to allow for conduit entry during installation. The top of these conduit entryway openings shall be 12 inches from the bottom of the base plate.
h. The baseplate shall be permanently marked to indicate the conduit entryway openings in the shaft.

i. An 8 inch diameter hole shall be constructed in the baseplate to allow access between the shaft and pole foundation.
j. The bolt circle of the foundation shall be variable such that it will be compatible with the bolt circle of the pole design.
k. At a minimum, the foundation base plate thickness shall match the base plate thickness of the pole in the contract documents.

3. Design Calculations.
a. The design reference for foundations shall be AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, First Edition, Section 13, Foundation Design. The device loadings specified in this document shall be used in all AASHTO design calculations. Calculations and detailed drawings shall be submitted demonstrating compliance with the AASHTO specification.
b. Assume a soil profile of uniform cohesive soil (sand) with an angle of internal friction of 30 degrees and a unit weight of 100 pounds per cubic foot. Also, assume the water table is at a depth that will not affect lateral capacity.
c. Using the determined loads and assumed soil profile, the size of the foundation (shaft diameter, shaft length, base plate thickness, etc.) needed for adequate service shall be calculated using Broms Method for Lateral Pile Support.
d. A minimum factor of safety of 2.5 shall be used when recommending an adequate foundation.

D. Poles.

1. General
a. All poles shall be tapered steel poles, 45 feet in length (excluding the transformer base).
b. Poles shall satisfy the requirements of Article 1107.06 of the Standard Specifications.
c. The poles shall be designed to satisfy deflection requirements.
d. The poles shall be provided with two handholes with removable covers. The handhole openings shall be reinforced with a minimum 0.432 inch wide hot rolled steel rim. The first handhole shall be located 1.5 feet above the base plate (measured from bottom lip of handhole) and have minimum outside dimensions of 6 inches by 10 inches. The second handhole shall be oriented directly above the first handhole but located 40 feet above the baseplate (measured from bottom lip of handhole) and have minimum outside dimensions of 3 inches by 5 inches.
e. Ensure each pole has an approved grounding provision for use during installation and that it is accessible and will function as intended after the galvanization process. Ensure the grounding lug is readily accessible through the handhole and from the bottom of the pole shaft.
f. Poles shall include a removable end cap at the top of the pole with a J-hook cable support above the upper handhole.
g. Ensure the poles and base plates are hot dip galvanized inside and out according to ASTM A123.
h. Unless otherwise noted in this specification, materials shall meet the applicable minimum requirements of Section 4185 of the Standard Specifications.

2. Pole Design Calculations and Fabrication Specifications
a. All poles shall be designed in accordance with the AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, First Edition.
b. The device loadings specified in this document shall be used in all AASHTO design calculations and pole deflection evaluations and the poles shall be capable of withstanding winds up to 90 mph with a 1.14 gust factor without failure. Calculations and detailed drawings shall be submitted demonstrating compliance with the AASHTO specification.
c. Mill certifications shall be supplied as proof of compliance with the specifications. The Fabricator shall be certified under Category I, "Conventional Steel Structures" as set forth by the American Institute of Steel Construction Quality Certification Program. Proof of this

certification will be required to ensure that the fabricator has the personnel, organization, experience, procedures, knowledge, equipment, capability and commitment to fabricate quality pole structures. All welding shall be in accordance with Article 2408.03, B, of the Standard Specifications. Tackers and welders shall be qualified in accordance with the code. Tube longitudinal seam welds shall be free of cracks and excessive undercut, performed with automatic processes, and be visually inspected. Longitudinal welds suspected to contain defects shall be magnetic particle inspected. All circumferential butt-welded pole and arm splices shall be ultrasonically or radiographically inspected.

d. All poles shall be designed to support the specified camera, sensor and device cabinet and shall be stiffened or otherwise manufactured to meet allowable deflection criteria contained herein. Pole design shall assume the following loadings. All mounting heights are measured from the base of foundation to bottom of equipment.

Radio Communication Equipment and Mounting Bracket
Weight: 10 pounds
Surface Area: 2 square feet
Mounting Height: 45 feet

Camera and Mounting Bracket
Weight: 9 pounds
Surface Area: 1 square feet
Mounting Height: 40 feet

Roadway Sensor
Weight: 6 pounds
Surface Area: 1 square feet
Mounting Height: 17 to 25 feet

Device Cabinet
Weight: 95 pounds
Surface Area: 6 square feet
Mounting Height: maximum 6 feet

e. The pole top deflection shall not exceed 1 inch in a 30 mph (non-gust) wind. Close consideration must be given to the effective projected area of the equipment along with the weight when designing the pole to meet the specified deflection performance criteria. The calculations shall include a pole, base plate, and anchor bolt analysis. The pole calculations shall be analyzed at the pole base, at 5 foot pole intervals/segments and at any other critical pole section. At each of these locations, the following information shall be given:

- The pole's diameter, thickness, section modulus, moment of inertia, and cross sectional area.
- The centroid, weight, projected area, drag coefficient, velocity pressure, and wind force of each pole segment.
- The axial force, shear force, primary moment, total moment, axial stress, bending stress, allowable axial stress, allowable bending stress, and combined stress ratio (CSR).
- The pole's angular and linear deflection.

f. All pole shafts shall have a minimum yield strength of 55 ksi and conform to ASTM A595 Grade A or ASTM A572 Grade 55. The shaft shall have a constant linear taper and contain only one longitudinal seam weld. Circumferential welded tube butt splices and laminated tubes are not permitted. Longitudinal seam welds within 6 inches of base plate welds shall be complete penetration welds.

g. Base plates shall conform to ASTM A36. Plates shall be integrally welded to the tubes with a telescopic welded joint or a full penetration butt weld with backup bar.

h. Anchor bolts shall conform to the requirements in Article 4185.02, B, 2 of the Standard Specifications.

3. **Breakaway Transformer Base.**
   - **a.** Transformer base shall be designed for installation with each ITS pole as specified above and is subsidiary to the pole.
   - **b.** Transformer base shall conform to breakaway criteria of AASHTO LRFD Specifications for Structural Support for Highway Signs, Luminaires and Traffic Signals, First Edition and in accordance with the guidelines of NCHRP Report 350.
   - **c.** The aluminum transformer base material shall conform to ASTM Designation B108 Alloy 356.0 T6.
   - **d.** Connecting hardware shall be finished to ASTM: B695 Class 50. All structural fasteners shall be galvanized high strength carbon steel. All non-structural fasteners shall be galvanized or zinc-plated carbon steel or stainless steel.
   - **e.** Height of transformer base shall be 17 inches.
   - **f.** Top plate bolt circle shall be 12.75 inch in diameter (+/- 0.75 inch) and accommodate bolts a maximum of one inch diameter. Top plate shall be 13.12 inch by 13.12 inch by 0.750 inch.
   - **g.** Bottom plate bolt circle shall be 14.5 inch in diameter (+/- 0.5 inch) and accommodate bolts a maximum of 1.25 inch diameter. Bottom plate shall be 14.5 inch by 14.5 inch by 0.625 inch.
   - **h.** Transformer base shall include one aluminum access door of 11 inches by 8.56 inches (at top) by 8.94 inches (at bottom).

E. Cabinet Foundations.

1. All concrete shall meet the requirements of Article 2403.02 of the Standard Specifications.

2. Use Class C concrete with 28 day compressive strength of 4000 PSI for cabinet foundations and all other non-paving concrete construction.

3. All reinforcement shall be epoxy coated and meet the requirements of Article 4151.03 of the Standard Specifications. All reinforcing steel shall be Grade 60.

F. Device Cabinets.

1. **General.**
   - **a.** Cabinets shall be dimensioned as identified in the contract documents.
   - **b.** Cabinets shall be corrosion resistant, NEMA Type 3R compliant, constructed of welded sheet aluminum with a minimum nominal thickness of 1/8 inch.
   - **c.** Cabinets shall be complete with all required internal components, fully wired back panel, side mount DIN rails, terminal strips, and stainless steel hardware.
   - **d.** Cabinets shall meet the requirements of ASTM B-209 for 5052 H-32 aluminum sheet. The aluminum shall be smooth and the exterior shall be left in its unpainted natural color.
   - **e.** The cabinet shall be effectively sealed to prevent the entry of rain, dust, and dirt.
   - **f.** All exterior seams for cabinet and doors shall be continuously welded.
   - **g.** Edges, seams, fittings, and hardware shall be finished free from burrs and sharp edges.
   - **h.** Use Type 316 stainless steel for all mounting hardware.
   - **i.** Use 3/4 inch wide and 0.03 inch thick banding for pole mounted cabinets.

2. **Cabinet Doors.**
   - **a.** The cabinet door shall be sturdy, torsionally rigid, and attached by a continuous heavy duty stainless steel butt hinge. The door shall substantially cover the full area of the front of the cabinet and have a stainless steel, pad-lockable handle.
   - **b.** The cabinet door shall be provided with a door stop catch mechanism to hold the door open at three positions; 90 degrees, 120 degrees and 180 degrees. Both the door and door stop mechanism shall be of sufficient strength to withstand a wind load of 5 pounds per square foot of door area applied to both inside and outside surfaces.

c. A closed-cell neoprene gasket shall be provided to act as a permanent and weather resistant seal at the cabinet door facing. The gasket material shall be of a non-absorbent material and shall maintain its resiliency after long-term exposure to the outdoor environment. The gasket shall have a minimum thickness of 1/3 inch. The gasket shall be located in a channel provided for this purpose either on the cabinet or on the door. An "L" bracket is acceptable in lieu of this channel if the gasket is fitted snugly against the bracket to insure a uniformly dust and weather resistant seal around the entire door facing.

d. LED cabinet light shall be provided and operated by door switch.

e. Each cabinet door shall be provided with a high quality, heavy duty tumbler-type lock. Two, No. 2 keys for each tumbler lock shall be provided for each cabinet. All locks for the project shall be keyed identically to key pattern 9R46142 or as otherwise identified by the Engineer. Keys shall be given to the Engineer. Do not attach keys to the exterior of the cabinet at any time during storage or installation.

f. A heavy-duty clear plastic envelope shall be provided, securely attached to the inside wall of the cabinet or cabinet door, for stowing cabinet wiring diagrams and equipment manuals. Minimum dimensions shall be 9 inches wide by 12 inches deep.

3. Electrical Components, Connecting Cables and Wiring.

a. Provide cabinets equipped and configured with internal power components as shown in the contract documents.

b. One four position service entrance terminal block with tin plated aluminum connectors, nickel plated steel screws, and a current rating up to 70 Amps.

c. One 20 Amp single pole breaker (Main).

d. One 15 Amp single pole breaker (Equipment).

e. One 15 Amp single pole breaker (Auxiliary).

f. One 120/240 VAC surge protector with surge current at minimum of 100 KA, nanosecond response time, and an operating temperature of -40°F to +185°F.

g. One auxiliary four-terminal electrical block rated for a maximum 250 VAC RMS maximum voltage and 20 Amps current.

h. One 15 Amp GFCI receptacle in Ivory color.

i. One 15 Amp Duplex receptacle in Ivory color.

j. One ten outlet, remotely resettable, Power Distribution Unit with eight individually switched circuits and two unswitched (always on) outlets. Built in surge suppressor, lithium-ion battery, resettable circuit breaker, minimum cord length of 6 feet, and a 10/100 autosensing, Static IP, RJ-45 Ethernet Interface.

k. One seven tapped Ground Bar.

l. One seven tapped Neutral Bar.

m. All miscellaneous wiring, harnesses connectors and attachment hardware.

n. All conductors used on the cabinet wiring shall be No. 14 AWG or larger with a minimum of 19 strands. Conductors shall conform to NEC.

4. Ventilation.

a. Vents.

1) Furnish cabinets containing a suitably designed rain tight vent or vents that:

a) Are equipped with suitable screens or dust filters, and

b) Allow the release of excessive heat and/or any explosive gases which may enter the cabinet.

2) Ensure when filters are utilized, positive retainment is provided on all sides to prevent warpage and entry of foreign matter around the edges.

3) The filters shall be dry type, easily removed and replaced, and standard dimensions commercially available.

b. Vent Fan.

1) A thermostatically controlled vent fan is furnished to provide air circulation within the cabinet.

2) The thermostat controlling the fan is manually adjustable to turn on between 90°F and 150°F with a differential of not more than 10°F between automatic turn on and turn off.

3) The fan is located with respect to the vent holes to direct the bulk of the air flow over the internal components within the cabinet.
4) Ventilation fan shall be fused separately and wired after the main AC+ circuit breaker.

5. Grounding.
a. The cabinet internal ground shall consist of one or more ground bus-bars permanently affixed to the cabinet and connected to the grounding electrode.
b. Use bare stranded No. 6 AWG copper wire between bus-bars and between the bus-bar and grounding electrode.
c. Each copper ground bus-bar shall have a minimum of 20 connector points. Each connector point shall be capable of securing at least one No. 6 AWG conductor.
d. AC neutral and equipment ground wiring shall return to bus-bars.

6. Pedestal.
a. Clean-cut in design and appearance to match cabinet.
b. Dimensioned as identified in the contract documents.
c. Corrosion resistant, NEMA Type 3R compliant, constructed of welded sheet aluminum with a minimum nominal thickness of 1/8 inch.
d. Complete with all stainless steel hardware.
e. Meet the requirements of ASTM B-209 for 5052 H-32 aluminum sheet. The aluminum shall be smooth and the exterior shall be left in its unpainted natural color.
f. Effectively sealed to prevent the entry of rain, dust, and dirt.
g. All exterior seams shall be continuously welded.
h. Edges, seams, fittings, and hardware shall be finished free from burrs and sharp edges.

G. Conduit.

1. High Density Polyethylene Conduit.
a. HDPE conduit shall be smooth wall and orange in color for communications.
b. HDPE conduit shall be smooth wall and orange, red, or black with red stripe in color for power. Verify conduit color requirements with local electrical utilities.
c. Comply with ASTM F 2160 (conduit) and ASTM D 3350 (HDPE material), minimum SDR 13.5 or 11 as specified in the contract documents.
d. Sequential foot markings printed on HDPE.
e. Continuous reel or straight pieces to minimize splicing.
f. For dissimilar conduit connections provide an adhesive compatible with both materials.

2. Rigid Steel Conduit
Comply with Article 4185.09 of the Standard Specifications.

3. Electric Metallic Tube Conduit
a. Listed and labeled in accordance with NEC.
b. EMT conduit shall be steel.
c. Comply with UL 797 and UL Category Control Number FJMX.
d. Zinc alternate corrosion-resistant coating exterior.
e. Zinc with organic top coating interior coating.
f. EMT fittings shall comply with UL 514B and UL Category Control Number FKAV.
g. EMT fittings shall be steel die cast.
h. Coupling shall use compression coupling or raintight compression coupling with distinctive color gland nut setscrew coupling. Setscrew couplings with only a single screw per conduit is unacceptable.

H. Handholes.

1. General.
a. Constructed of epoxy or polyester resin mortar with woven glass fiber reinforcement.

b. Handhole materials shall not support combustion when tested in accordance with ASTM D 635.
c. Water absorption shall not exceed 2% of the original weight of material under test conditions per ASTM D 570.
d. Functional without failure throughout a temperature range of -50°F to +170°F.
e. Walls shall not deflect more than 0.24 inches per foot of length of box when installed and subject to an ASTM C 857 TIER 22 load.
f. Meet or exceed ANSI/SCTE 77 requirements.
g. Lid strength shall be tested to 33,750 pounds (Tier 22).
h. Lid shall have skid resistant surface.
i. Label all handhole lids. ITS 36x24x36 and ITS 48x30x36 handhole shall be labeled as 'FIBER OPTIC'. ITS 30x17x24 handhole lids shall be labeled 'ELECTRICAL'.
j. ITS handholes shall not include cable hooks.

2. Test Station.
a. Triangular post station with anchor flaps on each side for securing the post into the ground.
b. Orange in color with a removable black cap.
c. Test station shall be 78 inch made of polyester resin with reinforcing fibers, be UV stable, and remain flexible from -40°F to +140°F.
d. The station shall include five internal stainless steel terminals on an eleven-hole terminal board, an isolation lever, and a set screw to hold terminal concealment cap on.
e. Provide and place Engineer approved custom warning decals on all sides.
f. Use bare stranded No. 6 AWG copper wire between terminal board and the ground rod.
g. An Isolation Ground Switch is an alternative when above ground test stations cannot be used. Supply isolation ground switches to mount on the interior of handholes. This alternative shall only be used at locations specified in the contract documents.

3. Ground Rod.
a. Use copper bonded steel ground rod.
b. Ground rod shall be 5/8 inch by 8 feet.

4. Fiber Marker.
a. Triangular post markers with anchor flaps on each side for securing the post into the ground.
b. Orange in color with an orange cap.
c. Markers shall be 78 inch, made of polyester resin with reinforcing fibers, be UV stable, and remain flexible from -40°F to +140°F.
d. Provide and place Engineer approved custom warning decals on all sides.

I. Wire and Cable.

1. Power Wire.
Comply with Article 4185.11 of the Standard Specifications.

2. Tracer Wire.
a. Comply with Article 4189.01, C, 3 of the Standard Specifications.
b. Use a direct bury, self-stripping, locking connector system used for making connections to underground tracer wire systems on all mainline and lateral connections.
c. Use locking tracer wire connectors compatible with No. 10 AWG copper clad steel wire.
d. Use one-piece connectors that utilize mechanical compression.
e. Use a sealed wire connection system for use in damp, wet, raintight, watertight, submersible, and direct bury locations.
f. Tracer Wire Tags.
1) Self-laminating polyester material.
2) 1.5 inch by 0.75 inch.
3) Black text with a white background.

4) Specific for wire and cable applications.

3. XHHW Wire.

a. Use annealed stranded bare copper conductors per ASTM B3 and B8.
b. Use Class B stranding per ASTM B8.
c. Use flame retardant cross-linked polyethylene insulation.
d. Use UL listed wire.
e. Wire shall be rated for 194°F (90°C) wet/ dry and -40°F (-40°C) operating temperatures.

4. Grounding/Bonding.

Comply with Article 4189.01 of the Standard Specifications.

5. Fiber Optic Cable.

a. General.

1) The cable shall meet the latest applicable standard specifications by ANSI, EIA and TIA for the single-mode fiber cable of the size specified per the contract documents.
2) Provide all fiber optic cable for installation.
3) Provide the Engineer the manufacturer's production test provided with the spool.
4) Provide the Engineer with documentation of wasted cable.
5) The buffer tubes shall be compatible with standard hardware and shall have 12 fibers per tube, the fibers shall not adhere to the inside of the buffer tube, each fiber shall be distinguishable by means of color coding in accordance with TIA/EIA-598-B "Optical Fiber Cable Color Coding" and be colored with ultraviolet (UV) curable ink.
6) The cable core shall be water blocked with dry water blocking materials to improve access and handling of individual tubes.
7) The cables shall be designed for point-to-point applications as well as mid-span access and provide a high-level of protection for fiber installed in the outside plant environment.
8) The optical fiber shall be fully capable of handling existing and legacy single-mode applications which traditionally operate in the 1310 nm and 1550 nm regions and shall also be designed to operate the full-spectrum from 1260 nm to 1625 nm for optical transmission.
9) The optical fiber shall be designed to provide optimum performance from 1260 nm to 1625 nm intended for 16 channel Course Wavelength Division Multiplexing applications.
10) The optical fiber glass shall comply with Article 1107.06 of the Standard Specifications.
11) The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C, Category 4 and Grades J4, E7 and E8.
12) The jacket or sheath shall be free of holes, splits, and blisters.
13) Mark cable jackets with the manufacturer's name, month, and year of manufacturer, sequential foot markings, the symbol for communication cable as required by Section 350G of the NESC, fiber count, and fiber type. The actual length of the cable shall be within -0/+1% of the length markings. The print color shall be white, with the exception that cable jackets containing one or more coextruded white stripes, which shall be printed in light blue. The height of the marking shall be approximately 2.5 mm.
14) The maximum pulling tension shall be 600 pounds during installation (short term) and 200 pounds installed (long term).
15) The shipping, storage, and operating temperature range of the cable shall be -40°C to +70°C (-40°F to 158°F). The installation temperature range of the cable shall be -30°C to +70°C (-22°F to 158°F).

b. Single-Mode, Fiber Optic OSP Cable – Dielectric Loose Tube.

1) Fiber optic, single-mode, graded loose tube dielectric cable constructed with industry standard 2.5 mm buffer tubes stranded around a central strength member.
2) Single-mode, dispersion-unshifted fiber meeting International Telecommunications Union – Telecommunications Standardization Sector (ITU-T) G.652D/G.657.A1 requirements.

3) Cables shall be sheathed with MDPE. The minimum nominal jacket thickness shall be 1.3 mm. Jacketing material shall be applied directly over cable core and water swellable tape. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

4) The cable jacket shall contain no metal elements and shall be of a consistent thickness.

c. Single-Mode, Fiber Optic OSP Cable – Single Armored Loose Tube.

1) Fiber optic, single-mode, graded loose tube armored cable constructed with industry standard 2.5 mm buffer tubes stranded around a central strength member.

2) Single-mode, dispersion-unshifted fiber meeting ITU-T G.652D/G.657.A1 requirements.

3) Armored cables shall have an armor layer applied directly over the water swellable tape and cable core. The armor shall be a corrugated steel tape, plastic-coated on both sides for corrosion resistance, and shall be applied around the outside of the water swellable tape and cable core with an overlapping seam with the corrugation in register. The outer jacket shall be applied over the corrugated steel tape armor. The outer jacket shall be sheathed with MDPE. The minimum nominal jacket thickness shall be 1.3 mm. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

d. Cable Identification Tags.

1) Use self-laminating rigid vinyl material rated for indoor/outdoor use. No adhesives.

2) Use tags with yellow background and black legend colors.

3) Pre-printed with “CAUTION/ FIBER OPTIC CABLE/ TYPE____/ COUNT____.”

4) Rated for use up to 176°F.

5) 2 inch by 3.5 inch by 16 mil.

6) Use indelible ink, etching, or a label maker which does not fade in sunlight, or in buried or underground applications. No handwriting.

J. Meter Pedestals.

1. Verify requirements with local electrical utilities.

2. Utility metering equipment shall meet the following at a minimum:

a. Aluminum enclosure with powder coated finish.

b. Direct bury pedestal mounted.

c. Include lever bypass.

d. Include 100 amp 240/120 volt main breaker.

e. Space for up to six branch breakers. Install circuit breakers of the size and quantity indicated in the contract documents.

f. UL tested and approved.

g. Rated NEMA 3R construction for outdoor use.

3. Six phase.

4. Meter pedestals and power connections shall comply with the requirements of the NEC, contract documents, electrical utility, and all generally accepted standards and requirements for the electrical components and power terminations in the individual power source.

K. Circuit Breakers.

1. Be of the size identified in the contract documents.

2. Be from the same manufacturer as the panel equipment, unless otherwise approved by the Engineer.

3. UL tested and approved.

L. Transformers.

1. NEMA 3R enclosure.

2. Single phase 1.0kVA; 60 Hz.

3. 240V primary, 240/120V secondary.

M. Fiber Optic Accessories and Hardware.

1. Fiber Optic Splice Closures.

a. Supply an outside plant case that provides environmental protection of cable and splices from water and dirt and that is designed to be submersed in water and installed underground for splicing fiber optic cables in handholes.

b. The splice closure shall be compatible with all sizes of fiber cables listed in the contract documents and large enough to accommodate the number of splices plus an additional 10% at locations where splices are shown in the contract documents.

c. The closures shall be a single-ended dome type splice closure manufactured from impact resistant polymer material with the following properties:

1) Cable entry shall be manufactured of similar material to the dome body and shall seal the closure with re-usable compressed gel-sealing technology instead of heat shrink, that accommodate a wide range of cable sizes.

2) Closures shall be re-enterable and re-sealable without the need for specialized tools or equipment or any additional parts.

3) No encapsulated materials shall be allowed.

4) Be provisioned for a minimum of six cable entries.

5) Hinging splicing trays that provide controlled access to splices and slack storage.

6) Splice and storage compartments accessible via a removable dome-clamp system.

7) The closure shall allow for the storage of at least eight unopened buffer tubes.

8) The closure shall be 11.5 inch diameter by 23 inch length, unless otherwise specified in the contract documents.

9) No factory installed trays.

10) Slack basket size shall be compatible with splice closure.

11) No ground-feed through lugs.

12) The closure shall include the standard valve for flash testing.

d. The splice closure shall contain all splice trays, storage baskets, splice sleeves, organizing materials, and any other incidental materials required to complete the splices at the locations shown in the contract documents.

e. After splicing is complete, flash test the fiber optic cable and closure for leaks.

f. Splice sleeves shall be from the same manufacturer as the splice closure and be compatible with all common fiber coatings. The sleeve shall consist of a clear outer heat shrink material, have a low temperature hot melt adhesive to encapsulate the splice, and include a stainless steel rod to ensure proper alignment and rigidity.

g. To seal tracer wire entering splice closure, use quick install gel sealing plugs, for a three cable seal.

2. Fiber Optic Splice Trays.

Splice trays shall be from the same manufacturer as the splice closure. The size of the splice tray shall be compatible with the splice closure and have capacity for 12, 24, or 72 splices as noted in the contract documents.

3. One Rack Unit Connector Housing.

a. Termination/splice housings shall provide for termination capabilities, splice protection, and associated fiber/pigtail storage.

b. Meets ANSI, TIA, and EIA-568A and 606 standards.

c. The housing shall be powder-coated metal with a polycarbonate tray.

d. Includes a durable polycarbonate-tinted front door for viewing jumpers and removable translucent top covers,
e. Accepts panels, modules, and cassettes. Connector position panel fitting standard 19 inch EIA racks or cabinets, with standard mounting, and hinged to allow complete access to the interior of the termination panel.
f. Supply appropriate cables and adapters to satisfy intended operation and use. The termination unit shall be lightweight and designed to operate fully from -40°C to 70°C (-40°F to 158°F).
g. Rack mountable closet connector housing shall hold two six-duplex connector adapter panels.

4. Four Rack Unit Connector Housing.
a. Termination/splice housings shall provide for termination capabilities, splice protection, and associated fiber/pigtail storage.
b. Meets ANSI, TIA, and EIA-568A and 606 standards.
c. The housing shall be powder-coated metal with a polycarbonate tray.
d. Includes a durable polycarbonate-tinted front door for viewing jumpers and removable translucent top covers,
e. Accepts panels, modules, and cassettes. Connector position panel fitting standard 19 inch EIA racks or cabinets, with standard mounting, and hinged to allow complete access to the interior of the termination panel.
f. Supply appropriate cables and adapters to satisfy intended operation and use. The termination unit shall be lightweight and designed to operate fully from -40°C to 70°C (-40°F to 158°F).
g. Rack mountable closet connector housing shall hold twelve six-duplex connector adapter panels.

5. Module Connector Housing Splice Cassettes
a. Use closet connector housing splice cassette modules for splice protection of connector pigtails.
b. Includes splice organizer.
c. Closet connector housing splice cassette modules shall be from the same manufacturer as the connector housing.

6. Floor Mount Equipment Rack
a. Floor mountable high-strength, lightweight aluminum EIA rack with black finish.
b. Size rack to hold equipment identified in the contract documents.
c. Rack shall include easy positioning of equipment with marked and numbered rack-mount spaces and cable lacing points for cable installation, routing, and management.
d. Include appropriate floor installation kit to secure the rack to the floor.

7. Wall Mount Equipment Rack
a. Wall mountable high-strength, lightweight aluminum EIA rack with black finish.
b. Size rack to hold equipment identified in the contract documents.
c. Rack shall include easy positioning of equipment with marked and numbered rack-mount spaces and cable lacing points for cable installation, routing, and management.
d. Include assembly hardware and mounting bolts.

8. Single Panel Housing.
a. Surface mounted termination/splice housings shall provide for termination capabilities, splice protection, associated fiber/pigtail storage, and stackable for growth capacity.
b. Surface mount housing shall be intended for splicing and management, and cross-connect or both for up to 12 fibers.
c. Top and bottom cable entry grommets for incoming fiber, fiber jumper.
d. Manufactured of metal and black in color.
e. 160 mm by 140 mm by 50 mm (6.3 inch by 5.5 by 2 inch).

f. Hinged front door, universal mounting brackets, jumper bend limiters, labels for identifying fiber terminations.
g. Wall mountable single panel housing shall hold one six-duplex SC connector adapter panel and splice organizer.

9. Connector Adaptor Panel
a. Use six-duplex SC connector adaptor panel with splice organizer.
b. Connector adaptor panel shall be from the same manufacturer as the single panel housing.

10. Six Duplex Connector Adapter Panel.
a. Termination adapter panels shall be duplex SC.
b. 6 adapters per panel.
c. Accommodate a fiber count of 12 strands, single-mode.
d. UPC polish type.
e. Adapter panels shall be from the same manufacturer as the housing.
f. Housing material shall be composite and blue in color.

11. UPC/SC Factory Terminated Fiber Connector and Pigtails.
a. All fiber connectors used on this project, including in shelves, cabinets, or panels, shall be factory installed connectors.
b. No field terminated connectors will be allowed.
c. Connectors shall be SC/UPC having a typical insertion loss (single-mode) of 0.15 dB or less, a maximum loss of 0.35 dB or less, with typical reflectance of -55 dB, and temperature stability from -40 °C to 75 °C (-40°F to 167°F).
d. Fiber used for pigtails must be of the same manufacturer as the main fiber cable.
e. Pigtails shall be rated for the environment they are installed in.
f. Pigtails shall be spliced in accordance with the splicing specifications and in fiber shelves or panels using manufacturer splice organizers.
g. Include splice and connector sleeves.

23074.03 CONSTRUCTION.

A. General Responsibilities.

1. Stake all handholes and proposed conduit alignment per location shown in the contract documents a minimum of 5 working days prior to construction and for approval by the Engineer. The Engineer will authorize any changes in location in writing before performing the installation. No additional compensation will be provided for additional work associated with or resulting from unauthorized changes to the contract documents.

2. The Contracting Authority will stake all ITS device pole and cabinet foundation locations. Do not adjust pole locations without approval by the Engineer. The Engineer will authorize any changes in location in writing before installation by the Contractor.

3. Figured dimensions on the plans shall be taken as correct but shall be checked before starting construction. Bring any errors, omissions, or discrepancies to the attention of the Engineer and the Engineer's decision thereon will be final. Correction of errors or omissions on the drawings or specifications may be made by the Engineer when such correction is necessary for the proper execution of the work.

4. Assign a responsible staff member that will work with the Engineer on decisions regarding order of work and coordination as needed throughout the duration of this project.

5. Provide the Engineer any requests to perform work during the dates of special events a minimum of 5 calendar days prior to the event. The decision of the Engineer regarding the request will be final.

6. During and after completion, employ appropriate measures for erosion control, where applicable. Seed and fertilize work areas upon completion of work in accordance with the Contract Documents.

7. Upon completion of the work at each work area, thoroughly clean the site and restore it to a condition at least equal to that existing prior to construction. The work area is defined as the approximate area disturbed during a normal week of work.

8. All existing infrastructure such as sidewalks, driveways, curbs, gutters, roadway pavement, roadway asphalt, unpaved areas, drainage ditches, culverts, drain tiles, embankments or any other items disturbed or damaged by the Contractor shall be restored to pre-construction conditions (or better) as directed by the Engineer at no additional cost to the Contracting Authority.

9. Comply with any special provisions and limitations identified in the contract documents.

B. ITS Construction Survey.

1. The Contracting Authority will stake permanent ROW corners per Section 2526 of the Standard Specifications.

2. **Documentation.**
Format the survey work documentation in a manner acceptable to the Engineer. Ensure documentation is sufficient to prove means and methods used to transfer design intent to construction stakes. Check tie-ins with existing roadways, structures, and utilities prior to staking; notify the Engineer if discrepancies are found.

3. **Qualifications.**
Perform ITS construction survey directly by or under responsible charge of a Professional Land Surveyor licensed in the State of Iowa.

4. Place lath at the following locations and label with item being staked:
   - Handholes.
   - Conduit and/or cable alignment direction changes.
   - Critical conduit locations where contract documents specify depth greater than standard and bored installation methods as described in Section 2553 of the Standard Specifications.
   - Transitions from plow to bore or bore to plow.
   - At locations requiring specific depths to avoid existing or future facilities.
   - A minimum of 100 feet apart along plowed conduit.
   - A minimum of 25 feet apart along bored conduit.
   - At other locations as noted within the contract documents.

5. Label lath marking bore locations with required minimum conduit depth shown in the contract documents. Survey to field verify current ground elevation and adjust minimum conduit depth if field conditions differ from plan existing grade.

C. Disruption to Existing Fiber Networks and ITS Devices.

1. **Planned Work Near Existing Fiber Networks.**
   a. Ensure continuous operation of the existing fiber networks and systems during construction of the project.
   b. Do not work on splicing, disconnecting and/or in any way disrupting normal operation of the existing fiber networks or systems without approval from all affected parties. Affected parties will be noted in the contract documents and may include the Iowa DOT, the ICN,

and local agencies. Provide a written request to the respective parties for approval at least 10 calendar days before work is done near an existing fiber network or equipment. Submit a copy of the written request to the Engineer in all cases. In addition to the written request, submit the work plan and schedule for approval by the Engineer. The work plan shall include all fiber strands and the parties possibly affected.

c. Restore the disrupted system upon completion of the work within the allowable working hours as noted in the contract documents. Remain on site until the affected parties give notification that the disrupted systems are fully operational. Failure to restore disrupted systems and equipment within the allowable working hours will constitute an unplanned disruption.

2. Planned Work Near Existing ITS Devices.

a. Ensure continuous operation of all existing Iowa DOT ITS devices during the construction of the project.

b. Maintain and protect all existing power and communications cables connected to the ITS devices unless otherwise directed by the Engineer.

3. Unplanned Disruption.

a. Apply Article 1107.15 of the Standard Specifications and the following:

b. In the event of an unplanned disruption, simultaneously notify the Engineer and any other affected party's representative(s). The notice shall include the type of facility damaged and the extent of the damage. Immediately stop all work in progress and expend all its efforts to restore the disrupted system(s) and/or correct the problem causing the disruption.

c. Remain on site until the affected parties give notification that the disrupted systems are fully operational. Unplanned disruptions shall result in the assessment of a price adjustment.

d. No extension of time for delays caused by repairing disrupted systems will be granted.

e. Correct any unplanned disruptions determined by the Engineer to be caused by the Contractor at no additional cost to the Contracting Authority. If repairs are not made in a timely manner, any costs incurred by the Contracting Authority to restore the disruption will be charged to the Contractor.

4. Price Adjustment.

A price adjustment will be assessed at the rate of $250.00 per 15 minutes, for each 15 minute period that the proper operation of an existing fiber optic network element is not restored following an unplanned disruption.

D. Grounding/Bonding.

1. Ground all installations as indicated in the contract documents.

2. Installation of grounds is incidental to the cost of the connected items of work.

3. Ground all installations in accordance with the requirements of NEC. Supply and install additional grounding rods and equipment as necessary to satisfy such requirements at no additional cost to the Contracting Authority.

E. Power Installed Foundation.

1. General.

a. If the power installed foundation is provided by the Iowa DOT, coordinate with the Iowa DOT regarding the time and location for the Contractor to accept the power installed foundation and deliver the power installed foundation to the field for installation or to the Contractor's construction yard for storage.

b. Install the power installed foundations in accordance with the contract documents and the manufacturer's recommendations.

c. Contact the Engineer a minimum of 7 calendar days in advance to arrange a field review prior to placing the power installed foundation.
d. Notify the Engineer immediately if an obstruction conflicts with a proposed power installed foundation location. The Engineer will relocate or determine another effective means of supporting the structure to eliminate the conflict. Payment will not be made for re-work or extra work as the result of an unauthorized relocation of a power installed foundation.

2. Installation Details.
a. Install all power installed foundations as staked by the Engineer and set level and to the proper elevation.
b. After power installed foundation is in place, hand dig with shovel in order to install conduits into the provided conduit entrances. Seal all conduit openings using duct plugs or as directed by the Engineer.
c. Install a sufficient number of conduits sized as indicated in the contract documents. Locate all conduits as indicated in the contract documents.

3. Improper Installation.
Remove and reinstall, at no additional cost to the Contracting Authority, all power installed foundations improperly installed or with improperly installed anchor bolts, conduit, or any other foundations components as determined by the Engineer.

F. Poles.

1. General.
a. If the poles are provided by the Iowa DOT, coordinate with the Iowa DOT regarding the time and location for the Contractor to accept the poles and deliver the poles to the field for installation or to the Contractor's construction yard for storage.
b. Install the pole in accordance with the contract documents and the manufacturer's recommendations.
c. Refer to Articles 2522.03, H, 2, b through h of the Standard Specifications for nut tightening procedure and requirements.
d. If pole has structural damage do not erect and notify the Engineer.
e. Repair any surface damage to galvanized components using a zinc-rich paint acceptable to the Engineer.
f. After drilling holes, apply a zinc-rich paint acceptable to the Engineer to the bare metal.

2. Pole Erection.
a. Erect poles (including camera mounting system and poles) and securely bolt to the foundation base plate such that the pole is vertical to the centerline of the nearest adjacent major roadway.
b. Use leveling nuts on each anchor bolt installed below the pole flange. Adjust the pole's vertical position by adjusting both the upper and lower nuts.

3. Breakaway Transformer Base.
a. If the transformer base is provided by the Iowa DOT, coordinate with the Iowa DOT regarding the time and location to accept the transformer bases and deliver the transformer bases to the field for installation or to the Contractor's construction yard for storage.
b. Install breakaway transformer base in accordance with the contract documents for each ITS pole not mounted on a roadway bridge per the manufacturer's recommendations.
c. Level transformer base with shims only. Do not use leveling nuts.
d. To approach optimum static loads, use the largest possible bolt circles and hardware supplied with the transformer base.

4. Grounding
a. Use a minimum of three copper bonded steel ground rods per steel pole. Ground rod shall be installed 12 inches below ground level.

b. The maximum grounding resistance shall be 20 ohms or less.
c. All ground connections shall be exothermic weld.

~~5~~. Pole Removal.
a. Coordinate with the Iowa DOT for removal of ITS devices mounted on ITS poles prior to removal.
b. Remove ITS poles, including foundation to a minimum depth of 2 feet below established grade.
c. Furnish, place, and compact backfill according to Section 2552 of the Standard Specifications.
d. Deliver salvaged materials to the location specified in the contract documents.

G. Cabinet Foundations.

1. General.
a. Install cabinet foundations in accordance with the contract documents and the manufacturer's recommendations.
b. Contact the Engineer a minimum of 7 calendar days in advance to arrange a field review prior to placing the cabinet foundation.
c. Notify the Engineer immediately if an obstruction conflicts with a foundation. The Engineer will relocate or determine another effective means of supporting the structure to eliminate the conflict. Payment will not be made for re-work or extra work as the result of an unauthorized relocation of a foundation.

2. Installation Details.
a. Install all foundations as located by the Engineer. Securely rest all foundations on firm ground and set level to the proper elevation. Foundation shall be finished level to ensure the cabinet is plumb after installation.
b. Excavate to the elevation and dimensions as shown in the Contract Documents. Excavation for the foundation shall be in accordance with Section 2402 of the Standard Specifications. Excavation is subsidiary to the cabinet foundation.
c. Install reinforcement in accordance with Article 2404.03 of the Standard Specifications.
d. Place all concrete in accordance with Article 2403.03 of the Standard Specifications. Surface finish shall be Class 1.
e. Install and secure conduits, ground rod, and reinforcement before concrete placement.
f. Anchor cabinet to foundation as specified by cabinet manufacturer.
g. The minimum distance from the edge of concrete foundation to centerline of any anchor shall be 6 inches. Increase foundation size as needed to maintain this minimum.
h. Install number and size of conduits and orient conduits as indicated in the contract documents. Place conduit within the foundation such that a minimum of 1 1/2 inch clearance is maintained between adjacent conduits. Mark the locations of all conduits entering the footing and seal all conduit openings using duct plugs prior to backfilling.
i. Provide 3/4 inch chamfer at all exposed edges of concrete.
j. Modification of a foundation after construction is not allowed.

3. Grounding
a. Use a minimum of one copper bonded steel ground rod. Ground rod shall be installed twelve inches below ground level.
b. The maximum grounding resistance shall be 20 ohms or less.
c. All ground connections shall be exothermic weld.

4. Improper Installation.
Remove and reinstall, at no additional cost to the Contracting Authority, all foundations improperly installed or with improperly installed anchor bolts, conduit, or any other foundation components as determined by the Engineer.

H. Device Cabinets.

1. General.

a. If the device cabinets are provided by the Iowa DOT, coordinate with the Iowa DOT regarding the time and location for the Contractor to accept the device cabinets and deliver the device cabinets to the field for installation or to the Contractor's construction yard for storage.

b. Install cabinets and hardware in accordance with the contract documents and the manufacturer's recommendations.

c. Do not penetrate the top of any cabinets without prior authorization by the Engineer.

d. Do not allow screws used for mounting shelves or other mounting purposes to protrude beyond the outside wall of the cabinet.

e. All exterior connections shall be watertight.

f. Contact the Engineer a minimum of 7 calendar days in advance to arrange a field review prior to placing the cabinets.

2. Mounting.

a. Orient cabinets as shown in the contract documents unless otherwise directed by the Engineer. If cabinet direction is not specified, position such that the maintenance staff will be facing oncoming traffic while working.

b. Ensure sufficient clamps, nuts, hardware, etc., as required for the specified mounting type, are furnished with each cabinet.

c. Seal all conduit openings in the device cabinet using duct plugs or as directed by the Engineer.

d. Mounting heights shall be as indicated or at minimum requirement allowed under current applicable electrical codes, whichever is greater.

3. Cabinet Removal.

a. Remove ITS cabinets, including mounting brackets, if applicable.

b. Disconnect power at power source. Cap and seal cable per NEC requirements.

c. Disconnect communications from the panel and reestablish communications per contract documents.

d. Protect and salvage any equipment inside ITS cabinets being removed.

e. Deliver salvaged materials to the location specified in the contract documents.

I. Conduit.

1. High Density Polyethylene Conduit.

a. General.

1) Install conduit in accordance with the contract documents and the manufacturer's recommendations.

2) Follow all general guidelines covering the construction of buried conduit.

3) Install conduit by plowing, boring, or other approved methods within the public ROW and in a manner that minimizes atypical damage from construction operations.

4) The minimum bending radius of HDPE conduit shall be the larger of 20 times the outside diameter or the HDPE manufacturer's recommendations for minimum bending radius.

5) Open trench installation is only permitted within 25 feet of any handhole, structure, or other similar improvements, and any other requested locations approved by the Engineer.

6) At the discretion of the Engineer, verify the integrity of the conduit structure in a manner acceptable to the Engineer.

7) Tunneling under the pavement or water jetting shall not be permitted.

8) No excavations are permitted to cross any roadways or any other paved or other similarly improved areas. At these locations, install conduits by boring method unless otherwise directed or approved in writing by the Engineer.

9) No direct-buried cable is allowed.
10) Seal all conduit openings using duct plugs or as directed by the Engineer, at all conduit openings at the handholes, foundations, and building entrances.
11) Expose and protect at all times any existing conduit at locations identified in the contract documents.
12) For accessing existing cabinets on foundations, drill foundation for new conduit entrance. Foundation drill will be subsidiary to the conduit installation. Bond new conduit to the ground rod after installation of conduit. Place grout seal around conduit and return foundation to normal appearance. Avoid damaging existing conduit, conductors, and anchor bolts. Damages shall be repaired at no extra cost.

b. Installation Clearances.

1) Depth of all conduit installation shall be a minimum of 48 inches unless otherwise specified in the contract documents.
2) Depth of all conduit installation under natural flowing water shall be a minimum of 10 feet below the flow line unless otherwise specified in the contract documents.
3) Maintain the typical offsets from referenced locations as shown in the contract documents.
4) Maintain the minimum depth throughout the length of all conduit installations.
5) Maintain a minimum of 2 feet of separation when underground conduits parallel an existing facility.
6) Maintain a minimum of 2 feet vertical separation when crossing existing utilities.
7) Maintain a minimum of 15 feet vertical separation from top of rail when crossing existing railroad, unless otherwise specified in the contract documents.
8) Maintain a minimum of 5 feet vertical separation from bottom of culvert when crossing existing culverts, unless otherwise specified in the contract documents.

c. Conduit Splicing.

1) Install conduit with minimal splices between handholes and structures as shown on contract documents.
2) All mechanically joined conduit splices shall use compression couplings designed for underground placement and blown-in fiber installation.
3) Butt fusion welding and solvent welding of conduits will not be allowed.
4) All conduit splices shall be designed to be watertight to 200 psi.
5) Conduit splicing is incidental to the connected items of work.

d. Facilities Protection.

1) The Contractor is responsible for entering new conduit installations into the Iowa One-Call system and providing all utility locates when requested through One-Call ticketing services or by the Engineer. Perform any locating services within 48 hours of receiving notice that location services are needed.
2) The Contractor is responsible for protecting, locating, and maintaining the conduit throughout construction and until final acceptance.
3) Prior to final acceptance and transition of ownership in the Iowa One-Call system, meet with the Engineer to demonstrate the locate system is working properly throughout the entire locate system.
4) If more than 48 hours lag is expected behind a segment installation, install additional protective measures acceptable to the Engineer.

e. Backfilling.

1) Apply Section 2552 of the Standard Specifications and the following.
2) Backfill trenches and other excavations in lifts of 6 inches or less in compacted depth. Compact each layer thoroughly before placing subsequent layers.
3) Remove all cinders, broken concrete, or other hard or abrasive materials in the backfill material before commencing backfilling operations.
4) Remove and dispose of surplus and unsuitable materials upon completion of the backfilling operations in the area.
5) Place and carefully hand tamp backfill under and around the structures in lifts not to exceed 4 inches in loose thickness. Use a suitably sized mechanical tamper for all areas inaccessible to rollers.

6) Perform operations in a manner that minimizes soil erosion and employs appropriate storm water pollution prevention measures during all construction operations.
7) Maintain work areas in a neat, clean, and orderly condition at all times.
8) Upon completion of conduit/cable placing operations and any other work in an area, remove all debris, materials, tools, and equipment from the area and restore the disturbed area(s) to original or better condition within 24 hours or as soon as practicable as determined by the Engineer. Backfill all excavations and grade all disturbed areas during the restoration process.
9) Remove and dispose of rock and debris excavated and remaining after backfilling as directed by the Engineer.

f. Multiple Duct Installation.
Install multiple ducts, in continuity, at locations indicated in the contract documents unless authorized in writing by the Engineer.

g. Plowed Conduit Installation.
1) Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.
2) Furnish competent supervision at all times at the site of plowing operations to assure compliance with the contract documents.
3) The equipment shall be capable of extending the plow in order to maintain the required minimum depths under all terrain conditions.
4) The reel carrier shall be of adequate size and be configured so that the reel sizes being used can be safely handled.
5) Avoid damaging any paved surfaces, ditches, or other similar surface features. Immediately repair any damage to such features to the satisfaction of the Engineer.
6) Perform plowing in accordance with standard industry practices using a prime mover with hydrostatic type steering and a vibratory plow. The design of the plowshare shall be such that the buried conduit passing through the plow shall not bind and shall not be bent in a radius less than 20 times the outside diameter of the conduit and maintains the structural integrity of the conduit. The feed chute shall have a removable gate for the purpose of inspection and to allow the conduit to be removed from or inserted into the feed chute at any intermediate point between splice locations. The conduit path inside the feed chute shall have low friction surfaces and be free of burrs and sharp edges to prevent damage to the conduit as it passes through. Smooth any welds before use. Internal guide rollers shall not be used. Exercise care during the plowing operation to avoid conduit damage. Feed the conduit into the ground through the plow loose and at no tension.
7) Excavate as needed start and finish pits and pits at points of intersection in advance of plowing. Expose ends of casings and crossings of foreign utilities before the start of plowing operations for a conduit segment. Exercise care in the use of trenching and excavating tools and equipment to avoid damaging installed and intersecting conduits or other facilities.
8) Restore plow furrowed areas to conform to the surrounding terrain using a rubber-tired tractor or heavy truck or a vibratory roller having a weight of 3 tons and a drum width between 4 and 6 feet or by other suitable means approved by the Engineer.
9) Boring may be used in lieu of plowing at the Contractor's expense.

h. Conduit in Trench.
1) Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.
2) Excavate open trench straight as practicable. Shape the trench to be smooth, free from any sharp edges, and clear of debris and loose rock. Excavate only gradual grade changes.
3) Do not leave trenches unattended at any time or open during non-working hours unless approved in writing by the Engineer. Install barriers or other protective measures to prevent livestock or persons from falling into an open trench when appropriate.
4) Notify the Engineer immediately if solid rock is encountered at any location. Excavate rock trenches using a rock saw or other suitable equipment. The excavation, backfill,

and road crossings in solid rock areas shall conform to the requirements stated above unless specifically exempted in this section.

5) Rock excavation will be considered extra work and will be paid according to Article 1109.03, B of the Standard Specifications. Obtain approval from the Engineer before commencing any rock excavation.

i. Bored Conduit Installation.

1) Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.

2) Bore all crossings beneath roadways, streets, other paved surfaces, railroads, or other structure in accordance with requirements and regulations of the authority having jurisdiction and as directed in the contract documents.

3) Limit bore hole sizes to the outside diameter of the conduit being placed.

4) Locate bore pits per the contract documents unless otherwise directed by the Engineer.

5) Rock excavation will be considered extra work and will be paid according to Article 1109.03, B of the Standard Specifications. Obtain approval from the Engineer before commencing any rock excavation.

j. Lower Conduit in Place.

1) Expose existing conduit in an open trench. Excavate to the depth specified in the contract documents.

2) If necessary, cut the conduit on either end of excavation to lower the conduit to the depth specified in the contract documents. Install split conduit with locking ridges and adhere a split coupling to each end of the split conduit.

3) The Contractor is responsible for protecting the existing cable inside the conduit.

4) Move cable slack needed to lower conduit as specified in the contract documents.

5) Ensure the bottom of the conduit rests securely on firm undisturbed soil.

6) Item includes the transition of conduit from existing depth to new depth specified in the contract documents.

7) Backfill open trench according to Section 2552 of the Standard Specifications and the additional requirements for conduit backfilling listed above.

2. Rigid Steel Conduit.

a. Comply with Article 2523.03 of the Standard Specifications.

b. Above ground risers shall be rigid steel conduit to a minimum depth of 18 inches below surface.

c. Thread and cap all rigid steel conduit ends with standard conduit caps until wiring is installed. Before wiring is installed, replace caps with threaded insulating bushing in accordance with Article 2523.03, N of the Standard Specifications.

3. Electric Metallic Tube Conduit.

Comply with NEC.

J. Handholes.

1. Handhole Installation.

a. Install handholes in accordance with the contract documents and the manufacturer's recommendations.

b. Install the type and size of handholes at the locations indicated in the contract documents.

c. Set top of all handholes level and flush with the pavement or soil grade.

d. Install aggregate bedding a minimum of 12 inches below and 6 inches beyond the outside edges of the handhole as identified in the contract documents. Aggregate material shall meet Gradation No. 3 or 5 of the Aggregate Gradation Table in Article 4109.02 of the Standard Specifications.

e. Conduit shall enter the handhole from the bottom and extend conduit ends between 4 and 6 inches above the aggregate bedding.

f. Side penetrations of the handholes are not permitted.

g. Terminate each tracer wire run in test stations in accordance with the contract documents.

h. Install ground rods as indicated in the contract documents.
i. Ground test station to ground rod with exothermic weld.
j. Seal all conduit openings using duct plugs, or as directed by the Engineer, at all conduit openings at the handholes after cable installation.
k. Rodent proof all handholes per the contract documents.
l. Place suitable backfill material according to Section 2552 of the Standard Specifications. Backfill is incidental to each handhole being installed and will not be paid for separately.
m. Do not install lid bolts.
n. Do not install cable hooks.

2. Test Station
a. Secure test station by placing over steel U- or T-post.
b. Set test station at or near right-of-way, if possible.

3. Handhole Removal.
a. Remove and dispose of handholes unless otherwise specified in the contract documents.
b. Restore disturbed surfaces to match adjacent areas.
c. Place suitable backfill material according to Section 2552 of the Standard Specifications. Backfill is incidental to each handhole being removed and will not be paid for separately.
d. Apply seed and fertilizer to the disturbed areas in accordance with the contract documents.

K. Wire and Cable.

1. General.
a. Install wire and cable in accordance with the contract documents and the manufacturer's recommendations.
b. Before wire or cable is installed inside existing conduit, clear the conduit of deleterious material. The cost of clearing the existing conduit will be subsidiary to wire or cable installation.
c. All installations and connections shall comply with the contract documents and all generally accepted codes and standards.
d. The Engineer will resolve all conflicts.

2. Tracer Wire.
a. Install tracer wire inside conduit as indicated on the contract documents.
b. Where new tracer wire is installed:
- Splice tracer wire only in handholes to form a continuous network using splice kits listed for wet locations.
- Leave 50 foot coil of tracer wire in all ITS handholes when being terminated at the test station.
- Install one tracer wire per armored fiber optic cable between the splice closure and test station.
- Test all tracer wire for continuity, with approval by the Engineer prior to final acceptance.

c. Labeling Requirement: Place tags on all tracer wire identifying the direction of the tracer wire at every test station.

3. XHHW Wire.
a. Install XHHW wire inside conduit as indicated on the contract documents.
b. Comply with Article 2523.03 of the Standard Specifications.

4. Fiber Optic Cable.
a. General.
1) If the fiber optic cable is provided by the Iowa DOT, coordinate with the Iowa DOT regarding the time and location for the Contractor to accept the fiber optic cable and

deliver the fiber optic cable to the field for installation or to the Contractor's construction yard for storage.

2) Remove fiber optic cable from the reel in accordance with the manufacturer's recommendations.

3) Do not twist or bend the fiber optic cable in excess of the limits recommended by the manufacturer.

4) As the cable is fed into the duct and conduit system use a manufacturer approved water-based cable lubricant for all fiber optic cable installations.

5) Protect at all times all proposed cables, cable ends, and any exposed portions of fiber optic cable from damage including water intrusion.

6) Replace in kind any existing pull tape or tracer wire that is used as a pull rope for fiber optic cable installation. The cost of any tracer wire or pull tape replacement will be subsidiary to the fiber optic cable installation.

7) Expose and protect at all times any existing buried fiber optic cable at locations identified in the contract documents for splicing.

b. Fiber Optic Cable Testing.

1) Visually inspect fiber optic cable prior to installation. Report any defects to the Engineer.

2) Pre-acceptance of Contracting Authority provided fiber (on-reel), test all strands of fiber (uni-directional) with an OTDR at 1310 nm and 1550 nm to verify attenuation, continuity and length of the cable. Measured length by the OTDR shall match manufacturer cable foot markings plus manufacturer provided helicity. Provide the Engineer with a PDF copy of the OTDR traces. Fiber test results submitted to the Engineer that exceed the max attenuation loss specification will be identified as Out of Specification.

3) Test all strands of fiber per the contract documents with an OTDR at 1310 nm and 1550 nm to verify attenuation, continuity, and length of the cable. Measured length by the OTDR shall match manufacturer cable foot markings plus manufacturer provided helicity. Measured post installation length shall match pre-installation (on-reel) length +/- 50 feet for each strand. Provide the Engineer with a PDF copy of the OTDR traces. Fiber test results submitted to the Engineer that exceed the max attenuation loss specification will be identified as Out of Specification.

4) The fiber optic cable is to have a maximum attenuation of 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm when measured with an OTDR. Fiber test results submitted to the Engineer that exceed the max attenuation loss specification will be identified as Out of Specification.

5) Replace, as directed by the Engineer, any defect discovered during final acceptance at no additional cost to the Contracting Authority. Consider a defect to be any cable with an OTDR measured length that differs from the actual cable footage, excluding manufacturer's helicity.

6) All test equipment shall be factory certified within the last year. Provide copies of the certification 10 calendar days prior to testing.

7) Test results will be recorded on a form supplied by the Contractor, with data compiled in PDF format through the meter manufacturer's software. No additional alteration using software from the Contractor beyond the meter manufacturer's software will be allowed. Submit test results in a format approved by the Engineer. Hand completed test forms on each fiber over to the Engineer. Provide native test (electronic version) with no alterations and meter software for viewing of fiber traces. At a minimum, 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.

8) OTDR testing shall use a launch and receiving cable. Each cable shall be a minimum 1000 meters (3290 feet), or greater than the dead zone for the OTDR used for this test, whichever is larger.

c. Fiber Optic Cable Installation.

1) Utilize a suitable cable feeding method between the cable reel and the face of the duct and conduit to protect the cable and guide it into the duct.

2) Utilize dynamometers and breakaway pulling swings to ensure that the pulling line tension does not exceed 600 pounds.

3) The mechanical stress placed on a cable during installation shall not be such that the cable is twisted or stretched. To prevent the cable from twisting, attach a pulling eye and swivel to the cable. Use the pulling eye and swivel to pull the cable through the conduit.

4) Do not force cables around sharp corners and take precautions during installation to prevent the cable from being kinked, gouged, or crushed.

5) Minimum bending radius during installation shall not be less than 20 times the outside diameter of the cable or as recommended by the manufacturer, whichever is greater.

6) Pulling of the cable shall be hand assisted.

7) Approved installation methods include pulling, high air speed blowing, air- assist, push/pull installation, and air blown cable. Installation shall comply with all manufacturers' recommendations for cable installation including pulling tensions, bending radii, and methods, including use of rollers.

8) Carefully inspect the cable for jacket defects. If defects are noticed, immediately stop the pulling operation and notify the Engineer. The Engineer will make a determination of acceptability or will reject the cable.

9) Install the fiber cable in continuous runs as marked in the contract documents. End of reel splices or butt splices not shown in the contract documents shall be pre-approved by the Engineer and are incidental to the cost of the installation of the cable. If approved, perform the end of reel or butt splices in existing splice vaults as shown in the contract documents. The cost associated with the end of reel or butt splices including splice closures, storage baskets, splice trays, protective sleeves, and all accessories shall be included in their respective items and shall not result in additional cost to the Contracting Authority.

10) No splices will be allowed unless indicated in the contract documents or approved by the Engineer.

11) Seal all conduit openings using duct plugs or as directed by the Engineer, at all conduit openings at the handholes after cable installation.

d. Fiber Optic Cable Removal.

1) Remove and dispose of fiber optic cable unless otherwise specified in the contract documents.

2) If the contract documents indicate that fiber optic cable is to be retained by DOT, place fiber optic cable onto a reel in accordance with the manufacturer’s recommendations. Test all strands of fiber (uni-directional) with an OTDR at 1310 nm and 1550 nm to verify attenuation, continuity, and length of the cable. Measured length by the OTDR shall match manufacturer cable foot markings plus manufacturer provided helicity. Provide the Engineer with a PDF copy of the OTDR traces. Deliver salvaged materials to the location specified in the contract documents.

e. Facilities Protection.

1) In the event it is suspected that cable damage has occurred prior to final acceptance, test the cable with an OTDR within 72 hours after notification and submit a copy of the OTDR test to the Engineer upon completion.

2) Replace or repair, as directed by the Engineer, any damage occurring before final acceptance at no additional cost to the Contracting Authority. Perform any repairs or

replacements as soon as reasonably possible unless otherwise approved by the Engineer.

3) Replace or repair any defect in the installed cable at no additional cost to the Contracting Authority. Consider a defect to be any condition resulting in a negative or adverse effect on current or future operations of the completed fiber optic communication system as determined by the Engineer.

4) Replace or repair any existing wiring that is damaged during fiber optic cable installation, as directed by the Engineer, at no additional cost to the Contracting Authority.

f. Slack Coils.

1) Leave sufficient slack at each end of the cable to allow proper cable splicing and termination. The minimum slack amount shall be as follows or as indicated in the contract documents:
   - Intermediate pulling handhole – 100 feet
   - Splice point handhole – 150 feet

2) Foot marker and cable size text shall be legible on the cable jacket coiled in the handhole.

3) Neatly coil slack cable in handholes. Bind the slack coils at a minimum of 3 points around the coil perimeter.

4) Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames and terminals.

5) For storage purposes, the minimum bending radius shall not be less than 10 times the outside diameter of the cable or as recommended by the manufacturer, whichever is greater.

g. Cable Identification.

1) Place tags on all fiber optic cable identifying the owner and direction of the cable.

2) Use tags to label fiber optic cable in every cabinet, handhole, and building termination.

3) Tags shall clearly identify where each individual cable run originated and where it ends (handhole to handhole, handhole to cabinet, handhole to building, etc.). Include mileposts for handholes.

4) Engineer will approve tag content before installation.

5) For joint fiber installations with the Contracting Authority, where the fiber will be owned by the other agency (or entity), install typical identifiers and/or markings for that fiber.

h. Lower Fiber Optic Cable in Place.

1) Expose existing direct buried fiber optic cable in an open trench. Excavate to the depth specified in the contract documents.

2) The Contractor is responsible for protecting the existing fiber optic cable.

3) Ensure the bottom of the fiber optic cable rests securely on firm undisturbed soil.

4) Item includes the transition of fiber optic cable from existing depth to new depth specified in the contract documents.

5) Backfill open trench according to Section 2552 of the Standard Specifications and the additional requirements for conduit backfilling listed above.

L. Meter Pedestals.

1. Apply Article 2523.03, C of the Standard Specifications and the following:

2. Install meter pedestals and power connections in accordance with the contract documents, the manufacturer's recommendations, NEC, and all requirements of local electrical utility. Approval from the Engineer and local electrical utility is required prior to revising any power locations.

3. Coordinate installations in advance as noted on the contract documents.

4. Provide all conduit, breaker enclosures, circuit breakers, wiring and accessories, neutral bars and accessories, ground bars and accessories, terminations and grounding in the power source.

5. Coordinate and schedule all locally required inspections of electrical work prior to putting a location into service.

6. Coordinate with the Engineer and power provider to request that electrical service at a device location be initiated. Complete and submit all new service applications to the local electrical utilities.

M. Circuit Breakers.

Install circuit breakers in accordance with the contract documents, the manufacturer's recommendations, NEC, and all requirements of local electrical jurisdiction.

N. Transformers.

1. Install transformer in accordance with the contract documents, the manufacturer's recommendations, NEC, and the manufacturer's recommendations.

2. Do not penetrate the top of any cabinets without prior authorization by the Engineer.

3. All exterior connections shall be watertight.

4. Ensure sufficient clamps, nuts, hardware, etc., as required for the specified mounting type, are furnished with each cabinet.

5. Provide all conduit, breaker enclosures, circuit breakers, wiring and accessories, neutral bars and accessories, ground bars and accessories, terminations, and grounding in the power source.

O. Fiber Optic Splicing.

1. **Fusion Splices.**
   - **a.** Use fusion splices to splice all continuous fiber runs in splice closures and factory terminated connector pigtails.
   - **b.** Splices shall be allowed only in the splice closures as located in the contract documents.
   - **c.** Maximum attenuation per splice as estimated by the fusion splicer shall not exceed 0.02 dB. Any splice exceeding 0.02 dB at the time of splicing shall be re-spliced.
   - **d.** Splice shall provide three axis core alignment using light injection and loss measurement techniques.
   - **e.** No mechanical splices of fiber cable will be allowed.
   - **f.** All fusion splice equipment shall be factory serviced within the last year. Provide copies of factory service 10 calendar days prior to splicing.
   - **g.** Maintain on site at all times all materials necessary to immediately install temporary and/or permanent repairs to active fiber damaged during the course of work, including availability of additional splicing equipment.

2. **Existing Fiber Optic Splice Closure Work.**
   - **a.** Provide a responsible supervisor at all times to monitor work being done at all splice locations having active fibers present.
   - **b.** The Engineer will notify the Contractor of any known active fiber optic cables in the work area.
   - **c.** Coordinate and supervise all work to avoid unplanned service interruptions of active facilities while performing the work.
   - **d.** The Engineer will approve any planned network interruptions by the Contractor before initiating the interruption.
   - **e.** Notify the Engineer at least 5 working days before commencing any work near active or potentially active fiber optic cables.

f. Notify the Engineer immediately if any active fibers are damaged.
g. Maintain on site at all times all materials necessary to immediately install temporary and/or permanent repairs to active fiber damaged during the course of work, including availability of additional splicing equipment.
h. Do not commence any work until repair measures are on site.
i. The Contractor is responsible for any direct or indirect costs related to the damage of the active fibers.

3. Splicing Requirements.
a. The Engineer will be responsible for requesting moratorium dates from the ICN NOC, completing a method of procedures (MOP) form, obtaining approval from the ICN NOC, and notifying the Iowa DOT TMC prior to any splicing work.
1) The notice to the Iowa DOT TMC shall include a listing of devices that will be inactive and the duration of the outage.
2) All MOPs require a minimum notice of 14 calendar days to the ICN NOC. Approval of ICN service affecting splicing windows is at the discretion of the ICN NOC. This may impact the scheduling of splicing work.
b. Maintenance windows for splicing are restricted to Monday night through Thursday night.
c. All splicing and splice case work require a minimum notice of 21 calendar days to the Engineer. Provide the Engineer with the Contractor's on-site splicing representative's contact information and proposed splicing date.
d. Multiple locations may be scheduled and spliced in the same night. Complete work at one location and call the ICN NOC at 1-800-572-3940, or 515-725-4400 prior to starting work at the next location.
e. Immediately before beginning and immediately following the completion of splicing work, it will be the responsibility of the Contractor to notify the ICN NOC, Iowa DOT TMC, and any other contacts specified in the contract documents.

4. Fiber Optic Cable Acceptance Testing.
a. Test splicing termination to termination per the contract documents with an OTDR at 1310 nm and 1550 nm to verify attenuation and continuity of strands for the entire length of cable. Provide the Engineer with up to two copies of any software required for viewing electronic files of the OTDR traces.
b. Each splice is to have an averaged loss value of 0.07 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm. Splice test results submitted to the Engineer that exceed the 0.07 dB or less specification will be identified as Out of Specification.
c. Each connector is to have an averaged loss value of 0.25 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm. Connector test results submitted to the Engineer that exceed the max loss of 0.25 dB specification will be identified as Out of Specification.
d. All test equipment shall be factory certified within the last year. Provide copies of the certification 10 calendar days prior to testing.
e. Test results will be recorded on a form supplied by the Contractor, with data compiled in PDF format through the meter manufacturer's software. No additional alteration using software from the Contractor beyond the meter manufacturer's software will be allowed. Submit test results in a format approved by the Engineer. Hand completed test forms on each fiber over to the Engineer. Provide native test (electronic version) with no alterations and meter software for viewing of fiber traces. At a minimum, 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.

f. OTDR testing shall use a launch and receiving cable. Each cable shall be a minimum 1000 meters (3290 feet), or greater than the dead zone for the OTDR used for this test, whichever is larger.

23074.04 METHOD OF MEASUREMENT.

For the purpose of subcontracting, all bid items associated with this developmental specification will be considered specialty items.

A. ITS Construction Survey.
Lump sum item; no measurement will be made.

B. ITS Power Installed Foundation.
By count.

C. ITS Steel Pole.
By count.

D. ITS Steel Pole, Remove and Reinstall.
By count.

E. ITS Steel Pole, Remove.
By count.

F. ITS Cabinet Foundation.
By count.

G. ITS Device Cabinet.
By count.

H. ITS Device Cabinet, Remove.
By count.

I. ITS Device Cabinet, Remove and Reinstall.
By count.

J. ITS Conduit, of the type and install method specified.
Linear feet shown in the contract documents.

K. ITS Conduit, lower in place.
Linear feet shown in the contract documents.

L. Expose Existing Conduit.
Linear feet shown in the contract documents.

M. ITS Handhole, of the type specified.
By count.

N. ITS Handhole, Remove.
By count.

O. ITS Fiber Marker.
By count.

P. ITS Test Station.
By count.

Q. ITS Isolation Ground Switch.
By count.

R. ITS Ground Rod.
By count.

S. ITS Tracer Wire and XHHW Copper Wire, of the type specified.
Linear feet shown in the contract documents.

T. Fiber Optic Cable, of the type specified.
Linear feet shown in the contract documents.

U. Fiber Optic Cable, Remove.
Linear feet shown in the contract documents.

V. Fiber Optic Cable, Lower in Place.
Linear feet shown in the contract documents.

W. Expose Existing Direct Buried Fiber Optic Cable.
Linear feet shown in the contract documents.

X. ITS Meter Pedestal.
By count.

Y. ITS Circuit Breaker
By count.

Z. ITS Transformer.
By count.

AA. Equipment Rack, of the type specified.
By count.

BB. Unit Connector Housing, of the type specified.
By count.

CC. Module Connector Housing Splice Cassettes.
By count.

DD. Connector Adaptor Panel, Six Duplex SC.
By count.

EE. Single Panel Housing.
By count.

FF. UPC/SC Factory Terminated Fiber Connector and Pigtails.
By count.

GG. Fiber Optic Splice Closure.
By count.

HH. Existing Fiber Optic Splice Closure Work.
By count.

II. Fiber Optic Splice Tray, of the type specified.
By count.

JJ. Fiber Optic Splice.
By count.

KK. Fiber Optic Cable Acceptance Testing.
Lump sum item; no measurement will be made.

23074.05 BASIS OF PAYMENT.

A. ITS Construction Survey.
Payment will be at the lump sum price for ITS Construction Survey. Payment is full compensation for staking and re-staking.

B. ITS Power Installed Foundation.

1. Each.

2. Payment is full compensation for:
- **a.** The furnishing, if specified, and installation of all power installed foundations.
- **b.** Including all surface excavations, repair or restoration of any nearby areas.
- **c.** Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

C. ITS Steel Pole.

1. Each.

2. Payment is full compensation for:
- **a.** The furnishing, if specified, and installation of all poles and accessories,
- **b.** Including all conduit entrances and attachments, all necessary electric grounding materials, and
- **c.** Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

D. ITS Steel Pole, Remove and Reinstall.

1. Each.

2. Payment is full compensation for:
- **a.** The removal, storage, and installation of all poles and accessories,
- **b.** Including all conduit entrances and attachments, all necessary electric grounding materials, and
- **c.** Furnishing new pole mounting hardware, all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

E. ITS Steel Pole, Remove.

1. Each.

2. Payment is full compensation for:
- **a.** The removal and salvaging of all poles and accessories.

b. Furnish all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

F. ITS Cabinet Foundation.

1. Each.

2. Payment is full compensation for:
a. The furnishing and installation of all cabinet foundations,
b. Including all surface excavations, repair or restoration of any nearby areas, concrete, steel reinforcement, and anchors, and
c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

G. ITS Device Cabinet.

1. Each.

2. Payment is full compensation for:
a. The furnishing, if specified, and installation of all cabinets,
b. Including all internal components and accessories required to provide a complete cabinet installation per the contract documents,
c. Providing and installing all mounting materials, cable pulling, routing and management, cable termination, and all necessary electric grounding materials, and
d. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

H. ITS Device Cabinet, Remove.

1. Each.

2. Payment is full compensation for:
a. The removal and salvaging of all ITS cabinets and accessories.
b. Furnish all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

I. ITS Device Cabinet, Remove and Reinstall.

1. Each.

2. Payment is full compensation for:
a. The removal, storage, and installation of all cabinets,
b. Including all internal components and accessories required to provide a complete cabinet installation per the contract documents,
c. Providing and installing all mounting materials, cable pulling, routing and management, cable termination, and all necessary electric grounding materials, and
d. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

J. ITS Conduit, of the type and install method specified.

1. Per linear foot.

2. Payment is full compensation for:
a. The furnishing and installation of all conduits per the contract documents.

b. Including all surface excavations or surface preparation work, repair or restoration of any disturbed areas to pre-construction conditions, proper water/moisture drainage materials.
c. Open trench installation is incidental to bored or plowed conduit installations and will not be paid for separately.
d. Boring in lieu of plowing is allowed at the Contractor's expense.
e. Conduit mounting on new or existing infrastructure.
f. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

K. ITS Conduit, Lower in Place.

1. Per linear foot.

2. Payment is full compensation for:
a. Lowering of existing conduit in place per the contract documents.
b. Including all surface excavations and restoration.
c. Furnishing all labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

L. Expose Existing Conduit.

1. Per linear foot.

2. Payment is full compensation for:
a. Exposing of existing conduit per the contract documents.
b. Including all surface excavations and restoration.
c. Furnishing all labor, tools, equipment, consumable items, and other incidental items necessary to meet the requirements of the contract documents.

M. ITS Handhole, of the type specified.

1. Each.

2. Payment is full compensation for:
a. The furnishing and installation of all handholes and lids.
b. Including all surface excavations, repair or restoration of any nearby areas, concrete, proper water/moisture drainage materials, all necessary electric grounding materials and installation.
c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

N. ITS Handhole, Remove.

1. Each.

2. Payment is full compensation for:
a. The removal and disposal of all handholes and lids per the contract documents.
b. Including all surface excavations and restoration.
c. Furnishing all labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

O. ITS Fiber Marker.

1. Each.

2. Payment is full compensation for:

a. The furnishing and installation of all fiber markers.
b. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

P. ITS Test Station.

1. Each.

2. Payment is full compensation for:
a. The furnishing and installation of all test stations.
b. Including all necessary electric grounding materials and installation.
c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

Q. ITS Isolation Ground Switch.

1. Each.

2. Payment is full compensation for:
a. The furnishing and installation of all test stations.
b. Including all necessary electric grounding materials and installation.
c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

R. ITS Ground Rod.

1. Each.

2. Payment is full compensation for:
a. The furnishing and installation of all ground rods.
b. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

S. ITS Tracer Wire and XHHW Copper Wire, of the type specified.

1. Per linear foot.

2. Payment is full compensation for:
a. The furnishing and installation of all wire per the contract documents.
b. Including the proper installation of the wire into existing conduit and new conduit systems, supply and installation of splices and connectors, and slack, coiled, or stored wire.
c. Furnishing all materials, labor, tools, equipment, consumable items, and other incidental items necessary to meet the requirements of the contract documents.
d. Prior to final acceptance, meet with the Engineer to demonstrate the locate system is working properly throughout the entire locate system.

T. Fiber Optic Cable, of the type specified.

1. Per linear foot.

2. Payment is full compensation for:
a. The furnishing, if specified, and installation of all cable per the contract documents.
b. Including the proper installation of the cable into existing conduit and new conduit systems, and slack, coiled, or stored cables.
c. Furnishing all labor, tools, equipment, consumable items, and other incidental items necessary to meet the requirements of the contract documents.

3. Payment for fiber optic cable installation will not be made until fiber optic cable is tested by the Contractor and OTDR results are accepted by the Engineer.

U. Fiber Optic Cable, Remove.

1. Per linear foot.

2. Payment is full compensation for:
- **a.** The removal and disposal of all cable per the contract documents.
- **b.** Furnishing all labor, tools, equipment, consumable items, and other incidental items necessary to meet the requirements of the contract documents.

V. Fiber Optic Cable, Lower in Place.

1. Per linear foot.

2. Payment is full compensation for:

- **a.** Lowering of existing direct buried fiber optic cable in place per the contract documents.
- **b.** Including all surface excavations and restoration.
- **c.** Furnishing all labor, tools, equipment, consumable items, and other incidental items necessary to meet the requirements of the contract documents.

W. Expose Existing Direct Buried Fiber Optic Cable.

1. Per linear foot.

2. Payment is full compensation for:
- **a.** Exposing of existing fiber optic cable per the contract documents.
- **b.** Furnishing all labor, tools, equipment, consumable items, and other incidental items necessary to meet the requirements of the contract documents.

X. ITS Meter Pedestal.

1. Each.

2. Payment is full compensation for:
- **a.** The furnishing and installation of all meter pedestals.
- **b.** Providing and installing all mounting materials, cable pulling, cable coil, routing and management, cable termination, and all necessary electric grounding materials.
- **c.** Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

Y. ITS Circuit Breaker.

1. Each.

2. Payment is full compensation for:
- **a.** The furnishing and installation of all circuit breakers.
- **b.** Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

Z. ITS Transformer.

1. Each.

2. Payment is full compensation for:
   a. The furnishing and installation of all transformers.
   b. Providing and installing all mounting materials, cable pulling, routing and management, cable termination, and all necessary electric grounding materials.
   c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

AA. Equipment Rack, of the type specified.

1. Each.

2. Payment is full compensation for:
   a. The furnishing and installation of all equipment racks.
   b. Providing and installing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

BB. Unit Connector Housing, of the type specified.

1. Each.

2. Payment is full compensation for:
   a. The furnishing and installation of all unit connector housings.
   b. Providing and installing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

CC. Module Connector Housing Splice Cassettes.

1. Each.

2. Payment is full compensation for:
   a. The furnishing and installation of all module connector housings splice cassettes.
   b. Providing and installing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

DD. Connector Adaptor Panel, Six Duplex SC.

1. Each.

2. Payment is full compensation for:
   a. The furnishing and installation of all connector adaptor panels.
   b. Providing and installing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

EE. Single Panel Housing.

1. Each.

2. Payment is full compensation for:
   a. The furnishing and installation of all single panel housings.
   b. Providing and installing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

FF. UPC/SC Factory Terminated Fiber Connector and Pigtails.

1. Each.

2. Payment is full compensation for:
   a. The furnishing and installation of all fiber optic splice closures.
   b. Providing and installing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

GG. Fiber Optic Splice Closure.

1. Each.

2. Payment is full compensation for:
   a. The furnishing and installation of all UPC/SC factory terminated fiber connectors and pigtails.
   b. Providing and installing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

HH. Existing Fiber Optic Splice Closure Work.

1. Each.

2. Payment is full compensation for:
   a. Providing all coordination, materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

II. Fiber Optic Splice Tray, of the type specified.

1. Each.

2. Payment is full compensation for:
   a. The furnishing and installation of all fiber optic splice trays.
   b. Providing and installing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

JJ. Fiber Optic Splice.

1. Each.

2. Payment is full compensation for:
   a. Providing all coordination, materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

KK. Fiber Optic Cable Acceptance Testing.
Payment will be at the lump sum price for Fiber Optic Cable Acceptance Testing. Payment is full compensation for providing testing results of installed fiber optic cable in a format that is accepted by the Engineer as described in the contract documents.