SP- 150920
(New)

SPECIAL PROVISIONS
FOR
ITS INFRASTRUCTURE INSTALLTION

Pottawattamie and Cass Counties
ITS-080-1(484)40--25-78

Effective Date
November 15, 2022

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

150920.01 DESCRIPTION.

A. This project involves installing Iowa DOT supplied poles, foundations, and cabinets. This project also involves supplying and installing conduit, handholes, tracer wire, test stations, power supplies and cabling, and fiber optic cable deemed necessary for a complete ITS Infrastructure installation designed for use with future proposed ITS fiber splicing and device deployments and other uses planned by the Iowa DOT. The Iowa DOT plans to initiate separate contracts to splice 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.

B. Special Requirements.

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

2. Comply with TIA and EIA latest editions.

C. Contractor Submissions.

1. Materials 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,
- Installation of device cabinets, foundations, and poles,
- Installation and energizing of power.

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 Network Operations Center (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.

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:

1) Pole Mount Cabinet Mounting Assemblies.
2) Cabinet Foundation.
3) HDPE Conduit.
4) Conduit Splice Kit.
5) Duct Plugs.
6) Handholes.
7) Test Stations.
8) Fiber Markers.
9) Ground Rods.
10) Meter Pedestals.
11) Exothermic Welding Kit.
12) Copper Cable (Power).
13) Copper Cable (Ground).
14) Tracer Wire.
15) Tracer Wire Splice Kit.
16) Fiber Optic Cable.
17) NEMA 3R 240/120 1.0 kVA Transformer.
18) OTDR Meter with Calibration Certificate from Manufacturer within last year.
19) 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 this project.

D. Contractor's Responsibility.

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

2. Conduit Locations.
Prior to final acceptance, meet with the Engineer to demonstrate the locate system is working properly throughout the entire locate system.

E. 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.

F. 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.

150920.02 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. Power Installed Foundation.

1. All power installed foundations shall be provided by the Iowa DOT.

2. Coordinate with the Engineer the time for the Contractor to accept the power installed foundations from the Iowa DOT Maintenance Garage in Adair, Iowa, and deliver the power installed foundations to the field for installation or to the Contractor's construction yard for storage.

C. Poles.

1. Install the device poles designed to mount future ITS equipment to as required for the planned ITS system.

2. All poles shall be provided by the Iowa DOT. Coordinate with the Engineer the time for the Contractor to accept the poles from the Iowa DOT Maintenance Garage in Adair, Iowa, and deliver the poles to the field for installation or to the Contractor's construction yard for storage.

D. Fiber Regeneration Cabinet.

1. The fiber regeneration cabinet shall be provided by the Iowa DOT.

2. Coordinate with the Engineer the time for the Contractor to accept the fiber regeneration cabinet from the Iowa DOT Maintenance Garage in Adair, Iowa, and deliver the fiber regeneration cabinet to the field for installation or to the Contractor's construction yard for storage.

E. Fiber Regeneration Cabinet Foundation

1. The foundation shall meet the recommendations per IBC 2015 and ASCE 7-05/7-10.

2. The concrete used for the foundation shall be minimum 2,500 psi compressive strength.

F. Device Cabinets.

1. All device cabinets shall be provided by the Iowa DOT.

2. Coordinate with the Engineer the time for the Contractor to accept the device cabinets from the Iowa DOT's ITS maintenance contractor and deliver the device cabinets to the field for installation or to the Contractor's construction yard for storage.

G. High Density Polyethylene Conduit.

1. HDPE conduit shall be smooth wall and orange in color.

2. Comply with ASTM F 2160 (conduit) and ASTM D 3350 (HDPE material), minimum SDR 13.5 or 11 as specified in the contract documents.

3. Sequential foot markings printed on HDPE.

4. Continuous reel or straight pieces to minimize splicing.

5. For dissimilar conduit connections provide an adhesive compatible with both materials.

H. Handholes.

1. General.
- **a.** 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 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.** Label handhole lids as indicated in the contract documents or as directed by the Engineer.

2. Test Stations.
- **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. 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. 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. 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 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) Black text with a white background.

3) Panduit part number S075X150YAJ or approved equal.

3. Grounding/Bonding.

Comply with Article 4189.01 of the Standard Specifications.

4. 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 following U.S. based manufacturing companies; Corning, OFS, or Prysmian/Draka.

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. The installation temperature range of the cable shall be –30°C to +70°C.

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 ITUT 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 ITUT 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) Self-laminating vinyl material.

2) Panduit part number PST-FO or approved equal.

3) Use indelible ink or etching which does not fade in sunlight, or in buried or underground applications. No handwriting.

4) Of a material that does not become brittle or deteriorate for a period of 20 years due to moisture, sunlight, soil minerals, chemicals or other environmental elements.

J. Meter Pedestals.

1. Verify requirements with local electrical utilities.

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

3. 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.

150920.03 CONSTRUCTION.

A. General Responsibilities.

1. 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 Contractor

2. 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.

3. 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.

4. 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.

5. 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. 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.

D. Power Installed Foundation.

1. General.

a. All power installed foundations will be 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 located 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.

E. Poles.

1. General.

a. All poles will be 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. If pole has structural damage do not erect and notify the Engineer.

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

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.

F. Fiber Regeneration Cabinet.

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

G. Fiber Regeneration Cabinet Foundation.

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.

H. Device Cabinets.

1. General.

a. All device cabinets will be 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 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.

I. High Density Polyethylene Conduit.

1. General.

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

b. Follow all general guidelines covering the construction of buried conduit.

c. Install conduit by plowing, boring, or other approved methods within the public right-of-way and in a manner that minimizes atypical damage from construction operations.

d. 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.

e. 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.

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

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

h. 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.

i. No direct-buried cable is allowed.

j. Unless otherwise indicated in the contract documents, installation of Schedule 40 PVC conduit or approved alternative is allowed only in open trench runs or when approved by the Engineer.

k. Seal all conduit openings using duct plugs or as directed by the Engineer, at all conduit openings at the junction boxes, handholes, foundations, and building entrances.

l. 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.

2. Installation Clearances.

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

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

c. Maintain the minimum depth throughout the length of all conduit installations.

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

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

3. Conduit Splicing.

a. Install conduit with minimal splices between handholes and structures as shown on contract documents.

b. All mechanically joined conduit splices shall use compression couplings designed for underground placement and blown-in fiber installation.

c. Butt fusion welding and solvent welding of conduits will not be allowed.

d. All conduit splices shall be designed to be watertight to 200 psi.

e. Conduit splicing is incidental to the connected items of work.

4. Facilities Protection.

a. The Contractor is responsible for protecting, locating, 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.

5. Backfilling.

a. Apply Section 2552 of the Standard Specifications and the following:

b. Backfill trenches and other excavations in lifts of 6 inches or less in compacted depth. Compact each layer thoroughly before placing subsequent layers.

c. Remove all cinders, broken concrete, or other hard or abrasive materials in the backfill material before commencing backfilling operations.

d. Remove and dispose of surplus and unsuitable materials upon completion of the backfilling operations in the area.

e. 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.

f. Perform operations in a manner that minimizes soil erosion and employs appropriate storm water pollution prevention measures during all construction operations.

g. Maintain work areas in a neat, clean, and orderly condition at all times.

h. 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.

i. Remove and dispose of rock and debris excavated and remaining after backfilling as directed by the Engineer.

6. Surface Restoration.

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

b. 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.

c. Complete restoration according to the applicable sections of the Standard Specifications.

7. Multiple Duct Installation.

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

8. 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 3 tons and a drum width between 4 and 6 feet or by other suitable means approved by the Engineer.

9. 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 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.

10. Trenchless Conduit Installation.

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.

J. Handholes.

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

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

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

4. Install coarse aggregate bedding below the handhole as identified in the contract documents.

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

6. Side penetrations of the handholes are not permitted.

7. Terminate each tracer wire run in test stations at 48 inch by 30 inch by 36 inch ITS handhole, locations.

8. Install ground rods at all 48 inch by 30 inch by 36 inch ITS handholes, and as indicated in the contract documents.

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

10. Rodent proof all handholes per the contract documents.

11. Conduit entrance into junction boxes shall be through slip holes. Fasten conduit to the box using sealing type locknuts.

12. 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.

K. 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 and splice tracer wire in all conduit installations 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 handholes when being terminated at the 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. 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.

4. Fiber-Optic Cable.

a. General.
1) Remove fiber-optic cable from the reel in accordance with the manufacturer’s recommendations.
2) Do not twist or bend the fiber-optic cable in excess of the limits recommended by the manufacturer.
3) 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.

4) Protect at all times all proposed cables, cable ends, and any exposed portions of fiber-optic cable from damage including water intrusion.
5) 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.
6) 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 Optical Time Domain Reflectometer (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 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. Attach a pulling eye and swivel to the cable to prevent the cable from twisting.
4) Do not force cables around sharp corners and take precautions during installation to prevent the cable from being kinked 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 the 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 junction boxes and handholes after cable installation.

d. 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) Repair or replace 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.

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

4) 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.

f. 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 use, where the fiber will be owned by the other agency (or entity), install typical identifiers and/or markings for that fiber.

L. Meter Pedestals.

1. Apply Article 2523.03, C of the Standard Specifications and the following:

2. Install meter pedestals and power connections in accordance with the contract documents, the manufacturer's recommendations, NEC, and all requirements of local electrical utility.

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.

M. 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.

150920.04 METHOD OF MEASUREMENT.

A. Install Power Installed Foundation.
By count.

B. Install Poles.
By count.

C. Install Fiber Regeneration Cabinet.
By count.

D. Fiber Regeneration Cabinet Foundation.
By count.

E. Install Device Cabinets.
By count.

F. Conduit.
Linear feet shown in the contract documents.

G. Handholes.
By count.

H. Fiber Markers.
By count.

I. Test Station.
By count.

J. Wire and Cable.
Linear feet shown in the contract documents.

K. Meter Pedestal.
By count.

L. Transformers.
By count.

150920.04 BASIS OF PAYMENT.

A. Install Power Installed Foundation.

1. Each.

2. Payment is full compensation for:

a. The 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.

B. Install Poles.

1. Each.

2. Payment is full compensation for:

a. The 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.

C. Install Fiber Regeneration Cabinet.

1. Each.

2. Payment is full compensation for:

a. The installation of all fiber regeneration cabinets,

b. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

D. Fiber Regeneration Cabinet Foundation.

1. Each.

2. Payment is full compensation for:

c. The furnishing and installation of all cabinet foundations,

d. Including all surface excavations, repair or restoration of any nearby areas, concrete, steel reinforcement, and anchors, and

e. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

E. Device Cabinets.

1. Each.

2. Payment is full compensation for:

a. The installation of all pole mounted 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.

F. Conduit.

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. Conduit mounting on new or existing infrastructure.

d. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

G. Handholes.

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.

H. Wire and Cable.

1. Per linear foot.

2. Payment is full compensation for:

a. The furnishing and installation of all wire and cable per the contract documents.

b. Exposing of existing fiber optic cable per the contract documents.

c. Including the proper installation of the wire and cable into existing conduit and new conduit systems, supply and installation of splices and connectors, and slack, coiled, or stored wire or cables.

d. Furnishing all materials, labor, tools, equipment, consumable items, and other incidental items necessary to meet the requirements of the contract documents.

e. Prior to final acceptance, meet with the Engineer to demonstrate the locate system is working properly throughout the entire locate system.

I. 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.

J. Transformers.

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.

ADDITIONAL BIDDING ATTACHMENTS

Equipment and Materials List for Submittal Requirements.

DESCRIPTION	MANUFACTURER	CATALOG NUMBER
POLE MOUNT CABINET MOUNTING ASSEMBLIES		
HANDHOLE, TYPE II		
HANDHOLE, 48”x30”x36”		
HANDHOLE, 24”x36”x36”		
TEST STATION		
FIBER MARKER		
METER PEDESTAL WITH COIL		
GROUND ROD		
EXOTHERMIC WELDING KIT		
HDPE CONDUIT		
CONDUIT SPLICE KIT		
DUCT PLUGS		
1C #10 TRACER WIRE		
TRACER WIRE SPLICE KIT		
#6 AWG COPPER CABLE		
#4 XHHW COPPER CABLE (POWER)		
#6 XHHW COPPER CABLE (POWER)		
#8 XHHW COPPER CABLE (POWER)		
#8 XHHW COPPER CABLE (GROUND)		
#10 XHHW COPPER CABLE (POWER)		
BREAKAWAY CABLE CONNECTORS		
NEMA 3R 240/120 1.0 kVA TRANSFORMER		
12 SM DIELECTRIC FIBER OPTIC CABLE		
48 SM ARMORED FIBER OPTIC CABLE		
OTDR METER (WITH CALIBRATION INFORMATION)		