MINUTES
OF
IOWA DOT SPECIFICATION COMMITTEE MEETING

April 13, 2023

Members Present:	Darwin Bishop	District 3 – DCE
	Mark Dunn	Contracts & Specifications Bureau
	Daniel Harness	Design Bureau
	Eric Johnsen, Chair	Contracts & Specifications Bureau
	Wes Musgrove	Construction & Materials Bureau
	Donna Matulac	Contracts & Specifications Bureau
	Willy Sorenson	Traffic & Safety Bureau
	Christy VanBuskirk	Local Systems Bureau
	Bob Welper	District 2 - DME
Members Not Present:	Scott Nixon	District 1 - DCE
	Mike Nop	Bridges & Structures Bureau
	Charlie Purcell	Project Delivery Division
Advisory Members Present:	Jeff Devries	Construction & Materials Bureau
	Andy Case	Dallas County
	Kuma Chibsa	FHWA
	Brian Worrel	Construction & Materials Bureau
	Ashley Buss	Construction & Materials Bureau
	Scott Sommers	Construction & Materials Bureau

The Specification Committee met on Thursday, April 13, 2023, at 9:00 a.m. Eric Johnsen, Specifications Engineer, opened the meeting. The items were discussed in accordance with the agenda dated April 3, 2023.

The minutes are as follows:

1. **Article 2116.02, C, Full Depth Reclamation.**

The Construction and Materials Bureau requested to update to include Type IL as it will be the only standard cement available soon.

2. **Section 2213, Base Widening.**
Section 2514, Curb Removal.

The Specifications Section requested cleaning up the duplication of curb removal language in these Sections by moving the language to Section 2514.

3. **Article 2301.02, B, 6, Portland Cement Concrete Pavement.**
Article 2433.02, B, 8, Concrete Drilled Shaft.
Section 4101, Portland Cement.

The Construction and Materials Bureau requested to update to include additional blends of cement.

4. Article 2505.03, D, 1, c, Guardrail Construction and Removal

The Design Bureau requested clarification in language to clarify that this specification applies to both new installations as well as replacements.

5. Article 2529.03, G, 3, Full Depth Finish Patches.

The Construction and Materials Bureau requested to update the requirement for curing blankets used by contractors in cold weather.

6. Section 2549, Pipe and Manhole Rehabilitation.

The Specification Section requested to modify this section to include culvert lining to eliminate the need for future SP's.

7. Article 4156.01, Glass Fiber Reinforced Polymer Dowel Bars.

The Construction and Materials Bureau requested to allow GFRP dowel bars on all primary pavements.

8. Article 4183.06, A, 3, Pavement Marking Tape.

The Construction and Materials Bureau requested to correct inaccurate language regarding ASTM reference and to eliminate extra language that is not needed.

9. DS-15105, Intelligent Transportation Systems.

The Specification Section and the Traffic Operations Bureau requested some minor clarifications of language in the newly approved DS.

10. New ERL Testing.

We hope to have the new version of ERL ready for testing soon. Reminder that we plan on issuing a new edition of the Standard Specifications in October that will be exclusively available in a digital format.

The Department plans to make a version of the Standard Specifications available for printing at the users cost. We are still reviewing how best way to make this available and will seek input from industry partners prior to the rollout of the 2023 Standard Specifications.

Form 510130 (08-15)

IOWA DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove	**Office:** Construction & Materials	**Item 1**
Submittal Date: March 2023	**Proposed Effective Date:** October 2023	
Article No.: 2116.02, C, 1 **Title:** Mineral Stabilizing Agents (Full Depth Reclamation)	**Other:**	

Specification Committee Action: Approved as recommended

Deferred:	**Not Approved:**	**Approved Date:** 4/13/2023	**Effective Date:** October 2023

Specification Committee Approved Text: See Specification Section Recommended Text

Comments: None

Specification Section Recommended Text:

2116.02, C, 1.

Replace the Article:

Portland cement meeting ~~ASTM C 150,~~ Type I or Type IL.

Comments:

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

2116.02, C

C. Mineral Stabilizing Agents.

A mineral stabilizing agent may be required by the mix design. When specified, the agent may be from any locally available commercial source meeting the following criteria:

1. Portland cement meeting ~~ASTM C 150,~~ Type I or Type IL.

Reason for Revision: Type IL will be the only standard cement available soon. Type I will no longer be available.

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/Donna Matulac	**Office:** Specifications	**Item 2**
Submittal Date:	**Proposed Effective Date:** October 2023	
Section No.: 2213 **Title:** Base Widening **Section No.:** 2514 **Title:** Curb Removal	**Other:**	

Specification Committee Action: Approved as recommended

Deferred:	**Not Approved:**	**Approved Date:** 4/13/2023	**Effective Date:** October 2023

Specification Committee Approved Text: See Specification Section Recommended Text

Comments: None

Specification Section Recommended Text:

2213.03, C, Removal of Curb.

Replace the Article

~~1.~~ When specified in the contract documents or directed by the Engineer, ~~remove integral curb by methods which will not damage the concrete that is to remain~~ remove curb according to Section 2514.

~~**2.** Remove curb by grinding (or other methods approved by the Engineer) to provide complete removal of curb extending above the pavement surface and a safe and smooth surface to accommodate traffic. Other curb removal methods may include sawing and breaking, or chipping. If removal is done by sawing and breaking, complete the work as shown in the contract documents and as follows:~~

~~**a.** Make a vertical saw cut along the edge of the curb nearest the center line of pavement.~~
~~**b.** At the end of the curb section, extend the saw cut to the extreme end of the curb.~~
~~**c.** At this point, make a saw cut at a right angle extending to the pavement edge.~~
~~**d.** Where flumes occur in curb sections, extend the saw cut across the throat of the flume.~~
~~**e.** On resurfaced pavement, locate the saw cut 7 1/2 inches from the pavement edge. Cut to a depth of 3 inches below the surface of the resurfacing.~~
~~**f.** Immediately before breaking the curb, clean the sawed groove and ensure it is free of dirt, stones, or foreign matter to a depth of at least 1 inch below the pavement surface.~~
~~**g.** Remove concrete (including resurfacing concrete and concrete across the throats of flumes) to comply with the dimensions shown. Cut off loosened and exposed reinforcement.~~

~~**3.** Clean up broken concrete according to Article 1104.08. This broken concrete becomes the property of the Contractor.~~

2213.04, Method of Measurement.

Replace the Articles:

a. Removal of Curb.
~~Stations to the nearest foot shown in the contract documents~~ According to Article 2514.04,

A.

b. Removal of Flumes.
~~Shown in the contract documents~~ According to Article 2514.04, B.

2213.05, Basis of Payment.

Replace the Articles:

A. Removal of Curb.
~~Per station~~ According to Article 2514.05, A.

B. Removal of Flumes.
~~Per unit~~ According to Article 2514.05, B.

2514.04, Method of Measurement.

Replace the Articles:

A. Removal of Curb.
~~According to Article 2213.04, A~~ Stations to the nearest foot shown in the contract documents.

B. Removal of Flumes.
~~According to Article 2213.04, B~~ Shown in the contract documents.

2514.05, Basis of Payment.

Replace the Articles:

A. Removal of Curb.
~~According to Article 2213.05, A~~ Per Station.

B. Removal of Flumes.
~~According to Article 2213.05, B~~ Per unit.

Comments:

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

Reason for Revision: Both Sections 2213 and 2514 had similar language regarding curb removal so we are proposing to put all language related to curb removal under Section 2514 to remove the duplication of language.

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

Comments: This will require bid items 2213-6745500 – RMVL OF CURB and 2513-6745700 – RMVL OF FLUME to be modified and moved to the 2514 bid item series.

County or City Comments:

Industry Comments:

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SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove	**Office:** Construction & Materials	**Item 3**
Submittal Date: March 2023	**Proposed Effective Date:** October 2023	
Article No.: 2301.02, B, 6 **Title:** Portland Cement Concrete Pavement **Article No.:** 2433.02, B, 8 **Title:** Concrete Drilled Shaft **Section No.:** 4101 **Title:** Portland Cement	**Other:**	

Specification Committee Action: Approved as recommended

Deferred:	**Not Approved:**	**Approved Date:** 4/13/2023	**Effective Date:** October 2023

Specification Committee Approved Text: See Specification Section Recommended Text

Comments: None

Specification Section Recommended Text:

2301.02 B. 6, Use of Supplementary Cementitious Materials.

Replace the Article:

The maximum allowable fly ash substitution rate is 20%. The GGBFS substitution rate shall not be more than 35% by weight. The total mineral admixture substitution rate shall not exceed ~~40~~ 50%. When Type IP, ~~or~~ IS, or IT cement is used in the concrete mixture, only fly ash substitution will be permitted. Between October 16 and March 15, substitution of Type I/II cement with fly ash and GGBFS, or Type IP, ~~or~~ IS, or IT cement with fly ash will be allowed only when maturity method is used to determine time of opening.

2433.02, B, 8.

Replace the Article:

~~Limit total mineral admixture substitution rate to 40%. Between October 15 and March 15, do not substitute GGBFS with Type I or Type II IL cement; or fly ash with Type IP, or IS, or IT cement.~~ Refer to Table 2433.02-3 for the maximum allowable substitution rates:

Table 2433.02-3: Maximum Allowable Substitution Rates.

Cement Type	Maximum Allowable Substitution[(a)]	Time Period
Type I, II, IL	35% GGBFS 20% Fly Ash	March 16 through October 15
Type IS, IP, IT	0% GGBFS 20% Fly Ash	March 16 through October 15
All	0% GGBFS 0% Fly Ash	October 16 through March 15

[(a)] Maximum total mineral admixture substitution is 50%.

4101.01, B, 4.

Replace the Article:
Limit total replacement of Type IT to no more than ~~40~~ 50 weight percent.

4101.01, C, 2.

Replace the Article:
Limit total replacement to no more than ~~40~~ 50 weight percent.

Comments:

Member's Requested Change: (Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)
2301.02 B. 6.

B. Portland Cement Concrete Pavement.

6. Use of Supplementary Cementitious Materials.
The maximum allowable fly ash substitution rate is 20%. The GGBFS substitution rate shall not be more than 35% by weight. The total mineral admixture substitution rate shall not exceed ~~40~~ 50%. When Type IP, ~~or~~ IS, or IT cement is used in the concrete mixture, only fly ash substitution will be permitted. Between October 16 and March 15, substitution of Type I/II cement with fly ash and GGBFS, or Type IP, ~~or~~ IS, or IT cement with fly ash will be allowed only when maturity method is used to determine time of opening.

2433.02, B, 8.

8. ~~Limit total mineral admixture substitution rate to 40%. Between October 15 and March 15, do not substitute GGBFS with Type I or Type II IL cement; or fly ash with Type IP, or IS, or IT cement.~~

Replace 8. with the following table

8. Refer to Table 2433.02-3 for the maximum allowable substitution rates:

Table 2433.02-3: Maximum Allowable Substitution Rates.

Cement Type	Maximum Allowable Substitution[(a)]	Time Period
Type I, II, IL	35% GGBFS 20% Fly Ash	March 16 through October 15
Type IS, IP, IT	0% GGBFS 20% Fly Ash	March 16 through October 15
All	0% GGBFS 0% Fly Ash	October 16 through March 15
[(a)] Maximum total mineral admixture substitution is 50%.		

4101.01.B.4

B. ASTM C 595 Cements.
4. Limit total replacement of Type IT to no more than ~~40~~ 50 weight percent.

4101.01.C.2

C. ASTM C 1157 Cements.

2. Limit total replacement to no more than ~~40~~ 50 weight percent.		
Reason for Revision: With new blends of cement becoming available utilizing Type IL cement, a new Type IT(S38)(L7) cement has been approved. This cement is at 45% replacement. Approved in Nebraska and could also be used in Iowa. New Type IT(S38)(L7) cement approved would not meet the current specification of 40% replacement. Replaced in table format due to clear up confusion in the field regarding the use of GGBFS.		
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: Sent to ICPA for review.		

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SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Mike Kennerly/Daniel Harness	**Office:** Design	**Item 4**
Submittal Date: 1/18/2023	**Proposed Effective Date:** 10/17/2023	
Article No.: 2505.03, D, 1, c **Title:** General	**Other:**	

Specification Committee Action: Approved as recommended

Deferred:	**Not Approved:**	**Approved Date:** 4/13/2023	**Effective Date:** October 2023

Specification Committee Approved Text: See Specification Section Recommended Text

Comments: None

Specification Section Recommended Text:

2505.03, D, 1, c.

Replace the first sentence:

When a roadway is open to traffic during construction, complete guardrail installations (including removal and replacement) within 5 working days from the day the structure, barrier rail, pavement, or shoulder (whichever is the controlling item of work) is sufficiently completed to allow guardrail installation.

Comments:

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

2505.03, D, 1, c.

Replace the first sentence:

When a roadway is open to traffic during construction, complete guardrail installations (including removal and replacement) within 5 working days from the day the structure, barrier rail, pavement, or shoulder (whichever is the controlling item of work) is sufficiently completed to allow guardrail installation.

Reason for Revision: Some confusion arose with an overlay project as to whether this article applies only to new guardrail installations or if it also applies guardrail to be removed and replaced with a project. The contractor claimed this spec only applies to new construction. This change is intended to clarify the specification applies to both new installations and to replacements.

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	**Bureau:** Construction & Materials	**Item 5**
Submittal Date: March 2023	**Proposed Effective Date:** October 2023	
Article No.: 2529.03, G, 3 **Title:** Full Depth Finish Patches	**Other:**	

Specification Committee Action: Approved as recommended

Deferred:	**Not Approved:**	**Approved Date:** 4/13/2023	**Effective Date:** October 2023

Specification Committee Approved Text: See Specification Section Recommended Text

Comments: None

Specification Section Recommended Text:

2529.03, G, 3.

Replace the Article:

After the concrete has been finished and surface water has disappeared, cure the concrete. Place curing materials no later than 20 minutes after completing finishing operations. Cure concrete by completely covering it with an insulating blanket-type cover consisting of a layer of closed cell polystyrene foam protected by at least one layer of plastic film, rated by the manufacturer with a minimum R-value of 0.5. Cover the blanket-type cover completely with insulation board having the following properties: cellulosic fiber sheathing with a minimum nominal 3/4 inch thickness. The board may be wrapped with plastic film to protect it from rain. ~~Two~~ An insulating blanket~~s~~ with a minimum R-value of ~~0.5~~ 3.0 may be substituted for the blanket and the insulation board. Place the board or blanket~~s~~ over the patch and adjacent surface and hold it tightly in place with weights to retain all possible heat in the concrete. If the ambient temperature is 75°F or greater for at least half of the cure period, patches may be cured with two coats of white pigmented curing compound in accordance with Article 2301.03, K, 2. Apply second coat when first coat is dry or within 30 minutes.

Comments:

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

3. After the concrete has been finished and surface water has disappeared, cure the concrete. Place curing materials no later than 20 minutes after completing finishing operations. Cure concrete by completely covering it with an insulating blanket-type cover consisting of a layer of closed cell polystyrene foam protected by at least one layer of plastic film, rated by the manufacturer with a minimum R-value of 0.5. Cover the blanket-type cover completely with insulation board having the following properties: cellulosic fiber sheathing with a minimum nominal 3/4 inch thickness. The board may be wrapped with plastic film to protect it from rain. ~~Two~~ An insulating blanket~~s~~ with a minimum R-value of ~~0.5~~ 3.0 may be substituted for the blanket and the insulation board. Place the board or blanket~~s~~ over the patch and adjacent surface and hold it tightly in place with weights to retain all possible heat in the concrete. If the ambient temperature is 75 °F or greater for at least half of the cure period, patches may be cured with two coats of white pigmented curing compound in accordance with Article 2301.03, K, 2. Apply second coat when first coat is dry or within 30 minutes.

Reason for Revision: Update of curing blankets used by contractors with better R value in cold

weather. Allow curing compound to be used when temperatures are greater than 75F. This will also help to reduce excessive temperatures in the patch concrete in hot weather.		
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: ICPA CPR committee has reviewed.		

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SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Eric Johnson/Donna Matulac	**Office:** Specifications	**Item 6**
Submittal Date: March 2023	**Proposed Effective Date:** October 2023	
Section No.: 2549 **Title:** Pipe and Manhole Rehabilitation	**Other:**	

Specification Committee Action: Approved as recommended			
Deferred:	**Not Approved:**	**Approved Date:** 4/13/2023	**Effective Date:** October 2023
Specification Committee Approved Text: See Specification Section Recommended Text			
Comments: None			
Specification Section Recommended Text: See attached.			
Comments:			

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

Reason for Revision: There was recently an SP for culvert lining that duplicated much of the text from Section 2549 so it was recommended to modify Section 2549 to include culverts to eliminate future SP's.

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: New bid items will be needed for the culvert lining.		
County or City Comments:		
Industry Comments:		

Section 2549. Pipe, Culvert, and Manhole Rehabilitation

2549.01 DESCRIPTION.

This section was developed in conjunction with Sections 4050 and 6020 of the SUDAS Standard Specifications, with modifications to suit the needs of the Department.

A. Cured-in-place Pipe (CIPP) Lining:

1. ~~Mainline~~ Sewer Main or Culvert.

2. Service (Lateral) Repair.

3. Point Repair.

B. Pressure Testing and Grouting of Sewer Joints.

C. ~~Pipe~~ Sewer pipe spot repairs.

D. Pre-rehabilitation cleaning and inspection is light ~~sewer~~ cleaning including an unlimited number of passes with a hydraulic flusher. Does not include root cutting or removal of deposits or protruding service connections.

E. Additional ~~sewer~~ cleaning is heavy ~~sewer~~ cleaning including an unlimited number of passes with high velocity hydro cleaning equipment / hydraulic spinner nozzle, cutting roots, removing deposits of attached encrustation (DAE), and removing deposits of attached grease (DAGS). Does not include lateral cuts.

F. Rehabilitate existing manholes to waterproof and to prevent inflow and infiltration, to prevent corrosion, or to reestablish the structural integrity of the manhole. Includes construction of structural liners, protective liners, and infiltration barriers.

2549.02 MATERIALS.

A. Pipe and Culvert Rehabilitation.

1. Apply Article 4147.01.

2. Submittals.

a. CIPP Rehabilitation.

1) Thickness Design: Submit design calculations for CIPP wall thickness based upon ASTM F 1216, prepared and signed by a licensed Professional Engineer in the State of Iowa.

2) Resin: Certificate of compliance with ASTM F 1216 or D 5813.

3) Tube: Certificate of compliance with ASTM F 1216 or F 2019. If glass fiber reinforcement is used, CIPP strain corrosion testing according to ASTM D 3681.

4) Wet Out and Curing: Complete description of the manufacturer's recommended wet out procedure and curing method for the type of lining proposed.

5) Safety Procedures: Submit documentation of National Institute of Occupational Safety and Health (NIOSH) testing, health hazard evaluation, and recommended safety procedures for CIPP workers and public. The safety plan is to include emission stacks a minimum of 6 feet tall and a method to establish a safe perimeter around manholes/emission stacks a minimum of 15 feet in diameter. Based on active air monitoring, workers must wear suitable Personal Protection Equipment (PPE) when initially opening and entering the transport truck or storage unit holding the liner.

b. Grouting Sewer Joints and Service Connections (For Sewer Pipe Only).

1) Grout: Description of chemical grout materials to be used.

2) Additives: Description of additives to be used including strengthening agents, shrinkage reducers, dye, viscosity modifiers, gel time modifier, freeze/thaw inhibiter, or others.

3) Root Inhibitor: Description of chemical root deterrent.

4) Procedures: Manufacturer's published recommendations for storing, mixing, testing, and handling chemical grouts.

c. Installer Information: When requested by the Contracting Authority, submit the following prior to the preconstruction meeting.

1) Installer name.

2) Completed project list for last 5 years including for each project and year completed, client name/address/contact person/phone number, footages installed by pipe diameter, and number of lateral reinstatements.
3) Detailed installation procedures, including estimated times for each task, lateral reinstatement methods, number of required excavations, and other items unique to each product.
4) Video of installation process, if available.
5) Evidence of properly trained personnel.
6) Related ASTM standards or any nationally recognized standards for product installation.
7) Available equipment list.
8) Detailed procedures for repairing the product in the event of future damage or failure and for tapping future service connections, including and required specialized equipment or training.
9) Videos of two rehabilitated sewer sections showing before and after conditions.

d. Additional information may be required. The submittal of prequalification information in no way implies that the product, manufacturer, or installer will be deemed to be qualified. The Contracting Authority, in its sole discretion, will determine whether a product, manufacturer, or installer does or does not qualify as an approved equal.

3. The Engineer may allow substitutions. Provide as a minimum the following information for evaluation:

a. Product Information.
1) Product name.
2) Year product first available in the United States.
3) Total footage or number of line segments installed in the United States.
4) Results of all available product testing, including but not limited to leakage, physical properties, pipe stiffness, chemical resistance, strain-corrosion, external loading, flow characteristics, infiltration/inflow reductions, structural capacity, and external hydrostatic loading capacity.
5) Samples of before and after product.
6) Design method.
7) Typical lining thickness for pipe sizes included in the project.

b. Manufacturer Information.
1) Manufacturer name.
2) Years of experience manufacturing the product.
3) Country of manufacture of all product components.
4) Quality control procedures for product manufacture, including inspection requirements, testing procedures, and allowable tolerance levels.
5) Related ASTM standards, or other nationally recognized standards for product manufacturing.

B. Manhole Rehabilitation.
Apply Article 4147.02

2549.03 CONSTRUCTION.

A. Pipe and Culvert Rehabilitation.

1. Public Relations Program (For Sanitary Sewer Only).
Establish a Public Information and Notification Program for contacting each home or business connected to the affected sanitary sewer, informing them of the work to be done and when the sewer will be off line. The following specific steps are part of the Public Information and Notification Program:

a. Provide written notice to be delivered to each affected home or business describing work, schedule, how the work affects them, and a local telephone number of the Contractor they can call to discuss the project or their problems.
b. Personally contact each home or business on the day lateral verifications using closed circuit video inspection are to be performed. The homeowner or business will be asked to run water down their drain to verify each lateral. If the homeowner is unavailable, attempt other arrangements (cleanouts) to drain water through the lateral to verify each connection.
c. Provide written notice and personally contact the home or business the day prior to beginning inversion of the section of sewer to which they are connected.
d. Personally contact all homes or businesses that cannot be reconnected within the time stated in the written notice.
e. Furnish and service portable toilets for use by the home or business occupants if so required by any affected served business or homeowner.

2. Special Requirements.

a. Prior to start of work, notify all affected parties 24 hours in advance as to the length of time their sanitary sewer service will be blocked.

~~c~~ **b.** Unless specified otherwise, the Contracting Authority will provide water at no cost for cleaning and installation of cured-in-place sewer pipe lining. Utilize an approved double check backflow assembly or open gap.

c. Water for cleaning and installation of cured-in-place culvert pipe lining will be the responsibility of the Contractor.

3. Sewer Cleaning and Inspection for Rehabilitation.

a. General.

1) Provide equipment specifically designed and constructed for ~~sewer~~ pipe cleaning and inspection or otherwise approved by the Engineer.

2) Use ~~sewer~~ pipe cleaning equipment manufacturer's recommended size tools for various pipe sizes.

3) Utilize equipment recommended by the manufacturer to protect the manhole and pipe during cleaning and inspection operations.

4) Perform all cleaning and removal operations under CCTV observation to monitor the progress of the work and to monitor the ~~sewer~~ pipe line for damage. Continue until the condition of the host pipe meets the requirements of the liner manufacturer.

5) Flush all debris to downstream manhole or end of culvert. Screen, collect, and remove debris from ~~sewer~~ pipe.

6) Dispose of all sanitary sewer debris and material at a location directed by the Contracting Authority. If specified in the contract documents, pay for all disposal fees.

b. Pre-Cleaning Inspection.

1) Complete CCTV inspection of sewer prior to initiating cleaning.

2) Inspect each pipe segment between manholes or access points in a single, continuous run where possible.

3) If line is impassable due to debris or obstructions, reverse setup and inspect from opposite manhole or access point.

c. Pre-Rehabilitation ~~Sewer~~ Pipe Cleaning.

1) Perform light cleaning with hydraulic flusher or high velocity cleaning equipment to remove loose debris.

2) Complete up to three passes in an attempt to remove all debris from ~~line~~ pipe.

3) If the pre-rehabilitation light cleaning fails to leave the ~~sewer line~~ pipe in a condition ready for lining, contact Engineer for authorization to proceed with additional sewer cleaning.

d. Additional Sewer Cleaning.

1) Notifying Engineer prior to performing heavy cleaning as required to remove obstructions, grease, rock, sticks, deposits settled (DS), deposits attached grease (DAGS), deposits attached encrustation (DAE), and roots, so the sewer is ready for lining. This item does not include cutting/grinding protruding service lines.

2) Utilize rotating nozzles, saws or cutters, or high velocity hydro-cleaning equipment.

3) Notify Engineer prior to use of mechanical/hydraulic spinner nozzle, chain flail, or other devices that may damage pipe or service connections.

4) If deposits and obstructions cannot be removed by tools normally used in the ~~sewer~~ pipe cleaning industry, notify Engineer immediately.

5) Maintain a log of time spent performing additional pipe cleaning on each ~~line~~ pipe segment.

e. Remove Protruding Service Connection (For Sewer Pipe Only).

1) Grind or cut services that protrude more than 1/2 inch into the sewer main.

2) Utilize a remote grinding/cutting device specifically designed to remove concrete, vitrified clay, PVC, and other types of pipe materials.

3) Notify Engineer if ductile iron, steel, cast iron, or other non-typical service materials are encountered to review the ability and risks of removing the protruding services.

4) Grind or cut protruding service flush to the main sewer pipe without scouring or damaging the main sewer or service connection.

5) Notify the Engineer immediately if the sewer main or service pipe are not structurally sound.

f. Post-Cleaning CCTV Inspection.

1) Complete CCTV inspection ~~of sewer~~ upon completion of all ~~sewer~~ cleaning, obstruction removal, and protruding service removal activities.

2) Inspect each pipe segment between manholes or access points in a single, continuous run.

3) Inspect all service connections at right angles utilizing pan and tilt capabilities of the camera.

4) Identify active and inactive service connections by the following:

a) Observe each service connection and identify active connections by active sewage flow or evidence of recent sewage flow.
b) If the status of the connection is inconclusive, run water down adjacent services to verify the location of each service.
c) Dye test connections if necessary to verify active status.
d) b. Accurately measure and log the location and clockwise position of all active service connections.

g. Groundwater.
If significant groundwater infiltration is present, which could result in resin loss, resin contamination, reduction in CIPP thickness, or inadequate curing, notify the Engineer prior to installing CIPP liner.

h. Inspection Reporting.
1) Provide a copy of the pre-cleaning and post-cleaning video inspections. Include on-screen continuous footage, pipe diameter, direction of viewing, manhole number, and street location reference in the recording. Affix labels to the recording media to include the name of the project, the date, and the location of the inspection.
2) Provide a written report of the inspections. Include true to scale drawings of all ~~sewer~~ defects and observation locations. Reference the time stamp on each line item entry on the written report.

4. Bypassing Sewage (For Sewer Pipe Only).
a. Submit a bypassing plan to the Engineer for review.
b. When sewer line flows exceed the values in Table 2549.03-1, or the depth recommended by the manufacturer of the sewer rehabilitation practice being implemented, reduce flows to acceptable levels.
1) Plug the line at a point upstream of pipe to be rehabilitated if bypassing is required.
2) Pump flow to a downstream point or adjacent system as directed by the Engineer.
a) Provide pump and bypass lines of adequate capacity to handle all flows.
b) Provide adequate reserve pumps on-site for emergency use and for storm flows.
c. Rehabilitation and inspection work may be completed without bypassing in certain situations including low flow conditions, adequate upstream storage, use of a flow-through packer, or other situations approved by the Engineer. If proposed work will be completed without bypassing, have equipment and plan of action available to implement bypass pumping in the event the work is delayed or sewage levels in the upstream line are in danger of causing backups.

Table 2549.03-1: Maximum Depth of Flow During Inspection, Testing, and Rehabilitation

Main Diameter	CCTV Inspection	Joint Testing/Sealing
6” to 10”	20% of pipe diameter	25% of pipe diameter
12” to 24”	25% of pipe diameter	30% of pipe diameter
27” and up	30% of pipe diameter	35% of pipe diameter

5. CIPP Sewer Main and Culvert Lining.
a. General.
1) Clean, prepare, and inspect the repair point according to Article 2549.03, A, 3.
2) Install liner according to the manufacturer’s published recommendations, ASTM F 1216, and ASTM F 2019.

b. Resin Impregnation.
1) Vacuum impregnate tube with resin (wet-out) at manufacturer’s plant under quality controlled conditions or on-site in mobile wet-out unit.
2) Fill all voids in the tube material, adding 5% to 10% excess resin to allow for migration of resin into the voids and cracks.

c. Insertion.
1) General.
a) Perform pre-lining video inspection immediately prior to insertion of the wet-out tube.
b) Insert the wet-out tube through an existing manhole or approved access.
c) Ensure the tube is continuous between manholes with no joints. A single tube may span several manhole reaches as allowed by the equipment, properties of the CIPP, and time limits imposed by sewage flows to the host pipe.
d) Insertion of CIPP indicates acceptance of the host pipe conditions and the suitability of the liner inserted into the host pipe. Repair any failure of CIPP liner due to inadequate cleaning, groundwater infiltration, or defects in the liner system at no additional cost to the Contracting Authority.

2) Inverted Heat-Cured Liner.

a) Prior to installation of the liner, place a temperature sensor on the bottom of the host pipe to monitor the temperature of the outside of the liner during the curing process. Place sensor at the termination point or location most distant from the heat source.

b) Insert the wet-out tube into the inversion device or standpipe with the impermeable plastic liner on the outside of the tube.

c) Turn back the end of the liner to form a cuff and secure the cuff to the inversion device or standpipe.

d) Apply air pressure or hydrostatic head as required to invert the tube into the host pipe with the impermeable liner on the inside of the pipe.

e) Apply lubricant directly to the tube or pour lubricant into the standpipe during the inversion process to reduce friction.

f) Maintain and adjust pressure as necessary to invert the tube from the point of insertion to the point of termination and to hold the tube tight against the wall, producing dimples at service connections.

3) Pull-In UV Light Cured Liner.

a) If CIPP manufacturer recommends the use of a sliding foil for the existing pipe conditions, provide sliding foil which covers the lower third to lower half of the pipe circumference. Pull sliding foil into place.

b) Fold the wet-out liner in half and pull into place through an existing manhole. Monitor pulling speed and tension to avoid exceeding the manufacturer's recommendations.

c) Pull 1 to 2 feet of excess liner into the termination manhole.

d) If the product is sensitive to elongation, measure the overall elongation of the tube after pull-in. Ensure the elongation of the tube is less than 2% of the overall length of the segment specified by the manufacturer.

e) Expand the resin-impregnated tube as necessary to hold the tube tight against the wall, producing dimples at service connections.

f) Perform CCTV inspection of the inflated liner prior to initiating cure. Confirm alignment and fit prior to initiating cure. Make corrections as necessary to provide a finished liner free of wrinkles and defects.

d. Curing.

1) Heat Cured.

a) Maintain consistent pressure, as recommended by the liner manufacturer, until curing is complete. Increase pressures to compensate for external ground water, if present.

b) Cure liner using circulating heated water or steam. Ensure the temperature is sufficient to affect a cure in all sections of the pipe.

c) Monitor and log the temperature from the sensor placed between the impregnated tube and the host pipe.

d) Initial cure will occur during heat up and is achieved when exposed portions of the new pipe appear to be hard and sound and the temperature sensor indicates the liner has reached the temperature necessary to effect a cure in the resin.

e) After initial cure is reached, raise the temperature to post-cure temperatures and hold for a period of time as recommended by the resin manufacturer.

f) Cool the new pipe to a temperature of 100°F for water cure and 113°F for steam cure before relieving the internal pressure within the section.

2) UV Light Cured.

1) Automatically record the time, rate of travel of the ultraviolet assembly, pressures, and amount of lamps in operation for each CIPP segment as documentation of correct curing of the fabric tube.

2) Maintain consistent pressure, as recommended by the liner manufacturer, until curing is complete.

3) Draw the multi-lamp ultraviolet curing assembly through the pipe at a consistent, predetermined, speed that allows for cross-linking/polymerization of the CIPP resin.

4) Adjust air pressure during curing as necessary to hold liner tight to the wall. Maintain pressure by adjustment of the outlet valve.

5) Remove the temporary internal calibration hose installed by the manufacturer after curing is complete.

e. CIPP End Seal Installation (For Sewer Pipe Only).

1) Hydrophilic Gasket Sleeve.

Install sleeve according to ASTM F 3240, sleeve manufacturer's published recommendations, and the following:

a) Do not install sleeve in host pipe more than 24 hours prior to CIPP lining.

b) Clean the first 6 inches of the main pipe to remove debris and visible grease deposits.
c) Install metal retaining clip at the leading edge of the sleeve. The metal clip may be held in place with adhesive tape if desired.
d) Install the sleeve in the main pipe so the leading edge is no more than 6 inches inside the end of the main pipe as measured from the manhole wall.
e) If the main pipe has a diameter of 18 inches or larger, utilize anchor screws to hold the sleeve in place.

2) Expansion Band System.
Install system according to manufacturer's published recommendations and the following:
a) After installation of the CIPP liner, trim the end of the liner squarely a distance of 2 to 6 inches from the inside face of the manhole.
b) Clean the exposed face of the main pipe to remove debris and loose resin.
c) Slide the rubber gasket into the pipe, centering it over the end of the liner. Ensure one expansion band will seat against the liner and the other will seat against the main pipe.
d) Expand the expansion bands using a hydraulic expansion tool approved by the band manufacturer.

f. Service Reinstatement (For Sewer Pipe Only).
1) Do not leave sanitary service blocked for more than 24 hours.
2) Reinstate active service lines from within the main with a CCTV camera and remote cutting tool. Do not reinstate inactive service connections.
3) Machine the opening to full size of the service connection opening area. Ensure the bottom of the liner opening and service line are flush.
4) Ensure the opening does not have pipe fragments or CIPP fragments that may obstruct flow or snag debris.
5) In the event that service reinstatement results in a liner opening greater than 100% of the service connection opening, or damage to the service connection occurs, install a CIPP service repair to cover the over-cut service connection at no additional cost to the Contracting Authority.
6) If service connection cannot be reinstated remotely and requires excavation complete according to the local plumbing code at no additional cost to Contracting Authority.

g. Inspection.
1) Perform CCTV video inspection of completed CIPP lining, including observance of reinstated service connections. Provide copy of video inspection to Jurisdiction.
2) Ensure the tube is free of dry spots, lifts (spots cured away from the sewer), and delaminations. Remove and replace deficient sections.
3) If the CIPP does not fit tight against the original pipe at its termination point, seal the space between the pipes by filling with a resin mixture or hydrophilic seal compatible with the CIPP.

6. CIPP Point Repair (For Sewer Pipe Only).
a. Preparation: Clean, prepare, and inspect the repair point according to ~~Section 4050, 3.01~~ Article 2549.03, A, 3.
b. Bypass Pumping: Develop a plan for flow diversion or stoppage. Review with Engineer prior to initiating repair.
c. Installation.
1) Bypass mainline flow according to the submitted bypass plan.
2) Install CIPP point repair according to system manufacturer's published recommendations.
3) Wet-out the liner with the entire volume of resin recommended by the manufacturer.
4) Load the wet-out liner onto the packer and secure in place. Ensure the ends of the packer extend beyond the ends of the liner.
5) Pull the packer into position within the pipe. Verify position with CCTV observation.
6) Apply air pressure to the packer to expand the CIPP point repair liner against the host pipe.
7) Maintain consistent pressure for the duration of the curing period.

d. Inspection.
1) Perform CCTV video inspection of completed CIPP point repair. Provide copy of video inspection to Jurisdiction.
2) Ensure the tube is free of foreign inclusions, dry spots, pinholes, wrinkles greater than 2% of the pipe diameter, and delamination. Remove and replace deficient sections.

7. CIPP Service Repair (For Sewer Pipe Only).
a. Preparation.
1) Prior to installation of the system, clean and prepare the interior of the host and service pipe in according to the manufacturer's written instructions.

2) Remove all debris and obstructions.
3) Perform a post cleaning CCTV inspection in preparation for installation of the lining system.
4) If any obstructions, joint misalignments, broken or collapsed pipe, or other conditions are identified that will prohibit proper installation of the system, notify the Engineer immediately.

b. Installation.

1) Install CIPP service repair according to system manufacturer's published recommendations and to the length specified in the contract documents.
2) Bypass main line flow according to the submitted bypass plan. Coordinate installation with service owner to prevent service line flows.
3) Wet-out the entire liner, including lateral and mainline portions, using vacuum impregnation.
4) Load the lining system inside or on a pressure apparatus and move into position in the mainline pipe at the service connection.
5) Align and verify the position of liner and service line via CCTV prior to initiating installation.
6) Apply air pressure to invert or expand the resin impregnated CIPP into the lateral pipe and push the main-line portion of the system against the main pipe. Maintain pressure until the curing process is complete.
7) Apply heat or UV light as required by the manufacturer to property cure the liner.
8) If liner is heat cured, follow manufacturer's recommendations for cool-down before relieving pressure.
9) If liner is ambient cured, maintain pressure according to the manufacturer's recommendations before relieving pressure.
10) Remove frayed ends of the system.

c. Inspection and Documentation.

1) Provide Engineer with video documentation of pre-installation conditions and post-installation conditions showing the repair.
2) Ensure the finished CIPP service repair is free of any leakage and visual defects including foreign inclusions, dry spots, lifts, pinholes, major wrinkles, and delamination. Repair any defects that could affect the structural integrity of the system or allow leaks.
3) Maintain a written log of installation conditions according to system manufacturer's recommendations. At a minimum, include time of wet out, time and location of insertion, time of inflation, bladder pressure requirements, required cure time, actual cure time, and cool down duration.
4) Submit documentation of results for CIPP liner material to Engineer.

8. Pressure Testing and Grouting of Sewer Joints (For Sewer Pipe Only).

a. General.

1) Clean, prepare, and inspect the repair point according to Article 2549.03, A, 3.
2) Complete sewer joint and service connection testing and grouting according to the grout supplier and equipment manufacturer's published recommendations, ASTM F 2304, and ASTM F 2454.

b. Equipment.

1) **Joint Testing Device:** Provide a joint testing device (packer), with means for introducing air under pressure into the void area created by the expanded ends of the packer against the host pipe and a means of continuously measuring, viewing, and recording the static pressure of the test medium and grout within the void area only. Provide packer constructed in a manner to allow a limited amount of sewage to flow through at all times.
2) **Service Connection Testing Device:** Provide a service connection testing device with inflatable mainline end elements and a service line grouting plug that creates a void area extending beyond the main connection. Use a service line grouting plug sized to match the diameter of the service being grouted with an effective sealing length of at least 18 inches, unless otherwise specified in the contract documents.
3) **Pumping Equipment.**
   a) Provide positive displacement metering grout pump and hose delivery system capable of supplying a mixed volume of grout at a minimum of 3 gallons per minute and 30 gallons of uninterrupted flow within 10 minutes.
   b) Ensure pump system has sufficient discharge pressure (in excess of system pressure losses and groundwater) to deliver grout volume to fill void space within the gel set time of the chemical grout.
4) **Grout Tanks:** When using non-soluble additives, ensure grout tanks have mechanical mixing devices to keep additives in suspension.
5) **Measuring Equipment:** Provide means of measuring and recording the volume of mixed grout pumped for each grouted joint or service connection.

c. Control Tests.

1) Prior to beginning testing and grouting, perform a demonstration test in an above ground 8 inch nominal diameter test cylinder suitable to contain the full length of the packer and sustain the void test pressure. For service line testing, provide an 8 inch test cylinder with 6 inch service tee to receive the lateral bladder.

2) Equip the test cylinder with a pressure gauge to monitor internal pressure and a release valve to exercise a controlled release of pressurized air from the void area to test the packer under both sound and leaking conditions.

a) With the void release valve closed, inflate the packer and air test the void at 7 to 10 psi. Ensure the observed void pressure at the test cylinder pressure gauge is within + 1/2 psi of the test monitoring equipment.

b) Crack open the release valve to simulate a small leak. Ensure the pressure drop of the cylinder gauge is within + 1/2 psi of the test monitoring equipment.

3) After entering each pipeline segment, but prior to commencement of joint testing, position the packer on a section of sound and clean sewer between two consecutive pipe joints and perform a pressure test. Pressurize packer to between 7 and 10 psi and hold for a period of 15 seconds with a pressure drop of less than 1.0 psi. Deflate packer and ensure that void pressure monitoring equipment drops + 1/2 psi of initial reading.

4) If any of the control tests are unsuccessful, clean equipment of excess grout or make necessary repairs and retest.

d. Sewer Main Joint Pressure Testing.

1) Test joints at a target pressure equal to 1/2 psi per vertical foot of pipe depth plus 2 psi (not exceeding 10 psi).

2) Position the packer within the pipe so the packer straddles the pipe joint to be tested. Verify location via CCTV monitoring.

3) Expand the packer ends to isolate the joint from the remainder of the pipe and to create a void area between the pipe joint and testing device.

4) Pump air into void space until the pressure reaches the required test pressure.

5) Stop the flow of air into the void space and observe the void pressure for 15 seconds.

6) If the pressure is maintained with a drop of less than 1 psi, the joint will be considered as having passed the test.

7) If the pressure drops more than 1 psi during the test period, the joint will be considered as having failed and sealing will be required.

8) Deflate packer and verify the void pressure monitor drops to within + 1/2 psi of 0 psi. Clean equipment if pressure fails to return to 0 psi.

e. Service Line Pressure Testing.

1) Test service lines at a target pressure equal to 1/2 psi per vertical foot of pipe depth plus 2 psi (not exceeding 10 psi).

2) Position the testing device within the line segment to straddle the service connection. Verify location via CCTV.

3) Align the service bladder with the service connection.

4) Apply air pressure to invert or inflate the bladder from the mainline assembly into the service pipe.

5) Expand the packer ends to isolate the section of the service connection to be tested.

6) Introduce air into the void area until a pressure equal to or up to 10% greater than the required test pressure is observed.

7) Stop the flow of air into the void space and observe the void pressure for 15 seconds.

8) If the pressure is maintained, with a pressure drop of less than 2 psi, the connection will be considered as having passed the test.

9) If the pressure drops more than 2 psi during the test period, the connection will be considered as having failed and sealing will be required.

10) Deflate packer and bladder and verify the void pressure monitor drops to within + 1/2 psi of 0 psi. Clean equipment if pressure fails to return to 0 psi.

f. Sewer Main Joint Sealing by Injection Grouting.

Perform joint sealing according to ASTM F 2304, equipment manufacturer, grout supplier, and the following:

1) Position packer over the faulty joint and expand packer ends, isolating the joint with a tight seal.

2) Pump two-part chemical sealant material into the ratio specified by the grout supplier.

3) Continue to pump grout, in stages if necessary, until “refusal” is achieved.

a) Refusal indicates the grout has flowed throughout the void, into the surrounding soil, forming a cohesive seal stopping further flow of grout.

b) Under pumping conditions, void pressure will slowly rise as grout is forced into the surrounding soil and begins to set. When void pressure spikes an additional 8 psi or more in a short pumping period of 1 to 5 seconds, the point of refusal is achieved.

c) If a quantity of grout equal to 1/2 gallon per inch diameter of pipe size is pumped without reaching the point of refusal, staging may be required. Staging is accomplished by repetitive cycles of pumping and curing until refusal is achieved. Notify Engineer for approval before staging is attempted.

d) If joint cannot be sealed by staging, abandon sealing operations at that joint and notify Engineer.

4) Upon reaching refusal, stop grout pumps and allow grout to cure for 30 to 40 seconds.

5) Deflate packer to break away the ring of gel formed in the void and move at least one packer length away from the joint in either direction.

6) Ensure pressure gauge reads zero pressure + 1/2 psi. If gauge does not return to zero clean equipment.

7) Reposition packer over joint and retest at a pressure equal to the initial test pressure.

8) If joint fails pressure test, repeat grouting and pressure testing procedure until the joint is sealed or Engineer determines grout consumption is too high and continued attempts to seal joint are abandoned.

9) Remove residual sealing materials that extend into the pipe or restrict the flow. Ensure sealed joint surfaces are left flush with existing pipe surface. Remove residual grout material from manhole; do not allow grout to be flushed down the sewer.

g. Service Connection Sealing by Injection Grouting.

Perform service sealing according to ASTM F 2454, equipment manufacturer, grout supplier, and the following requirements.

1) Pump two-part chemical sealant material at the ratio specified by the grout supplier.

2) Continue to pump grout, in stages if necessary, until refusal is achieved.

a) Under initial pumping conditions, the void pressure will slowly rise to a range of approximately 2 to 4 psi.

b) Continue pumping until there is a sudden increase to over 8 psi in a few seconds, indicating refusal.

c) If a quantity of grout equal to 1 gallon per foot of service line bladder plus 3 gallons is pumped without reaching the point of refusal, staging may be required.

d) Stage grouting by pumping additional grout equivalent to 1 gallon plus 0.25 gallons per foot of bladder, waiting 1 full minute and retesting. Do not exceed two stages unless approved by Engineer.

3) Upon reaching refusal, stop grout pumps and allow grout to cure for 1 full minute.

4) Deflate service packer, re-inflate, and repeat service line pressure testing.

5) If the service connection test fails, repeat injection grouting and pressure testing procedures until service is sealed or Engineer determines grout consumption is too high and continued attempts to seal service are abandoned.

6) Confirm flow after sealing of each service. If a grout blockage exists, immediately clear the service of the blockage.

7) A thin film of residual grout inside the service, which does not significantly impede flow, is a normal result of sealing and is not considered a blockage.

h. Inspection and Reporting.

Comply with ASTM F 2304 Section 12.9 as noted below.

1) Inspection:

a) Perform CCTV observation and recording of initial pressure testing, sealing operations (if required), and final pressure testing (if required) for each joint or service.

b) Perform final CCTV video inspection of sewer main rehabilitated by injection grouting after all grouting work is completed. Provide copy of video to the Jurisdiction.

2) Reporting.

Upon completion of each pipe segment, submit a report showing the following information for each joint and service connection tested, grouted or both.

a) Identification of sewer pipe section tested.

b) Type of pipe material, diameter, and depth of pipe to surface at manholes.

c) Length of pipe sections between joints.

d) Test pressure used before and after sealing and duration of test.

e) Location of each joint or service connection tested and any joints or service connections not tested with and explanation for not testing.

f) Pass/fail results for each joint or service connection tested.

g) Volume of grout material used on each joint or service connection.

h) Grout mix record of the batches mixed including amount of grout and catalyst, additives, temperature of the grout solution in the tanks, and gel set time used.

9. Spot Repairs by Pipe Replacement (For Sewer Pipe Only).

a. Excavate trench according to Section 2552.
b. Remove existing pipe to the extent required and disconnect affected sewer services.
c. Install replacement pipe of the same nominal size as the existing pipe.
1) Use the same materials as specified in the contract documents that comply with Section 2504.
2) Place bedding material according to Section 2552.
d. Install pipe repair coupling.
1) Cut pipes to length require allowing no more than a 1/2 inch gap between butted pipe ends at coupling location. Cut pipes perpendicular to centerline.
2) Clean the outside surface of the existing and replacement pipes as required to provide a positive seal with the pipe repair coupling.
3) Wrap coupling around pipes, centered on butt joint, and tighten bolts according to manufacturer's recommendations.
e. Reconnect sewer services.
f. Place backfill material in trench according to Section 2552.

10. Cleanup and Closeout.

a. Verify that the services are reconnected and fully operable, with at least 90% of original capacity.
b. Submit initial and final video tapes, CDs, or DVDs to the Engineer.
c. Remove all equipment and debris.

B. Manhole Rehabilitation.

1. Submittals.

a. Concrete mix design, if required by the Engineer.
b. Catalog cuts of all mortar mixes, sealants, and liners.

2. Infiltration Barrier.

Apply Article 2435.03, A.

3. Urethane Chimney Seal.

a. Prepare the surface according to the manufacturer's recommendations, including sandblasting, pressure washing, sealing leaks or gaps, and drying the surface.
b. Apply primer, prepare product, and brush-apply the seal to a minimum thickness of 175 mils, covering 2 inches above the bottom of the frame and the entire adjustment ring area to 3 inches below the bottom adjustment ring.

4. In-Situ Manhole Replacement, Cast-in-place Concrete.

a. Preparation.

Prepare according to the forming system manufacturer's recommendations, including the following:
1) Clean the existing surface to remove loose material and debris.
2) Remove existing steps that might interfere with the erection of the forms.
3) Control infiltration that may affect placement of concrete.

b. Installation.

Install and test according to the forming system manufacturer's recommendations, including the following:
1) Place pipe extensions through the structure to maintain flow during installation.
2) Erect forms inside the manhole. Secure the assembled internal forms to prevent shifting and to provide sufficient stiffness and strength to prevent collapse.
3) Install a plastic liner when specified.
4) Seal the forms at the bottom of the manhole to ensure the concrete does not enter the sewer.
5) Carefully place concrete between the forms and the existing manhole walls. Place concrete from the bottom up to prevent segregation of concrete.
6) Consolidate concrete as required to fill all pockets, seams, and cracks within the existing manhole wall.
7) Remove the forms when the concrete has cured sufficiently.
8) Weld and test joints if a plastic liner is installed.
9) Apply a sealing strip around the circumference of the invert top where it meets the vertical wall and around all pipe penetrations to form a waterstop.

10) Overlay the invert top with concrete or high-strength mortar. Vary thickness from 3 inches at the wall to 1/2 inch at the edge of the channel.
11) Apply an epoxy lining to the invert top. Apply clean sand to the epoxy to create a non-slip surface.
12) Seal the plastic liner to the manhole casting and existing pipe stubs as recommended by the manufacturer.
13) Install a new casting.

5. Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal.

a. Surface Preparation.
Prepare according to the manufacturer's recommendations, including the following:
1) Wash the interior with a high pressure washer.
2) Plug active leaks with the appropriate sealing material.

b. Mortar Application.
Apply according to the manufacturer's recommendations, including the following:
1) Apply with a rotating centrifugal casting applicator, beginning at the bottom of the manhole.
2) Retrieve the applicator head at the manufacturer's recommended speed to achieve the desired thickness.
3) Apply to the full required thickness utilizing multiple passes as necessary. Minimize the time between passes so subsequent passes are cast against fresh mortar.
4) Verify thickness with a wet gage at several locations to ensure proper depth.
5) Hand-apply high-strength mortar to the invert surface. Vary thickness from 3 inches at the wall to 1/2 inch at the edge of the channel.

c. Epoxy Seal Application.
Seal according to the manufacturer's recommendations, including the following:
1) Apply with a rotating centrifugal casting applicator or airless sprayer onto the fresh mortar liner.
2) If the epoxy seal is applied more than 24 hours after application of the mortar liner, or if the mortar liner is contaminated, clean the liner and then apply the epoxy.

d. Finishing.
Install a new casting.

2549.04 METHOD OF MEASUREMENT.

A. Pipe and Culvert Cleaning and Inspection for Rehabilitation.

1. Pre-Rehabilitation Cleaning and Inspection.
Measurement will be made for each diameter range of sewer main or diameter of culvert cleaned and inspected prior to rehabilitation. ~~Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch.~~

2. Additional Sewer or Culvert Cleaning.
Measurement will be made on an hourly basis for additional pipe cleaning for each diameter range of sewer main or diameter of culvert. ~~Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch~~.

B. Remove Protruding Service Connections.
Each protruding service connection removed will be counted. Quantity will be based on number of protruding service connections identified in the pre-rehabilitation CCTV inspection and removed from the post-rehabilitation CCTV inspection.

C. Cured-in-Place Pipe Lining.

1. Cured-in-Place Pipe Main Lining.
Each diameter of main pipe lining will be measured in linear feet along the centerline of the pipe lining from center of manhole to center of manhole.

2. Cured-in-Place Culvert Lining.
Each diameter of Cured-in-Place Culvert Pipe Lining will be measured in linear feet along the centerline of the culvert.

~~2~~ 3. Building Sanitary Sewer Service Reinstatement.
Each active sanitary sewer service reinstated, including those reinstated by excavation, will be counted.

~~3~~ 4. Cured-in-Place Pipe End Seal.

Each size of CIPP end seal installed will be counted.

D. Cured-in-Place Pipe Point Repair.
Each diameter of CIPP point repair will be counted. Repairs in excess of 10 feet in length will be counted as multiple repairs.

E. Cured-in-Place Pipe Service Repair.

1. Cured-in-Place Pipe Service Pipe, Connection.
Each size combination of main and service connection diameters repaired will be counted.

2. Cured-in-Place Pipe Service Repair, Partial Pipe.
Each size combination of main and service diameters and specified service length lined will be counted.

F. Pressure Testing and Grouting of Sewer Joints and Service Connections.

1. Pressure Testing of Mainline Sewer Joints.
Each mainline sewer joint tested will be counted. Separate measurement will be made for each diameter of sewer main. Visually leaking joints, whether tested or not, will be counted if they are grouted.

2. Injection Grouting of Mainline Sewer Joints.
Each mainline sewer joint grouted will be counted. Separate measurement will be made for each diameter of sewer main.

3. Pressure Testing of Service Connections.
Each sewer service connection tested will be counted. Separate measurement will be made for service connections on each diameter of sewer main.

4. Injection Grouting of Service Connections.
Each service connection grouted will be counted. Separate measurement will be made for service connections on each diameter of sewer main.

5. Chemical Grout.
Each gallon of chemical grout used for sealing mainline sewer joints and service connections will be counted.

G. Bypass Pumping.
Lump sum item, no measurement will be made.

H. Spot Repairs by Pipe Replacement.
Both of the following methods will be specified for measurement of spot repairs by pipe replacement:

1. Spot Repairs by Count.
Each spot repair location will be counted.

2. Spot Repairs by Linear Foot.
Measurement will be in linear feet along the centerline of the replacement pipe.

I. Infiltration Barrier.
Each infiltration barrier installed on an existing manhole will be counted.

J. Urethane Chimney Seal.
Each urethane chimney seal installed on an existing manhole will be counted.

K. In-Situ Manhole Replacement, Cast-in-place Concrete.
Measurement of the vertical dimension of in-situ manhole replacement will be in feet from the lowest flowline to the top of the rim.

L. In-Situ Manhole Replacement, Cast-in-place Concrete with Plastic Liner.
Measurement of the vertical dimension of in-situ manhole replacement with plastic liner will be in feet from the lowest flowline to the top of the rim.

M. Manhole Lining with Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal.
Measurement for depth of the vertical dimension of manhole lining will be in feet from the bottom of the lining to the top of the lining for each liner thickness specified.

2549.05 BASIS OF PAYMENT.

A. Pipe and Culvert Cleaning and Inspection for Rehabilitation.

1. Pre-Rehabilitation Cleaning and Inspection.
a. Payment will be made at the unit price per linear foot for each diameter of pre-~~lining~~ rehabilitation cleaning and inspection.
b. Payment is full compensation for pre-cleaning CCTV inspection, light sewer cleaning, debris removal and transport, post cleaning CCTV inspection for Engineer review, and identification and logging of active service taps (if applicable). ~~If specified in the contract documents, u~~Unit price also includes disposal and associated costs for all debris removed from ~~sewer~~ pipe.

2. Additional Sewer or Culvert Cleaning.
a. Payment will be made at the unit price per hour for additional pipe cleaning.
b. Payment is full compensation for heavy ~~sewer~~ pipe cleaning; root cutting; deposit cutting; and removing, transporting, disposing, paying associated costs for all debris removed from sewer, and post cleaning CCTV inspection for Engineer review.

B. Remove Protruding Service Connections.

1. Payment will be made at the unit price for each protruding service connection removed.

2. Payment is full compensation for removal of protruding service connections and debris removal.

C. Cured-in-Place Pipe Lining.

1. Cured-in-Place Pipe Main Lining.
a. Payment will be made at the unit price per linear foot for each diameter of pipe lining.
b. Payment is full compensation for furnishing and installing the liner and appurtenances, CCTV inspection immediately prior to lining, bypass pumping unless otherwise specified, sliding foil, post-lining CCTV inspection, and all costs associated with the public information and notification program.

2. Cured-in-Place Culvert Lining.
a. Payment will be made at the unit price per linear foot for each diameter of Cured-In-Place Culvert Lining.
b. Payment is full compensation for furnishing and installing the liner and appurtenances, CCTV inspection immediately prior to lining, and post-lining CCTV inspection.

~~2~~ 3. Building Sanitary Sewer Service Reinstatement.
a. Payment will be made at the unit price for each active sewer service reinstated.
b. Payment is full compensation for reinstating sanitary sewer service connections, removal of debris, and coordination with service owners.

~~3~~.4. Cured-in-Place Pipe End Seal.
a. Payment will be made at the unit price for each CIPP end seal installed.
b. Payment is full compensation for end seal and installation.

D. Cured-in-Place Pipe Point Repair.

1. Payment will be made at the unit price for each diameter of CIPP point repair.

2. Payment is full compensation for furnishing and placing point repair liner, bypass pumping unless otherwise specified, sewer cleaning, removal of obstructions, debris removal, pipe preparation, and pre and post repair CCTV inspection.

E. Cured-in-Place Pipe Service Repair.

1. **Cured-in-Place Pipe Service Pipe, Connection.**
   - **a.** Payment will be made at the unit price for each size combination of CIPP service pipe, connection.
   - **b.** Payment is full compensation for furnishing and placing service connection liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.

2. **Cured-in-Place Pipe Service Repair, Partial Pipe.**
   - **a.** Payment will be made at the unit price for each size combination of CIPP service repair, partial pipe.
   - **b.** Payment is full compensation for furnishing and installing service repair liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.

F. Pressure Testing and Grouting of Sewer Joints and Service Connections.

1. **Pressure Testing of Mainline Sewer Joints:**
   - **a.** Payment will be made at the unit price for each sewer joint tested.
   - **b.** Payment is full compensation for by-pass pumping unless otherwise specified, control testing, and documentation.

2. **Injection Grouting of Mainline Sewer Joints:**
   - **a.** Payment will be made at the unit price for each sewer joint grouted.
   - **b.** Payment is full compensation for bypass pumping unless otherwise specified, material testing, pressure testing after grouting, re-grouting of failed joints, and documentation. Unit price does not include the quantity of chemical grout used.

3. **Pressure Testing of Service Connections.**
   - **a.** Payment will be made at the unit price for each service connection tested.
   - **b.** Payment is full compensation for bypass pumping unless otherwise specified, and documentation.

4. **Injection Grouting of Service Connections.**
   - **a.** Payment will be made at the unit price for each service connection grouted.
   - **b.** Payment is full compensation for bypass pumping unless otherwise specified, material testing, pressure testing after grouting, and documentation. Unit price does not include the quantity of chemical grout used.

5. **Chemical Grout:**
   - **a.** Payment will be made at the unit price for each gallon of chemical grout used.
   - **b.** Payment is full compensation for grout additives; root inhibitor; and supplying, mixing, and measurement of chemical grout.

G. Bypass Pumping.

1. Payment will be made at the lump sum price for bypass pumping.

2. Payment is full compensation for development and submittal of the bypassing plan, all staffing, equipment, and appurtenances necessary to accomplish the approved bypassing plan, including reserve equipment.

H. Spot Repairs by Pipe Replacement.

Both of the following methods will be specified for payment of spot repairs by pipe replacement:

1. **Spot Repairs by Count.**
   - **a.** Payment will be made at the contract unit price for each spot repair.
   - **b.** Payment is full compensation for uncovering and removing existing pipe, placing backfill material for replacement pipe, and restoring the surface.

2. **Spot Repairs by Linear Foot.**
   - **a.** Payment will be made at the contract unit price per linear foot of spot repair.
   - **b.** Payment is full compensation for furnishing and installing replacement pipe and connections.

I. Infiltration Barrier.

1. Payment will be made at the contract unit price for each infiltration barrier.

2. Payment is full compensation for all necessary compression or expansion bands and extension sleeves as necessary to complete infiltration barrier.

J. Urethane Chimney Seal.
Payment will be at the contract unit price for each urethane chimney seal.

K. In-Situ Manhole Replacement, Cast-in-place Concrete.

1. Payment will be at the contract unit price per vertical foot.

2. Payment is full compensation for handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, and testing the manhole upon completion.

L. In-Situ Manhole Replacement, Cast-in-place Concrete with Plastic Liner.

1. Payment will be at the contract unit price per vertical foot.

2. Payment is full compensation for handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, sealing at the frame and cover, sealing pipe penetrations as recommended by the manufacturer, and testing the manhole upon completion.

M. Manhole Lining with Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal.

1. Payment will be at the contract unit price per vertical foot for each liner thickness properly installed.

2. Payment is full compensation for the handling of sewer flows during lining operations as required to properly complete the installation, and replacement of the existing casting with a new casting.

Form 510130 (08-15)

IOWA DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove	**Bureau:** Construction & Materials	**Item 7**
Submittal Date: March 2023	**Proposed Effective Date:** October 2023	
Article No.: 4156.01 **Title:** Description (Glass Fiber Reinforced Polymer Dowel Bars)	**Other:**	

Specification Committee Action: Approved as recommended

Deferred:	**Not Approved:**	**Approved Date:** 4/13/2023	**Effective Date:** October 2023

Specification Committee Approved Text: See Specification Section Recommended Text

Comments: None

Specification Section Recommended Text:

4156. 01, Description.

Replace the Article:

Dowels consisting of a single uncoated non-metallic material, glass fiber reinforced polymer. Use only in load transfer assemblies for CD joints and individual dowels for dowel bar retrofits or patches on non-Interstate PCC pavements ~~with 20 year design truck traffic of less than 1000 per day, as approved by the Engineer~~.

Comments:

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

4156. 01 Description.

Dowels consisting of a single uncoated non-metallic material, glass fiber reinforced polymer. Use only in load transfer assemblies for CD joints and individual dowels for dowel bar retrofits or patches on non-Interstate PCC pavements ~~with 20 year design truck traffic of less than 1000 per day, as approved by the Engineer~~.

Reason for Revision: After review of test data and truck loadings on the primary system, it was decided that the loadings represented by the lab testing equated to our highest truck levels on the primary system. We have discussed with the manufacturer the required testing needed in order to be approved for the interstate.

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: Industry has been notified and agrees with the change.

Form 510130 (08-15)

IOWA DOT

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Wes Musgrove / Brian Worrel	**Office:** Construction & Materials	**Item 8**
Submittal Date: March 2023	**Proposed Effective Date:** October 2023	
Article No.: 4183.06 A 3 **Title:** Pavement Marking Tape	**Other:**	

Specification Committee Action: Approved as recommended

Deferred:	**Not Approved:**	**Approved Date:** 4/13/2023	**Effective Date:** October 2023

Specification Committee Approved Text: See Specification Section Recommended Text

Comments: None

Specification Section Recommended Text:

4183.06, A, 3, Retroreflectance.

Replace Articles b and c.

b. Measure and report wet retroreflectance values under a "condition of wetness" according to ASTM E 2177. ~~Test may be performed with marking installed on road. Perform laboratory measurements using a 3 to 5 degree lateral slope. Use wetting agent to improve wetting of pavement marking with water. Use of a 0.1% (by volume) liquid soap solution is recommended. Report measurements as an average for each roll tested, in a minimum of three locations.~~

c. Measure and report wet retroreflectance values under a "condition of continuous wetting" (simulated rain) according to ~~ASTM E 2176~~ ASTM E 2832 ~~in a controlled laboratory environment while the marking is positioned with a 3 to 5 degree lateral slope~~. ~~Use wetting agent to improve wetting of pavement marking with water. Use of a 0.1% (by volume) liquid soap solution is recommended. Report measurements as an average for each roll tested, in a minimum of three locations.~~

Comments:

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

4183.06 PAVEMENT MARKING TAPE.

A. Wet, Retroflective Removable Tape Markings.
Comply with Materials I.M. 483.06 and meet the following requirements:

1. Ensure film is free of lead, chrome, and other heavy metals as defined by the EPA.

2. Precoat markings with pressure sensitive adhesive capable of adhering to the pavement at temperatures as low as 50°F in accordance with the manufacturer's recommendations.

3. Retroreflectance.

a. Ensure white and yellow markings have initial expected retroreflectance values as shown in Table 4183.06-1 under dry, wet, and rainy conditions.

b. Measure and report wet retroreflectance values under a "condition of wetness" according to ASTM E 2177. ~~Test may be performed with marking installed on road. Perform laboratory measurements using a 3 to 5 degree lateral slope. Use wetting agent to improve wetting of pavement marking with water. Use of a 0.1% (by volume) liquid soap solution is recommended. Report measurements as an average for each roll tested, in a minimum of three locations.~~

c. Measure and report wet retroreflectance values under a "condition of continuous wetting" (simulated rain) according to ~~ASTM E 2176~~ ASTM E 2832. ~~in a controlled laboratory~~

~~environment while the marking is positioned with a 3 to 5 degree lateral slope. Use wetting agent to improve wetting of pavement marking with water. Use of a 0.1% (by volume) liquid soap solution is recommended. Report measurements as an average for each roll tested, in a minimum of three locations.~~

Table 4183.06-1: Expected Initial R_L under dry, wet, and rainy conditions

WHITE	**Dry, Wet, & Rainy**
Entrance Angle	88.76 degrees
Observation Angle	1.05 degrees
Retroreflected Luminance R_L [(mcd • ft^{-2}) • fc^{-1}]	150
YELLOW	**Dry, Wet, & Rainy**
Entrance Angle	88.76 degrees
Observation Angle	1.05 degrees
Retroreflected Luminance R_L [(mcd • ft^{-2}) • fc^{-1}]	100

4. Removability.
Pavement markings shall be removable from the pavement intact or in large pieces, at temperatures above freezing without the use of heat, solvents, grinding, or blasting; and with no permanent scarring of the roadway surface.

5. Patchability.
Pavement marking material shall be capable of being patched in accordance with manufacturer's instructions.

Reason for Revision: Current ASTM reference for continuous wetting testing is not accurate and has been updated. In addition the standard has all the info needed for testing and reporting – No need for the extra language.

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 (08-15)

SPECIFICATION REVISION SUBMITTAL FORM

Submitted by: Eric Johnson/Donna Matulac/Mark Van Dyke	**Office:** Specifications/TOB	**Item 9**
Submittal Date:	**Proposed Effective Date:** June 20, 2023	
Article No.: **Title:**	**Other:** DS-15105, Intelligent Transportation Systems	

Specification Committee Action: Approved as recommended

Deferred:	**Not Approved:**	**Approved Date:** 4/13/2023	**Effective Date:** June 20, 2023

Specification Committee Approved Text: See Specification Section Recommended Text

Comments: None

Specification Section Recommended Text:

15105.02, G, 1, High Density Polyethylene Conduit.

Replace the Article:

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 a red stripe in color for power. Verify conduit color requirements with local electrical utilities.

~~**b**~~ **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.

~~**c**~~ **d.** Sequential foot markings printed on HDPE.

~~**d**~~ **e.** Continuous reel or straight pieces to minimize splicing.

~~**e**~~ **f.** For dissimilar conduit connections provide an adhesive compatible with both materials.

15105.03, C, 4.

Replace the third bullet:

Critical conduit locations where contract documents specify depth greater than standard and ~~trenchless~~ ~~(~~bored~~)~~ installation methods as described in Section 2553 of the Standard Specifications.

15105.03, J, 1, h, Plowing.

Replace title:

~~**Plowing**~~ **Plowed Conduit Installation.**

15105.03, J, 1, j, Trenchless Conduit Installation.

Replace title:

~~**Trenchless**~~ **Bored Conduit Installation.**

15105.05, I, 2.

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

c. Open trench installation is incidental to bored or plowed conduit installations and will not be paid for separately.
~~c~~ d. Conduit mounting on new or existing infrastructure.
~~d~~ e. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

Comments: Full DS document is attached for reference.

Member's Requested Change: **(Do not use 'Track Changes', or 'Mark-Up'. Use ~~Strikeout~~ and Highlight.)**
See attached draft Developmental Specifications for Intelligent Transportation Systems.

Reason for Revision: Since this is a new DS, there was some minor clarifications to the text that were requested.

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-15106
(Replaced DS-15105)

DEVELOPMENTAL SPECIFICATIONS
FOR
INTELLIGENT TRANSPORTATION SYSTEMS

Effective Date
June 20, 2023

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

15106.01 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
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
RMS – Root Mean Square
SC – Subscriber Connector
SCTE - Society of Cable Telecommunications Engineers
SM – Single Mode
TMC – Traffic Management Center
UPC - Ultra-Physical Contact
UV – Ultraviolet
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. Request moratorium dates from the ICN NOC at ICNServicedesk@iowa.gov, 1-800-572-3940, or 515-725-4400.

d. Coordinate with the ICN NOC 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.
- 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.
- 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.
- Cameras.
- Sensors.
- 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. The Engineer will be responsible for collecting GPS data of all installations including, but not limited to, conduit and/or cable routing and handholes.

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.

c. Mark the conduit alignment at least every 50 feet to allow GPS data to be collected. For any segments that are bored, make note on the flag or stake of the bore depth at the location that is being marked.

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

15106.02 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 "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 2013."

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 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 "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 2013".

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: 3 square feet
Mounting Height: 44 feet

Camera and Mounting Bracket
Weight: 12 pounds
Surface Area: 1.5 square feet
Mounting Height: 40 feet

Roadway Sensor
Weight: 4.2 pounds
Surface Area: 1.5 square feet
Mounting Height: 25 feet

Device Cabinet
Weight: 600 pounds
Surface Area: 6 square feet
Mounting Height: 5 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.

E. Cabinet Foundations.

All concrete shall meet the requirements of Section 2403 of the Standard Specifications. Use Class C concrete for cabinet foundations and all other non-paving concrete construction.

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 TAP Ground Bar.
l. One seven TAP 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 a red stripe in color for power. Verify conduit color requirements with local electrical utilities.

~~b~~ **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.
~~c~~ **d.** Sequential foot markings printed on HDPE.
~~d~~ **e.** Continuous reel or straight pieces to minimize splicing.
~~e~~ **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'.

2. Test Station.
- **a.** 78 inch triangular flexible orange plastic marker with five separate access terminals, isolation lever, and set screw to hold terminal concealment cap on.
- **b.** Orange in color with a black cap.
- **c.** Place Engineer approved custom warning decals on all sides.
- **d.** Use bare stranded No. 6 AWG copper wire between terminal board and the ground rod.
- **e.** 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.** Supply triangular post markers orange in color with an orange cap.
- **b.** Markers shall be 78 inch, polyester resin with reinforcing fibers, and remain flexible from -40°F to +140°F.

c. 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. Single conductor copper clad steel, No. 10 AWG with orange colored HDPE jacket.
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 be manufactured by one of the U.S. based manufacturing companies.

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.

6. Microwave Vehicle Detection System (MVDS) Cable.

Supply all necessary materials and incidental items required to install the MVDS cable furnished by the Contracting Authority.

J. Meter Pedestals.

1. Verify requirements with local electrical utilities.

2. 100 amp, 120/240 volt circuit breaker.

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. Transformers.

1. NEMA 3R enclosure.

2. Single phase 1.0kVA; 60 Hz.

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

L. 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

Use 19 inch wide floor mountable EIA rack.

7. Wall Mount Equipment Rack

Use 19 inch wide wall mountable EIA rack.

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.

15106.03 CONSTRUCTION.

A. General Responsibilities.

1. Stake all handholes and proposed conduit alignment per coordinates provided 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 pole 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. Comply with any special provisions and limitations identified in the contract documents.

B. Material and Equipment Storage and Construction Site Access.

1. Secure a designated material storage area for this project. Any request to store material in the ROW in order to complete the current work activity shall be approved by the Engineer.

2. Construction equipment may be stored within the ROW during non-working hours if it is outside of the roadway clear zone, as far from the traveled way as practical and as approved by the Engineer. Do not store equipment at the toe of any roadway slope.

3. No worker vehicles will be allowed to park in the ROW or access a job site directly from an Interstate or Freeway facility. Access to the job site for both workers and materials shall only be via interchanges or intersecting roadways unless otherwise approved by the Engineer. Park worker vehicles off-site or at a location acceptable to the Engineer.

4. Do not leave open holes or mounds of dirt unprotected during non-working hours.

C. 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 stakes 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 ~~trenchless~~ ~~(~~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 stakes marking bore locations with required minimum conduit depth below existing grade.

D. Disruption to Existing Fiber Networks.

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. 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.

3. 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.

E. Finishing Activities.

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

F. 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.

G. 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 power installed 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. Grounding
a. Use a minimum of three copper bonded steel ground rods per steel pole. Ground rod shall be 5/8 inch by 8 feet.
b. The maximum grounding resistance shall be 20 ohms or less.
c. All ground connections shall be exothermic weld.

4. Pole Removal.
a. Remove ITS poles, including foundation to a depth of 2 feet below established grade.
b. Furnish, place, and compact backfill according to Section 2552 of the Standard Specifications.
c. Deliver salvaged materials to the location specified in the contract documents.

H. Cabinet Foundations.

1. General.
a. Install cabinet foundations in accordance with the contract documents and the manufacturer's recommendations.
b. All cabinet foundations shall include a concrete maintenance pad area that is cast and reinforced as a single unit with the cabinet foundation dimensioned as shown in the contract documents.
c. Prepare and submit for Engineer approval, design plans and details for all cabinet foundations at no additional cost to the Contracting Authority.

d. Contact the Engineer a minimum of 7 calendar days in advance to arrange a field review prior to placing the cabinet foundation.
e. 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.
b. Form the upper portion of all concrete foundations and for all instances where the excavation is irregular in shape to provide the proper dimensions. Forming materials shall be level and braced to avoid displacement, warping, or deflection from the specified pattern during construction and curing.
c. Install and secure anchor bolts, conduits, and reinforcement before concrete placement. Use a rigid template to position anchor bolts in accordance with the appropriate pattern. The center of the template and the center of the concrete base shall coincide unless otherwise directed by the Engineer.
d. Install a sufficient number of conduits sized as indicated in the contract documents. Locate all conduits as indicated in the contract documents. Seal all conduit openings using duct plugs or as directed by the Engineer.
e. Place all concrete within 90 minutes of batching and consolidate using a high-frequency vibrator during construction.
f. Modification of a foundation after construction is not allowed.
g. Cover all anchor bolts to protect them against damage and to protect the public from possible injury until erecting.
h. Allow a minimum of 7 calendar days curing of concrete foundations before setting cabinets.

3. 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.

I. 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.
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.

J. 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) 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.

12) Expose and protect at all times any existing conduit at locations identified in the contract documents.

b. Installation Clearances.

1) Depth of all conduit installation shall be a minimum of 48 inches unless otherwise specified in the contract documents.

2) Maintain the typical offsets from referenced locations as shown in the contract documents.

3) Maintain the minimum depth throughout the length of all conduit installations.

4) Maintain a minimum of 2 feet of separation when underground conduits parallel an existing facility.

5) Maintain a minimum of 2 feet vertical separation when crossing existing utilities.

6) Maintain a minimum of 15 feet vertical separation from top of rail when crossing existing railroad, unless otherwise specified in the contract documents.

7) 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. Surface Restoration.

1) Replace or reinstall features removed as a part of the work, such as sidewalks, driveways, curbs, roadway pavement, unpaved areas, or any other items.

2) Immediately repair or replace any unauthorized disturbance or damage. Replace improved landscaping, lawns, scrubs, and hedge removed or damaged during construction in a manner acceptable to the Engineer. Re-sod damaged lawns using like grasses.

3) Complete restoration according to the applicable sections of the Standard Specifications.

g. Multiple Duct Installation.

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

h. ~~Plowing~~ 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.

i. 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.

j. ~~Trenchless~~ 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 a minimum of 2 feet from the edge of pavement or shoulder unless otherwise directed by the Engineer.

k. 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.
Comply with Article 2523.03 of the Standard Specifications.

3. Electric Metallic Tube Conduit.
Comply with National Electric Code (NEC).

K. 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.

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.

L. Wire and Cable.

1. General.

- **a.** Install wire and cable in accordance with the contract documents and the manufacturer's recommendations.
- **b.** All installations and connections shall comply with the contract documents and all generally accepted codes and standards.
- **c.** 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. Grounding/Bonding.

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

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

c. 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.

5. 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.

Remove and dispose of fiber optic cable unless otherwise 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.

6. Microwave/Radar Vehicle Detection System Cable.

a. Apply Article 2523.03, Q of the Standard Specifications and the following:

b. Install MVDS and Radar cable in continuous runs from the unit to the controller as splicing shall not be permitted.

c. Install additional slack at the locations shown in the contract documents.

M. 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.

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.

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. Obtain approval from the ICN NOC prior to any splicing work.
b. Maintenance windows for splicing are restricted to Monday night through Thursday night.
c. Complete cable cuts (insertion splice locations) require a minimum notice of 14 calendar days to the ICN NOC. Splicing work at insertion splice locations shall be separated by a minimum of 10 working days.
d. Multiple maintenance windows per week may be scheduled for splicing that does not impact ICN traffic depending on NOC approval.
e. Only one splicing crew is allowed per night. Multiple locations may be spliced in the same night. Notify ICN NOC prior to splicing work and upon completion of splicing before moving to the next location.
f. Prior to splicing, notify the following project contacts unless specified elsewhere in the contract documents:
- ICN NOC,
- Engineer,
- Iowa DOT TMC, and
- Iowa DOT Statewide ITS Maintenance Contractor.

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.

15106X.04 METHOD OF MEASUREMENT.

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 and Reinstall.
By count.

I. ITS Conduit, of the type and install method specified.
Linear feet shown in the contract documents.

J. ITS Conduit, lower in place.
Linear feet shown in the contract documents.

K. Expose Existing Conduit.
Linear feet shown in the contract documents.

L. ITS Handhole, of the type specified.
By count.

M. ITS Handhole, Remove.
By count.

N. ITS Fiber Marker.
By count.

O. ITS Test Station.
By count.

P. ITS Isolation Ground Switch.
By count.

Q. ITS Ground Rod.
By count.

R. ITS Tracer Wire and XHHW Copper Wire, of the type specified.
Linear feet shown in the contract documents.

S. Fiber Optic Cable, of the type specified.
Linear feet shown in the contract documents.

T. Fiber Optic Cable, Remove.
Linear feet shown in the contract documents.

U. Fiber Optic Cable, Lower in Place.
Linear feet shown in the contract documents.

V. Expose Existing Direct Buried Fiber Optic Cable.
Linear feet shown in the contract documents.

W. ITS Meter Pedestal.
By count.

X. ITS Transformer.
By count.

Y. Equipment Rack, of the type specified.
By count.

Z. Unit Connector Housing, of the type specified.
By count.

AA. Module Connector Housing Splice Cassettes.
By count.

BB. Connector Adaptor Panel, Six Duplex SC.
By count.

CC. Single Panel Housing.
By count.

DD. UPC/SC Factory Terminated Fiber Connector and Pigtails.
By count.

EE. Fiber Optic Splice Closure.
By count.

FF. Existing Fiber Optic Splice Closure Work.
By count.

GG. Fiber Optic Splice Tray, of the type specified.
By count.

HH. Fiber Optic Splice.
By count.

II. Fiber Optic Cable Acceptance Testing.
Lump sum item; no measurement will be made.

15106.05 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 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 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.

I. 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.
- ~~**c**~~ **d.** Conduit mounting on new or existing infrastructure.
- ~~**d**~~ **e.** Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents

J. 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.

K. 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.

L. 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.

M. 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.

N. 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.

O. 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.

P. 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.

Q. 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.

R. 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.

S. Fiber Optic Cable, of the type specified.

1. Per linear foot.

2. Payment is full compensation for:
a. The furnishing, if specified, 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.

T. 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.

U. 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.

V. 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.

W. 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.

X. 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.

Y. 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.

Z. 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.

AA. 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.

BB. 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.

CC. 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.

DD. 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.

EE. 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.

FF. Existing Fiber Optic Splice Closure Work.

1. Each.

2. Payment is full compensation for providing all coordination, materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

GG. 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.

HH. Fiber Optic Splice.

1. Each.

2. Payment is full compensation for providing all coordination, materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

II. 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.