SP-150392
(New)

SPECIAL PROVISIONS
FOR
ITS INFRASTRUCTURE WORK

Dallas County
ITS-080-3(233)119--25-25

Effective Date
May 15, 2018

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.

PART I. PROJECT DESCRIPTION AND 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, handholes, tracer wire, test stations, 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.

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 contract documents, special provisions, and the documents listed below.

1. NEC, latest edition adopted by the State of Iowa.
2. Telecommunications Industry Association/Electronic Industries Association (TIA/EIA) latest editions.

1.02. Contractor's Responsibility.

A. 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.

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

1.03. Disruption to Existing Fiber Networks.

A. Planned Work Near Existing Fiber Networks.
The Contractor shall ensure continuous operation of the existing fiber networks and systems during construction of the project.

The Contractor shall 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. Parties include the Iowa DOT and the Iowa Communications Network (ICN). The Contractor shall provide a written request to the Iowa DOT and the ICN for approval at least 10 calendar days before work is done near an existing fiber network or equipment. A copy of the written request shall be submitted to the Engineer in all cases. In addition to the written request, the Contractor shall submit the work plan and schedule for approval by the Engineer. The work plan shall include all fiber strands and the parties possibly affected.

B. Unplanned Disruption.
The Contractor shall be responsible for repairing, to ICN's satisfaction and at no cost to Iowa DOT, any damage the Contractor causes to the existing fiber networks and systems during the life of the project.

In the event of disruption, the contractor shall simultaneously notify the Engineer and affected parties and immediately stop all work in progress and shall expend all of its efforts to restore the disrupted system(s) and/or correct the problem causing the disruption. The notice shall include the type of facility damaged and the extent of the damage.

The Contractor shall remain on site until the ICN confirms that the disrupted systems are fully operational. Unplanned disruptions shall result in the assessment of liquidated damages.
The Contractor will not be granted an extension of time for delays caused by repairing disrupted systems.

C. Liquidated Damages.
Unplanned disruptions to the existing fiber-optic network will result in impacts to the traveling public, increase fuel consumption, vehicle operating costs, pollution, and time needed for Iowa DOT administration, engineering, inspection, and supervision, and other inconveniences and harm far in excess of those resulting from delay of most projects.
Accordingly, the Contractor agrees:

1. To pay $250.00 liquidated damages per 15 minutes, for each 15 minute period that the Contractor fails to restore the proper operation of an existing fiber-optic network element following an unplanned disruption.
2. To authorize the Engineer to deduct these liquidated damages from any money due or coming due to the Contractor.

1.04. Contractor Submissions.

A. Materials List.
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 or before the construction kickoff meeting, 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 foundations, device cabinets and foundations, electrical installations, and fiber optic cable.
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.

1. After approval of the Materials List and before any items are ordered, the Shop Drawings shall be submitted for approval according to Article 1105.03 of the Standard Specifications.
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 contract documents or Special Provisions.
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.

D. 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 plans will be the responsibility of, and completed by, an on-site representative of the Engineer. As such, it will be the responsibility of the Engineer's representative 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 daily construction progress.
2. 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. 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.

B. The Contractor shall stake per coordinates provided in the plans, all handholes and proposed conduit alignment a minimum of one week prior to construction and for approval by the Engineer. 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.

C. Notify the Engineer immediately if an obstruction conflicts with a foundation. 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 foundation.

2.02. Wire and Cable.

A. Materials.

1. Tracer Wire.
Single conductor, solid copper or copper clad steel, Type XHHW, No. 12 AWG with orange colored jacket.

2. Grounding/Bonding.
Ground all installations using a No. 6 AWG copper, non-insulated wire bonded to copper clad metal, driven electrodes using an exothermic weld.

B. Construction.

1. General.

a. All installations and connections shall comply with the contract documents and all generally accepted codes and standards.

b. Install cable connectors in accordance with contract documents at the base of all breakaway poles, cabinets, or other installations for all non-low voltage installations unless otherwise directed by the Engineer. Cable connectors shall be unfused and listed for the specific application. All costs associated with these connectors are incidental to the cost of the connected items of work.

c. The Engineer shall resolve all conflicts.

2. Tracer Wire.

a. Install, splice, and test for continuity tracer wire in all conduit installations as indicated on the contract documents.

b. Where new tracer wire are installed, the Contractor shall:

- Splice tracer wire only in fiber vaults, handholes, cabinets, and pole bases to form a continuous network using splice kits listed for wet locations.
- Terminate each tracer wire run at Type IV handholes in test stations per detail in plans.
- Test all tracer wire for continuity, with approval by the Engineer, prior to final acceptance.

c. Labeling Requirement

- Place tags on all fiber-optic cable identifying the owner and direction of the cable at each termination point and in every handhole, fiber vault, and cabinet.
- Tags shall clearly identify where each individual cable run originated and where it ends (handhole to handhole, handhole to cabinet, handhole to building, etc.).

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.

C. Method of Measurement and Basis of Payment.

1. Measurement and payment for all wire and cable shall be paid for at the contract unit price per linear foot for the pay item 1C #12 Tracer Wire.

2. Payment is full compensation for:

- The furnishing and installation of all wire and cable,
- 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, and
- Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.
- Prior to final acceptance, the Contractor shall meet with the Engineer to demonstrate the locate system is working properly throughout the entire locate system.

2.03. Fiber-Optic Cable.

A. Materials.

1. General.

a. The cable shall meet the latest applicable standard specifications by American National Standards Institute (ANSI), Electronic Industries Association (EIA) and Telecommunications Industries Association (TIA) for the single-mode fiber cable of the size specified per the Plans.
b. All fiber-optic cable for installation on this project shall be provided by the Contractor.
c. The Contractor shall provide the Engineer the manufacturer's production test provided with the spool.
d. The Contractor shall provide the Engineer with documentation of wasted cable.
e. 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.
f. The cable core shall be water blocked with dry water blocking materials to improve access and handling of individual tubes.
g. 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.
h. 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.
i. 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.
j. The optical fiber shall be manufactured by Corning, OFS or Draka.
k. The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C, Category 4 and Grades J4, E7 and E8.
l. The jacket or sheath shall be free of holes, splits, and blisters.
m. Cable jackets shall be marked 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 National Electrical Safety Code (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.

n. The maximum pulling tension shall be 600 pounds during installation (short term) and 200 pounds installed (long term).
o. 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.

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

a. Fiber-optic, single-mode, graded loose tube dielectric cable constructed with industry standard 3 mm buffer tubes stranded around a central strength member.
b. Single-mode, dispersion-unshifted fiber meeting ITUT G.652D requirements.
c. Cables shall be sheathed with medium density polyethylene (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.
d. The cable jacket shall contain no metal elements and shall be of a consistent thickness.

B. Construction.

1. General.

a. Remove fiber-optic cable from the reel in a manner acceptable to the Manufacturer and Engineer.
b. Do not twist or bend the fiber-optic cable in excess of the limits recommended by the manufacturer.
c. As the cable is fed into the duct and conduit system the Contractor shall use a manufacturer approved water-based cable lubricant for all fiber-optic cable installations.
d. Protect at all times all proposed cables, cable ends, and any exposed portions of fiber-optic cable from damage including water intrusion.
e. Any existing pull tape or tracer wire that is used as a pull rope for fiber-optic cable installation shall be replaced in kind. The cost of any tracer wire or pull tape replacement shall be subsidiary to the fiber-optic cable installation.

2. Fiber-Optic Cable Testing.

a. Visually inspect fiber-optic cable prior to installation. Report any defects to Engineer.
b. Pre-installation (on-reel), all strands of fiber shall be tested (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. The contractor shall perform all tests in the presence of the Engineer and provide the Engineer with up to two copies of any software required for viewing electronic files 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.
c. Post installation, all strands of fiber shall be tested (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. Measured post installation length shall match pre-installation (on-reel) length +/- 50 feet for each strand. The contractor shall perform all tests in the presence of the Engineer and provide the Engineer with up to two copies of any software required for viewing electronic files 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.
d. 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.

e. Contractor shall replace, as directed by the Engineer, any defect discovered during final acceptance at no additional cost to the Iowa DOT. Consider a defect to be any cable with an OTDR measured length that differs from the actual cable footage, excluding manufacturer's helicity.

f. All test equipment shall be factory certified within the last year. The Contractor shall provide copies of the certification ten days prior to testing.

g. 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. The Contractor shall submit test results in a format approved by the Engineer. Completed test forms on each fiber shall be handed over to the Engineer. Contractor shall also provide native test (electronic version) with no alterations and meter software for viewing of fiber traces. At a minimum, test results shall show the following:
   - Cable and fiber identification (as approved by Iowa DOT).
   - Operator Name.
   - Date and Time.
   - Setup and test parameters including wavelength, pulse width, range, scale and ambient temperature.

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

3. Cable Installation.

a. A suitable cable feeding method shall be used between the cable reel and the face of the duct and conduit to protect the cable and guide it into the duct.

b. Dynamometers and breakaway pulling swings shall be used to ensure that the pulling line tension does not exceed 600 pounds.

c. The mechanical stress placed on a cable during installation shall not be such that the cable is twisted or stretched. A pulling eye and swivel shall be attached to the cable and used to install the cable through the duct conduit system to prevent the cable from twisting.

d. Cables shall not be forced around sharp corners and precautions shall be taken during installation to prevent the cable from being kinked or crushed.

e. 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.

f. Pulling of the cable shall be hand assisted.

g. Iowa DOT 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.

h. The cable shall be carefully inspected for jacket defects. If defects are noticed, the pulling operation shall be stopped immediately and the Engineer notified. The Engineer shall make a determination of acceptability or shall reject the cable.

i. The fiber cable shall be installed in continuous runs as marked on the plans. End of reel splices or butt splices not shown in the plans shall be pre-approved by the Engineer and are incidental to the cost of the installation of the cable. If approved, the end of reel or butt splices shall be performed in existing splice vaults as shown on the plans. 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 Iowa DOT.

j. No splices shall be allowed unless indicated by the plans or approved by the Engineer.

k. Seal all conduit openings using Iowa DOT provided ETCO duct plugs, or as directed by the Engineer, at all conduit openings at the junction boxes, handholes, poles, and cabinets after cable installation.

4. Facilities Protection.

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

b. Contractor shall replace or repair, as directed by the Engineer, any damage occurring before final acceptance at no additional cost to the Iowa DOT. Perform any repairs or replacements as soon as reasonably possible unless otherwise approved by the Engineer.

c. Contractor shall repair or replace any defect in the installed cable at no additional cost to the Iowa DOT. 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.

d. Any existing wiring that is damaged during fiber-optic cable installation shall be replaced or repaired, as directed by the Engineer, at no additional cost to the Iowa DOT.

5. Slack Coils.

a. Sufficient slack shall be left 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 plans:

- Handhole, type FOR27 – 60 feet
- Handhole, type IV – 150 feet
- Device Cabinets and DMS Cabinets – 30 feet

b. Storage of slack cable in cabinets and handholes shall be neatly coiled. The slack coils shall be bound at a minimum of three points around the coil perimeter.

c. 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.

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

6. Cable Identification.

a. Place tags on all fiber-optic cable identifying the owner and direction of the cable.

b. Tags shall clearly identify where each individual cable run originated and where it ends (handhole to handhole, handhole to cabinet, handhole to building, etc.).

c. Handwritten tags are not allowed.

d. Tags shall use indelible ink or etching which does not fade in sunlight, or in buried or underground applications.

e. Tags shall be 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.

f. Engineer shall approve tag content before installation.

g. For fiber installations with joint Department of Transportation/other agency (or entity) use where the fiber will be owned by the other agency (or entity), install typical identifiers and/or markings for that fiber.

C. Method of Measurement and Basis of Payment.

1. Measurement and payment for all fiber-optic cable shall be paid for at the contract unit price per linear foot for the pay items 12 SM Fiber Optic Cable and 96 SM Fiber Optic Cable.
2. Fiber-optic cable length is calculated from plan dimensions as the linear, one-way length of new and existing conduits. No allowance has been added to this quantity.

3. Payment is full compensation for:
   a. The furnishing, testing, and installation of all cables and wire per the contract documents,
   b. Furnishing all materials, labor, tools, consumable items 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 0.24 inches per foot of length of box when installed and subject to an ASTM C-857 TIER 22 load.
f. Handholes shall meet or exceed ANSI/SCTE 77 “Specification for Underground Enclosure Integrity” requirements.
g. Handhole lid strength shall be tested to 33,750 pounds (Tier 22).
h. Handhole lids shall be labeled as indicated in the plans or as directed by the Engineer.

2. Test Stations.

a. Supply Rhino part TVTI780B-EM9125-0R or approved equivalent test stations at all Type IV handholes.
b. Test Stations shall be 78 inch triangular flexible orange plastic marker with five separate access terminals, isolation lever, 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. Fiber Marker.

a. Supply Rhino Part# TVF78OB or approved equivalent markers at FOR27 handhole locations noted in the plans.
b. Markers shall be 78 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. Set top of all handholes to depths as indicated in the contract documents for different handhole types and installation locations.
c. Install course aggregate bedding below the handhole as identified in the contract documents.
d. Conduit shall enter the handhole from the bottom and extend conduit ends between 4 and 6 inches above the aggregate bedding.
e. Side penetrations of the handholes are not permitted.
f. Terminate each tracer wire run in test stations at Handhole, Type IV locations.

g. Install ground rods at all Type IV handholes and as indicated in the contract documents.
h. Plug all open conduit ends within the handhole in a manner acceptable to the Engineer.
i. Rodent proof all handholes to the satisfaction of the Engineer.

C. Method of Measurement and Basis of Payment.

1. Measurement and payment for all handholes shall be paid for at the contract unit price per each for the pay items Handhole, Type FOR27; Handhole, Type IV; Test Station; and Fiber Marker.
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 IV 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.
c. Sequential foot markings printed on HDPE.
d. Continuous reel or straight pieces to minimize splicing.
e. 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 documents and at all roadway and stream crossings, install conduit sections with external protection as specified herein.
h. No direct-buried cable is allowed.
i. 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.

j. Seal all conduit openings using Iowa DOT provided ETCO duct plugs, or as directed by the Engineer, at all conduit openings at the junction boxes handholes, poles, cabinets, and building entrances.
k. 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 bores shall be a minimum of 48 inches unless otherwise specified in the plans.
b. Maintain the typical offsets from referenced locations as shown in the plans.
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.

3. Conduit Splicing.

a. Conduit shall be installed with minimal splices between handholes, foundations, 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 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. 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.
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 Engineer.

6. Surface Restoration.

a. Replace or reconstruct 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 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 shall be considered extra work and shall be paid as a separate cost item. Obtain approval from the Engineer before commencing any rock excavation.

10. 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 and Basis of Payment.

1. Measurement and payment for all conduit shall be paid for at the contract unit price per linear foot for the pay items 2" HDPE Conduit, Plowed; 2" HDPE Conduit, Bored; 2" Schedule 80 HDPE Conduit, Bored; and 2" Galvanized Rigid Steel Conduit.
2. Conduit length is calculated from plan dimensions as the linear, one-way length of new conduits. No allowance has been added to this quantity.
3. 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.

PART III
ADDITIONAL BIDDING ATTACHMENTS

3.01. Equipment and Materials List for Submittal Requirements.

DESCRIPTION	MANUFACTURER	CATALOG NUMBER
HANDHOLE, TYPE FOR27		
HANDHOLE, TYPE IV		
LOCATE TEST STATIONS		
FIBER MARKER		
GROUND ROD		
EXOTHERMIC WELDING KIT		
HDPE CONDUIT		
SCHEDULE 80 HDPE CONDUIT		
CONDUIT SPLICE KIT		
RIGID STEEL CONDUIT AND FITTINGS		
1C #12 TRACER WIRE		
TRACER WIRE SPLICE KIT		
#6 AWG COPPER CABLE		
12 SM DIELECTRIC FIBER OPTIC CABLE		
96 SM DIELECTRIC FIBER OPTIC CABLE		
OTDR METER (WITH CALIBRATION INFORMATION)		