



Iowa Department of Transportation

SPECIAL PROVISIONS FOR ITS INFRASTRUCTURE INSTALLATION

Pottawattamie County
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THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

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PART I GENERAL REQUIREMENTS

This part consists of the general provisions necessary when furnishing and installing the ITS Infrastructure as described in the project plans and these special provisions.

This project involves supplying and installing conduit, bridge attachments, handholes, building entrances, device poles and footings, device cabinets and footings, fiber termination cabinets and footings, tracer wire and pull tape, power supplies and cabling, and power terminations deemed necessary for a complete ITS Infrastructure installation designed for use with future proposed ITS fiber and device deployments and other uses planned by the Iowa DOT. The Iowa DOT plans to initiate separate contracts to install and terminate the fiber optic cable and place it in service (light the fiber network). Separate contracts will also be initiated to supply and install the cameras, sensors, and other ancillary equipment in or on the cabinets and poles, as well as other items required to provide a complete and functioning network of ITS devices.

The Contractor shall not take advantage of any apparent error, discrepancy or omission in the plans or specifications. Upon discovery of such an error, discrepancy or omission, the Contractor shall notify the Engineer immediately. The Engineer will then make such corrections or interpretations as necessary to fulfill the intent of the plans and specifications.

Materials or work described in words which, so applied, have known technical or trade meaning shall be held to refer to such recognized standards.

Figured dimensions on the plans shall be taken as correct but shall be checked by the Contractor before starting construction. Any errors, omissions, or discrepancies shall be brought to the attention of the Engineer and the Engineer's decision thereon shall 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.

The Contractor for this project shall coordinate work with the contractor(s) working on the fiber optic cable and device deployment projects. The Iowa DOT will assist in the coordination and scheduling of work. The Contractor for this project shall assign a responsible staff member that will work with the Iowa DOT on decisions regarding order of work and scheduling as needed throughout the duration of this project.

1.01 Related Specifications and Standards

The work as detailed on the plans for the ITS Infrastructure Installation shall be completed in accordance with the plans, special provisions and all other contract documents. A requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete project.

1. Specifications of the Underwriter's Laboratories, Inc.
2. National Electric Code
3. Manual on Uniform Traffic Control Devices

1.02 Local Requirements

A. General

Comply with any special requirements and limitations identified in the Plans.

B. Coordination of Work

Contractor for this project shall coordinate work with the Contractor(s) working on other Iowa DOT projects in the vicinity as noted in Tab 111-01 on sheet C.01 of the plans.

C. Building Facilities

All work in or around any building facility shall be coordinated with the Engineer and the Iowa DOT District staff. Provide a minimum of 48 hours notice to the Engineer before performing any work in the immediate vicinity of a building or surrounding parking area.

1.03 Contractor's Responsibility

A. Coordination with Utilities

1. The Contractor is responsible for determining the exact location and elevation of all public utilities in proximity to any construction work and shall conduct all activities to ensure that public utilities are not disturbed or damaged.
2. The Contractor is fully liable for all expenses incurred as a result of failing to obtain required clearances, location of utilities, and any damage to utilities caused by construction.
3. Utility companies whose facilities are shown on the plans or known to be within the construction limits shall be notified by the Contractor of the starting construction date.

B. One Call Locating

Until final acceptance, the Contractor shall provide all utility locates of the work performed under this contract when requested through One-Call services or by the Engineer. The Contractor shall perform any such locations within 48 hours of receiving notice that such locations are needed.

C. Material and Equipment Storage and Construction Site Access

1. Contractor shall secure a designated material storage area for this project. Any request to store material in the right-of-way in order to complete the current work activity shall be approved by the Engineer.
2. Construction equipment may be stored within the right-of-way 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. No equipment shall be stored at the toe of any roadway slope.
3. No worker vehicles will be allowed to park in, 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. Worker vehicles shall be parked off-site or at a location acceptable to the Engineer

D. 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.

1.04 Contractor Submissions

A. Materials List

The Engineer shall furnish a list of materials required for the project to each bidder with the proposal. Complete and submit one electronic pdf file of the materials list within 14 calendar days after award of the project contract. Include the name of the materials supplier and catalog number of each item listed.

B. Construction Schedule

1. Within 30 days after award of contract, the Contractor shall 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.
2. Major items of work to be included on the schedule are installation of conduit, handholes, device poles and footings, device cabinets and footings, and electrical installations.
3. 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.
4. Submittal and approval of the proposed construction schedule by the Engineer is required before the Contractor can commence construction activities.

C. Shop Drawings/Catalog Cuts

1. Prior to construction and after approval of the Materials List, submit one electronic pdf file of the shop drawings or catalog cuts for the materials to the Iowa DOT for approval.
2. The Engineer shall review the shop drawings/catalog cuts for the purpose of assuring general conformance with the project design concept and contract documents.
3. Provide written notice of any deviations from the requirements of the plans or contract documents.
4. 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.
5. The Engineer shall provide approval before any materials are ordered.

D. Materials Procurement

1. Shop drawings, specification data, and samples for acceptance testing (when requested) shall be submitted to the Iowa DOT for approval and/or selection prior to the placing of orders for any equipment and materials.
2. The Contractor shall order all materials requiring production lead time greater than 4 weeks within 5 business days of receiving the approved shop drawing(s).
3. The Contractor shall submit to the Engineer proof of material purchase order in electronic pdf format.

E. Warranty

1. Transfer all required standard materials warranties on the date of final acceptance to the Iowa DOT.
2. Warranty periods shall not commence prior to final acceptance of the work.

1.05 As-Built Documentation**A. General**

1. As-built record drawings will be the responsibility of, and completed by, the Engineer. As such, it will be the responsibility of the Engineer to coordinate directly with the Contractor to ensure that a master record set of the plans is maintained throughout construction to document all installations and any deviations from the design shown in the contract documents.
2. It is the responsibility of the Contractor to maintain written records of daily construction progress, areas worked and quantities installed to aid in the completeness of as-constructed documentation by the Engineer's on-site representative.

B. GPS Data Recording Staking Assistance

1. The Engineer's on-site representative will be responsible for collecting GPS data of all installations including, but not limited to: conduit routing, handholes, device poles, device cabinets, and power supplies. All efforts will be made by the Engineer's on-site representative to coordinate with the Contractor and collect construction progress daily.
4. The Contractor shall be responsible to coordinate and assist the Engineer's on-site representative in this effort by staking, flagging or otherwise locating all installed features until such time that the GPS data can be collected.

PART II TECHNICAL PROVISIONS

This part consists of the material requirements, construction details, and methods of measurement and basis of payment necessary to complete construction of the ITS Infrastructure project, in place, as described in the Contract Documents.

2.01 General

- A. Supply only new materials from reputable suppliers and manufacturers approved by the Engineer. 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 UL-approved. Securely store and protect all materials delivered to the project site. Provide appropriate material quantities for testing or verification at no additional cost when requested by the Engineer.
- B. The Contractor shall expect some reasonable variation in location of the facilities shown due to unforeseen conflicts, changes in proposed work, installation difficulties, or other circumstances. The Engineer shall authorize any changes in location in writing before performing the installation. No additional compensation shall be provided for additional work associated with or resulting from unauthorized changes to the contract documents.

2.02 Device Cabinets

Furnish all work, apparatus, and materials to construct and install the device cabinets designed to house the control equipment required for the planned ITS system.

A. Materials

Furnish materials of new stock only.

1. General

- a. Supply device cabinets, clean-cut in design and appearance
- b. Cabinets shall be dimensioned as identified in the Contract Documents.
- c. Cabinets shall be corrosion resistant, UL-50 approved, NEMA Type 3R compliant, constructed of welded sheet aluminum with a minimum nominal thickness of 0.125 inch.
- d. Cabinets shall be complete with all required internal components, fully wired back panel, side mount DIN rails, terminal strips, and stainless steel hardware.
- e. Cabinets shall include one mounting shelf.
- f. 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.
- g. The cabinet structure shall be effectively sealed to prevent the entry of rain, dust, and dirt.
- h. All exterior seams for cabinet and doors shall be continuously welded. All edges shall be filed to a radius of 1/32 inch minimum.
- i. All pole mount cabinets shall be equipped with top and bottom mounting flanges.

2. Cabinet Doors

- a. The cabinet door shall be sturdy, torsionally rigid, and attached by a continuous heavy duty gauge aluminum butt hinge utilizing a stainless steel 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, with plus or minus 10 degrees accuracy. Both the door and door stop mechanism shall be of sufficient strength to withstand a simulated wind load of five 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. Cabinet light (LED) with light bulb provided operated by door switch.
- e. Each cabinet door shall be provided with a high quality, heavy duty tumbler-type lock. Two #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. Power Panel, 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 125 Amp load center, 120/240 VAC, 8 space.
- d. One 60 Amp double pole breaker (Main).
- e. One 15 Amp single pole breaker (Equipment).
- f. One 15 Amp single pole breaker (Auxiliary).
- g. One 40 Amp double pole breaker (DMS/LCS).
- h. A 120/240 VAC surge protector with surge current at minimum of 100KA, nanosecond response time, and an operating temperature of -40°C to +85°C.
- i. An auxiliary six terminal electrical block rated for a maximum 250 VAC RMS maximum voltage and 20 Amps current.
- j. A DMS/LCS four terminal electrical block rated for a maximum 250 VAC RMS maximum voltage and 40 Amps current.
- k. A 15 Amp GFCI receptacle in Ivory color (Auxiliary).
- l. A 15 Amp Duplex receptacle in Ivory color (DMS/LCS controller).
- m. An eight outlet Power Distribution Unit with built in surge suppressor (1800 Joules of surge/lightning protection) that includes a resettable circuit breaker and minimum cord length of 6 feet.
- n. One 7 TAP Ground Bar.
- o. One 7 TAP Neutral Bar.
- p. All miscellaneous wiring, harnesses connectors and attachment hardware.
- q. All conductors used on the cabinet wiring shall be No. 14 AWG or larger with a minimum of 19 strands. Conductors shall conform to MIL SPEC MIL-W-168780, Type B or D. The insulation shall have a minimum thickness of 10 MILS. All wiring containing line voltage shall be a minimum size of No. 12 AWG.

4. Ventilation

a. Vents

- 1) Furnish cabinets containing a suitably designed rain tight vent or vents that:
 - Are equipped with suitable screens or dust filters, and
 - 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

Meet the following requirements:

- A thermostatically controlled vent fan is furnished to provide air circulation within the

cabinet.

- 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.
- 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.
- 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. Supply cabinet pedestals, clean-cut in design and appearance
- b. Cabinet pedestals shall be dimensioned as identified in the Contract Documents.
- c. Cabinet pedestals shall be corrosion resistant, UL-50 approved, NEMA Type 3R compliant, constructed of welded sheet aluminum with a minimum nominal thickness of 0.125 inch.
- d. Cabinet pedestals shall be complete with all stainless steel hardware.
- e. Cabinet pedestals 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.
- f. The cabinet pedestal shall be effectively sealed to prevent the entry of rain, dust, and dirt.
- g. All exterior seams for cabinet pedestals shall be continuously welded. All edges shall be filed to a radius of 1/32 inch minimum.

B. Construction

1. General

- a. Install cabinets in accordance with the contract documents and the manufacturer's recommendations.
- b. Do not penetrate the top of any cabinets without prior authorization by the Engineer.
- c. Do not allow screws used for mounting shelves or other mounting purposes to protrude beyond the outside wall of the cabinet.
- d. All connections shall be watertight.
- e. Contact the Engineer a minimum of 1 week 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 controller cabinet with a sealing compound that meets the following requirements:
 - Readily workable, soft plastic
 - Workable at temperatures as low as 30°F, and
 - Does not melt or run at temperatures as high as 300°F.
- d. Do not install the controller cabinet on preplaced caulking material on the concrete base or place caulking material around the base of the cabinet after installation.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for device cabinets shall be paid for at the contract unit price per each for the bid items Cabinet, Furnish and Install, 36 Inch X 24 Inch X 17 Inch, 120V and Cabinet, Furnish and Install, 36 Inch X 24 Inch X 17 Inch, 120V/240V.
2. Payment is full compensation for:
 - The furnishing and installation of all pole mounted and pedestal mounted cabinets,
 - Including all internal components and accessories required to provide a complete cabinet installation per the contract documents,
 - Providing and installing all mounting materials, cable pulling, routing and management, cable termination, and all necessary electric grounding materials, and
 - Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.03 Cabinet Footings

A. Materials

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

B. Construction

1. General

- a. Install cabinet footings in accordance with the contract documents and the manufacturer's recommendations.
- b. All cabinet footings shall include a full depth 4 feet concrete maintenance pad area that is cast and reinforced as a single unit with the cabinet footing.
- c. Prepare and submit for Engineer approval, design plans and details for all cabinet footings at no additional cost to the Engineer. Such plans and details shall be sealed by a professional engineer licensed in the State of Iowa.
- d. Contact the Engineer a minimum of 1 week in advance to arrange a field review prior to placing the cabinet footing.
- e. Notify the Engineer immediately if an obstruction conflicts with a footing. The Engineer is responsible for relocating or determining another effective means of supporting the structure to eliminate the conflict. Payment shall not be made for re-work or extra work as the result of an unauthorized relocation of a footing.

2. Installation Details

- a. Construct all footings as located by the Engineer. Securely rest all footings on firm undisturbed ground and set level and to the proper elevation.
- b. Form the upper portion of all concrete footings 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. All conduits shall be located as indicated in the contract documents.
- e. Place all concrete within 90 minutes of batching and consolidate using a high-frequency vibrator during construction.
- f. Modification of a footing 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 poles.

h. Allow a minimum of 7 calendar days curing of concrete footings before setting cabinets.

3. Improper Construction

Remove and reconstruct, at no additional cost to the Engineer, all footings improperly constructed or with improperly installed anchor bolts, conduit, or any other footing components as determined by the Engineer.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for cabinet footings shall be paid for at the contract unit price per each for the bid item Cabinet Footing.
2. Payment is full compensation for:
 - The furnishing and installation of all cabinet footings,
 - Including all surface excavations, repair or restoration of any nearby areas, concrete, steel reinforcement, and anchors, and
 - Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.04 Handholes

A. Materials

1. General

- a. Supply handholes constructed of epoxy or polyester resin mortar with woven glass fiber reinforcement and an appropriate aggregate dimensioned as indicated in the contract documents.
- b. Handhole materials shall not support combustion when tested in accordance with "Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position" ASTM D-635.
- c. Water absorption shall not exceed 2% of the original weight of material under test conditions per "Standard Test Method for Water Absorption of Plastics" ASTM D-570.
- d. The handhole shall be functional without failure throughout a temperature range of -50°F to +170°F.
- e. The handhole walls shall not deflect more than 0.024 inches per foot of length of box when installed and subject to an ASTM C-857 TIER 22 load.
- f. Handholes shall meet ANSI/SCTE 77 standards and be verified by a registered third party and stamped by a registered Professional Engineer.
- g. Handhole lid strength shall be tested to 22,500 pounds (Tier 15).
- h. Handhole lids shall be labeled as indicated in the plans or as directed by the Engineer.
- i. The Engineer shall provide approval prior to use of any handholes satisfying the contract documents requirements for structural, physical, and chemical properties.

2. Test Stations

- a. Supply Rhino part TVTI60OB5 or approved equivalent test stations at all Type Fiber Vault handholes.
- b. Test Stations shall be 60 inch triangular flexible orange plastic marker with five separate access terminals and set screw to hold terminal concealment cap on.
- c. Place custom warning decals on all sides, the Engineer shall provide prior approval of decals.

3. Handhole Marker

- a. Supply Rhino 3-Rail or approved equivalent markers at all FOR 27 handhole locations.
- b. Markers shall be 66 inch, orange, polyester resin with reinforcing fibers, and remain flexible from -40 F to +140 F.
- c. Place custom warning decals on all sides, the Engineer shall provide prior approval of decals.

B. Construction

1. General

- a. Install the type and size of handholes at the locations indicated in the contract documents.
- b. Construct all Type Fiber Vault handholes as located by the Engineer
- c. Set handholes flush with the surface when constructing in a sidewalk or driveway. Set handholes approximately 1 inch above the finished surface of the surrounding ground when constructing in an earth embankment or non-paved surface.
- d. Install Portland cement concrete fine aggregate gradation No. 1 in the Standard Specifications Aggregate Gradation Table bedding to a depth of 1 foot below the handhole.
- 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 at Handhole, Type Fiber Vault locations.
- h. Install ground rods at all Type Fiber Vault handholes as indicated in the contract documents.
- i. Plug all open conduit ends within the handhole in a manner acceptable to the Engineer.
- j. Rodent proof all handholes to the satisfaction of the Engineer.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all handholes shall be paid for at the contract unit price per each for the bid items Handhole, Furnish and Install, Type I; Handhole, Furnish And Install, For27; and Handhole, Furnish and Install, Fiber Vault.
2. Payment is full compensation for:
 - The furnishing and installation of all handholes,
 - Including all surface excavations, repair or restoration of any nearby areas, concrete, proper water/moisture drainage materials, all necessary electric grounding materials and installation,
 - Furnishing and installing all test stations at Handhole, Type Fiber Vault locations, and
 - Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.05 Conduit

A. Materials

1. High Density Polyethylene (HDPE) conduit

- a. High Density Polyethylene (HDPE) conduit shall be smooth wall ORANGE in color.
- b. Comply with ASTM F 2160 (conduit) and ASTM D 3350 (HDPE material), minimum SDR 13.5, and NEMA TC-7 EPEC-B standards.
- c. Sequential foot markings printed on HDPE.
- d. A custom message of stated material specifications that product meets shall be printed a minimum of every 10 feet.
- e. Continuous reel or straight pieces to minimize splicing.
- f. For dissimilar conduit connections provide an adhesive compatible with both materials.

B. Construction

1. General

- a. Follow all general guidelines covering the construction of buried conduit.
- b. Install conduit by plowing, jacking, pushing, boring, or other approved methods within the public right of way and in a manner that minimizes atypical damage from construction operations.
- c. 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.

- d. Open trench installation is only permitted within 25 feet of any handhole, pole, structure, or other similar improvements, and any other requested locations approved by the Engineer.
 - e. At the discretion of the Engineer, verify the integrity of the conduit structure in a manner acceptable to the Engineer.
 - f. Tunneling under the pavement or water jetting shall not be permitted.
 - g. 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. Where indicated in the contract document and at all roadway and stream crossings, install conduit sections with external protection as specified herein.
 - h. No direct-buried cable is allowed.
 - i. Seal all conduit openings using an approved sealing compound (duct seal) at all conduit openings at the junction boxes handholes, poles, cabinets, and building entrances.
- 2. Installation Clearances**
- a. Depth of all bores shall be a minimum of 48 inches unless otherwise specified in the plans.
 - c. Unless otherwise indicated, install all conduit at rail crossings at a minimum of 15 feet below base of rail or 15 feet below natural ground line, whichever is greater.
 - d. Maintain the minimum depth throughout the length of all conduit installations.
 - e. Maintain a minimum of 2 feet of separation when underground conduits parallel an existing facility.
- 3. Conduit Splicing**
- a. Conduit shall be installed in continuous runs between handholes, foundations, and structures unless otherwise directed by the Engineer.
 - b. Conduit splicing shall only be permitted at locations where conduit of differing materials must be joined.
 - c. All mechanically joined conduit splices shall use compression couplings designed for underground placement and blown-in fiber installation.
 - d. Butt fusion welding and solvent welding of conduits will not be allowed.
 - e. All conduit splices shall be watertight to 200 psi.
 - f. Conduit splicing is incidental to the connected items of work.
- 4. Facilities Protection**
- a. The contractor is responsible for protecting and maintaining the conduit throughout construction and until final acceptance.
 - b. To avoid possible damage to buried conduit from exposure to traffic, livestock and other hazards, complete trenching of laterals, trenching around culverts, construction of aerial inserts and similar operations as soon as practicable behind all segment installations.
 - c. If more than 48 hours lag is expected behind a segment installation, install additional protective measures acceptable to the Engineer.
- 7. Backfilling**
- a. Backfill trenches and other excavations in lifts of 6 inches or less in compacted depth. Compact each layer thoroughly before placing subsequent layers.
 - b. Remove all cinders, broken concrete, or other hard or abrasive materials in the backfill material before commencing backfilling operations.
 - c. Remove and dispose of surplus and unsuitable materials upon completion of the backfilling operations in the area.
 - d. 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. Operate pneumatic or other mechanical tampers in accordance with the manufacturer's recommendations.
 - e. Perform operations in a manner that minimizes soil erosion and employs appropriate storm water pollution prevention measures during all construction operations.
 - f. Maintain work areas in a neat, clean, and orderly condition at all times.

- g. 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.
- h. Remove and dispose of rock and debris excavated and remaining after backfilling as directed by the Iowa DOT.
- i. 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.

8. Multiple Duct Installation

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

9. Plowing

- a. Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.
- b. Furnish competent supervision at all times at the site of plowing operations to assure compliance with the contract documents.
- c. The equipment shall be capable of extending the plow in order to maintain the required minimum depths under all terrain conditions.
- d. The reel carrier shall be of adequate size and be configured so that the reel sizes being used can be safely handled.
- e. Avoid damaging any paved surfaces, ditches, or other similar surface features. Immediately repair any damage to such features to the satisfaction of the Engineer.
- f. 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.
- g. 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.
- h. 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 three tons and a drum width between 4 and 6 feet or by other suitable means approved by the Iowa DOT.

10. Conduit In Trench

- a. Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.
- b. 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.
- c. 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.
- d. 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.

- e. Rock excavation shall be considered extra work and shall be paid as a separate cost item. Obtain approval from the Engineer before commencing any rock excavation.

11. Bored Crossings

- a. Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.
- b. 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
- c. Limit bore hole sizes to the outside diameter of the conduit being placed.
- d. Locate bore pits a minimum of 2 feet from the edge of pavement or shoulder unless otherwise directed by the Engineer.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all conduit shall be paid for at the contract unit price per linear foot for the bid items Conduit, Furnish and Bore, Hdpe, 2 Inch; and Conduit, Furnish and Plow, Hdpe, 2 Inch.
2. Payment is full compensation for:
 - The furnishing and installation of all conduits per the contract documents,
 - Including all surface excavations or surface preparation work, repair or restoration of any disturbed areas to pre-construction conditions, proper water/moisture drainage materials,
 - Conduit mounting on new or existing infrastructure, and
 - Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.06 Poles

Furnish all work, apparatus, and materials to construct and install the device poles designed to mount future ITS equipment to as required for the planned ITS system.

Specific poles are required to have lowering device equipment to facilitate access. These poles are only required at the locations clearly specified in the plan sheets.

A. Materials

1. General

- a. All 20 feet steel poles shall be breakaway and be mounted on transformer bases
- b. Pole stiffeners are not required on 20 feet steel poles.
- c. All poles shall be designed in accordance with the 2013 AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals." Minimum Loading requirements shall be based on an isotach wind velocity for the area of installation according to 1994 AASHTO isotach wind chart with a 1.3 gust factor. Calculations and detailed drawings shall be submitted demonstrating compliance with the AASHTO specification. All materials and products shall be manufactured in the United States of America, and comply with ASTM or AASHTO specifications. 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 Sections 1 through 8 of the American Welding Society (AWS) D1.1 Structural Welding Code. 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 and any other identified attachments and shall be stiffened or otherwise manufactured to meet allowable deflection criteria contained herein. Pole loading calculations should be conducted assuming a sensor mounting height of 20 feet. The traffic sensor specified below should be utilized in the calculations.

Roadway Sensor

Model: Wavetronix SmartSensor HD

Weight: 4.2 pounds

Dimensions: 13.2 inches by 10.6 inches by 3.3 inches

- f. The pole top deflection shall not exceed one inch in a 30 mph (non-gust) wind. Close consideration must be given to the effective projected area of the complete sensor equipment including mounting 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.
- g. All pole shafts shall conform to ASTM A595 Grade A with a minimum yield strength of 55 ksi or ASTM A572 with a minimum yield strength of 65 ksi. The shaft shall be round, 12-sided or 16 sided with a 4 inch corner radius, have a constant linear taper of 0.14 inches per foot, 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 complete penetration pole to base plate welds shall be complete penetration welds. The shaft shall be hot dip galvanized per the requirements of the contract documents.
- h. Base plates shall conform to ASTM A36 or A572 Grade 42. Plates shall be integrally welded to the tubes with a telescopic welded joint or a full penetration butt weld with backup bar. Plates shall be hot dip galvanized per the requirements of the contract documents.
- i. Anchor bolts shall conform to the requirements of ASTM F1554 Grade 55. The upper 12 inches of the bolts shall be hot dip galvanized per ASTM A153. Each anchor bolt shall be supplied with two hex nuts and two flat washers. The strength of the nuts shall equal or exceed the proof load of the bolts.
- j. The hand hole opening shall be reinforced with a minimum 0.432 inch wide hot rolled steel rim. The minimum outside dimension shall be 7.31 inches by 5.63 inches. Unless otherwise required, the bottom lip of this handhole shall be 18 inches from the pole base.

B. Construction

1. General

Repair any surface damage to galvanized components using a zinc rich paint acceptable to the Engineer.

2. Pole Erection

- a. Erect poles and securely bolt to the transformer base 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.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all steel poles shall be paid for at the contract unit price per each for the bid item Steel Pole, Furnish and Install, 20 Foot.
2. Payment is full compensation for:
 - The furnishing and installation of all poles and accessories,
 - Including fitting the appropriate bolt pattern to the transformer base foundation base plate, all conduit entrances and attachments, all necessary electric grounding materials, and
 - Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.07 Meter Pedestals

A. Materials

Meter pedestals shall comply with the requirements of the contract documents and all generally accepted standards and requirements for the electrical components entering and exiting the pedestal.

B. Construction

1. Install meter pedestals in accordance with the contract documents, Local Utilities, and all NEC requirements. Locate and orient meter pedestals as directed by the Engineer.
2. Contractor shall provide all conduit and power cable from the meter pedestal to the device cabinet.
3. Unless otherwise directed by the Engineer, the Contractor shall install the meter pedestal at the location and obtain power from the electrical service location shown in the contract documents.
4. All electrical service cables shall be continuous runs with no splices between the meter pedestal and the cabinet.
5. All connections to power sources owned by the power providers, as identified in the contract documents, shall be completed by the individual power companies.
6. All riser conduits and line side feeder cables will be provided by the power companies at no expense to the Contractor.
7. The Contractor shall complete all required power terminations at the meter pedestal and device cabinet.
8. The Contractor is responsible for permits, coordinating and scheduling all locally required inspections of electrical work prior to putting a location into service.
9. The Contractor shall coordinate with the Engineer and power provider to request that electrical service at a device location be initiated.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all meter pedestals shall be paid for at the contract unit price per each for the bid item Meter Pedestal.
2. Payment is full compensation for:

- The furnishing and installation of all meter sockets and meter pedestals,
- Including the proper installation of the wire and cable into existing conduit and new conduit systems installed, supply and installation of cable splices and connectors, circuit breakers, and slack, coiled, or stored cables
- Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.08 Power Installed Foundation

A. Materials

None.

B. Construction

1. General

- a. Install the power installed foundations in accordance with the contract documents and the manufacturer's recommendations.
- b. Contact the Engineer a minimum of 1 week in advance to arrange a field review prior to placing the power installed foundation.
- c. Notify the Engineer immediately if an obstruction conflicts with a proposed power installed foundation location. The Engineer is responsible for relocating or determining another effective means of supporting the structure to eliminate the conflict. Payment shall 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. Construct all power installed foundations as located by the Engineer and set level and to the proper elevation.
- b. Hand dig with shovel after power installed foundation is in place in order to install conduits into the provided conduit entrances.
- c. Install a sufficient number of conduits sized as indicated in the contract documents. All conduits shall be located as indicated in the contract documents.
- d. Modification of a footing after construction is not allowed.

3. Improper Construction

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

C. Method of Measurement & Basis of Payment

1. Measurement and payment for power installed foundations shall be paid for at the contract unit price per each for the pay item Power Installed Foundation, Install Only.
2. Payment is full compensation for:
 - The installation only of all power installed foundations,
 - Including all surface excavations, repair or restoration of any nearby areas, bolts, and bolt mounting assemblies for connection to poles or other structures, and
 - Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.09 Pull Tape

A. Materials

1. Pull tape shall be clearly marked with durable, sequential footage markings.

2. Pull tape shall have a minimum proper tensile strength of 600 pounds.

B. Construction

1. All installations and connections shall comply with the contract documents and all generally accepted codes and standards.
2. Pull tape shall be installed in continuous runs between handholes, foundations, and structures unless otherwise directed by the Engineer.
3. The Engineer shall resolve all conflicts.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all pull tape shall be paid for at the contract unit price per linear foot for the bid item Pull Tape.
2. Payment is full compensation for:
 - The furnishing and installation of all pull tape,
 - Including the proper installation of the pull tape into existing conduit systems, and
 - Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.10 Power Connections

A. Materials

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

B. Construction

1. Install power connections in accordance with the contract documents and all NEC requirements.
2. Contractor shall coordinate installations in advance as noted on the contract documents.
3. Contractor shall 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.
4. Unless otherwise directed by the Engineer, the Contractor shall install the power connections as illustrated in the contract documents.
5. The Contractor is responsible for coordinating and scheduling all locally required inspections of electrical work prior to putting a location into service.
6. The Contractor shall coordinate with the Engineer and power provider to request that electrical service at a device location be initiated.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all power connections shall be paid for at the contract unit price per each for the pay items Power Connection to Meter and Power Connection to Electrical Cabinet.
2. Payment is full compensation for:

- The furnishing and installation of all power connection accessories as shown in the contract documents,
- Including the proper installation of the conduit, breaker enclosures, circuit breakers, wiring and accessories, neutral bars and accessories, ground bars and accessories, terminations, and grounding in the power source, and
- Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.