**SP- 150059**
**(New)**

**SPECIAL PROVISIONS**
**FOR**
**FIBER OPTIC SYSTEMS**

**Linn County**
**HDP-100-1(73)--71-57**

**Effective Date**
**November 21, 2017**

**THE IOWA DEPARTMENT OF TRANSPORTATION 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.**

**150059.01 DESCRIPTION.**
This part consists of the general provisions necessary when furnishing and/or installing fiber optic system components complete, in place as described in the project plans and these special provisions.

**A. Related Specifications and Standards.**
Unless otherwise specified in the project plans, the equipment installed under this specification shall comply with:

**1.** Specifications of the Underwriters Laboratories, Inc.

**2.** National Electrical Code

**B. Local Requirements.**
Local requirements such as requiring the Contractor to be a licensed electrical contractor in accordance with Cedar Rapids City Ordinance and adherence to local Building Code shall be met.

**C. Contractor's Responsibility.**
All work included under this contract shall be done in accordance with the Occupational Safety and Health Act of 1970 (Williams Steiger Act) as amended and enforced by the governmental authority responsible for the enforcement of the Act. Enforcement and responsibility for fulfilling this provision of the specifications shall rest solely with the Contractor, their superintendents, and their foremen and in no way shall rest with the Contracting Authority or the Engineer. The presence of the Engineer, the Contracting Authority, or their representatives shall not obligate the Engineer, Contracting Authority, or their representatives to the Contractor 's responsibilities. The Contractor shall inform their subcontractors to this also.

**D. Order of Work.**
The order of work shall be determined by the Contractor, subject to the approval of the Engineer. Contractor shall refer to the overall phasing plan for the project and prepare the order of work accordingly.

**E. Utilities.**

**1.** The location of utilities indicated on the plans is approximate only. In general, the public utilities are shown on the plans. Private utilities are not always shown. The Contractor must determine the exact location and elevation of all utilities. It shall be the duty of the Contractor to ascertain whether any additional facilities other than those shown on the plans may be present.

**2.** The Contractor shall replace or repair any existing utilities damaged by their operations at their own expense.

**F. Equipment and Materials.**

**1.** Equipment and materials shall be of new stock unless the plans provide for the use of existing equipment, or equipment furnished by others. New equipment and materials shall be the product of reputable manufacturers and shall meet the approval of the Engineer.

**2.** Before beginning work on the project, the Contractor shall submit four copies of catalog cuts for all equipment and materials supplied by the Contractor.

**3.** Prior to ordering any materials the Contractor shall provide certification from the manufacturers of all furnished materials and equipment, stating said material complies with the specifications.

**4.** All miscellaneous equipment shall be UL approved.

**G. Fiber Optic Cable.**

This work shall consist of installing a fiber optic cable of the type, size and number of fibers specified.

**1. Contractor Qualifications**

Trained and experienced personnel shall supervise the fiber optic cable installation. As a minimum, the Contractor shall have at least 5 years experience in fiber optic cable installation. The Contractor shall have at least one Building Industry Consulting Services, International ( BICSI) registered technician on staff, in a supervisory position, and be available for reference and supervision of installation. The Contractor upon request of the Engineer shall provide documentation of qualifications and experience for fiber optic equipment installations. The Engineer shall determine if the Contractor is qualified to perform this work. The Contractor shall have attended a certified fiber optic training class mandated by these specifications prior to starting work.

**2. Codes Requirements**

The fiber optic cable installation shall be in accordance with or exceed all minimal requirements of State codes, National codes, and manufacturer codes as applicable.

**3. Miscellaneous Equipment**

The Contractor shall furnish and install all necessary miscellaneous connectors and equipment to make a complete and operating installation in accordance with the plans, standard sheets, standard specifications, special provisions, and accepted good practice of the industry.

**150059.02 MATERIALS.**

**A. Electrical.**

Tracer wire shall be a No. 10 AWG wire single conductor, stranded copper, Type THHN, with UL approval and orange jacket. Tracer wire shall be supplied by the Contractor. Contractor shall also supply all nuts, bolts, screws, clips, and other attachments or hardware necessary to install and

secure the tracer within the conduit system.

**B. Fiber Optic Cable.**

**1.** Fiber Optic Cable shall be manufactured by Prysmian. Product code is FEDH1JKT12CExxxE3. (xxx = fiber count code to be inputted, for example 24 count fiber = 024 and 48 count fiber = 048).

**2.** Pull Tape shall be 1200 pound tensile strength pull tape and manufactured by Lamson. Product Code: TL14505.

**3.** 72 Count Splice Enclosures shall be manufactured by Tyco, Product Code: FOSC 450 B6-6-NT-0-B3V.

**C. Conduit.**

**1.** High density polyethylene (HPDE) conduit, where specified in the contract documents, shall meet or exceed the requirements of ASTM F 2160 “Standard Specification for Solid Wall High Density Polyethylene (HPDE) Conduit Based on Controlled Outside Diameter (OD)”. Joints and couplings shall meet or exceed ASTM F 2176 “Standard Specification for Mechanical Couplings Used on Polyethylene Conduit, Duct and Innerduct”. Orange conduit will be required for underground fiber optic cable installation. Manufacturer’s certification may be required for HDPE conduit. HDPE Conduit, HDPE couplings, miscellaneous fittings, couplings, adapters, and all miscellaneous hardware shall be provided by the Contractor, incidental to the various conduit bid items. When connecting to risers, use double e-loc couplings.

**2.** 2 inch diameter HDPE shall be SDR 13.5 and manufactured by Blue Diamond Industries, LLC.

**3.** 2 inch diameter HDPE conduit couplings shall be Polyurethane Elastomeric Conduit Couplings and manufactured by Condux-Comfit, Product Code: 08566120.

**4.** Unless otherwise specified, fittings shall have the Underwriters Laboratories approval.

**5.** Conduit sizes are as shown on the plans. These are the minimum sizes permitted for the application, the Contractor may, at their own expense, substitute a larger size.

**D. Ground Rods and Ground Wire.**

**1.** Ground rods shall be high strength steel rods with chemically bonded copper coverings to provide high conductivity and to prevent electrolytic action. Rods shall be full length as shown on the plans and shall have a nominal diameter of 5/8 inch unless otherwise specified. Ground rods shall conform to the requirements of IMSA specification No. 621956. Ground wires shall be connected to ground rods with one-piece nonferrous clamps which employ setscrews as tightening devices. Connections to ground rods need not be taped.

**2.** All ground wires shall be No. 6 AWG, bare, solid annealed copper wire unless otherwise specified on the plans.

**3.** All ground rods, wires, fittings and hardware are incidental to the other bid items in the contract.

**E. Handholes.**

**1.** Polymer concrete handholes and lids shall be manufactured by Martin Enterprises.
- **a.** 24 inch W by 36 inch L by 30 inch D handhole Product Code: 243630PC-GBLS
- **b.** 30 inch W by 48 inch L by 36 inch D handhole Product Code: 304836PC-GBLS

**c.** Contractor shall order handholes with the appropriate lid and cable hook hardware necessary for installation. All other materials for handhole installation shall be supplied by the Contractor (sealants for conduit entry, 8 inch thick aggregate base material under the handhole, etc.) The polymer concrete material shall meet or exceed all appropriate ANSI/ SCTE 77 tests and requirements. The bottom shall be "open" unless otherwise specified in the Plans. The lids shall include the Ground Bar Locate System (GBLS) manufactured by Martin Enterprises. The lid shall be imprinted (molded or engraved) with the legend "JCN FIBER HH ####" in the center. The handhole number will be provided to the Contractor by the City of Cedar Rapids Information Technology Department upon receival of construction submittals. The lid shall satisfy loading requirements of ANSI Tier Rating as specified in the plans. Unless otherwise specified, Tier 15 rated lids shall be used where handholes are installed in grassy areas and Tier 22 rated lids shall be used where there is possibility of heavy traffic or heavy equipment driving over the lids. A minimum of four cable hooks shall be installed to support cables. Custom stainless steel security bolts and opening tool required for installation will be provided by the City of Cedar Rapids IT Department. Opening tool shall be returned to the IT Department upon completion of the project. Anti-seizing compound shall be applied to all bolt threads prior to installation to prevent corrosion.

**2.** Sealing Compound for conduit entries into handholes. This compound shall be a readily workable soft plastic. It shall be workable at temperatures as low as 30°F, and shall not melt or run at temperatures as high as 300°F.

**3.** Tracer Pucks shall be installed in all handholes. Tracer pucks shall be manufactured by Pro-Trace. Product Code: 739010250

**150059.03 CONSTRUCTION.**

**A. General.**

The Contractor shall be prepared to furnish, upon request from the Engineer, a sample for evaluation, of any item or material, which they propose to furnish for this project.

**B. Handholes.**

**1.** The ends of all conduits leading into the handhole shall fit approximately 2 inches beyond the inside wall.

**2.** Every effort must be made to avoid installing handholes in sidewalks. However, in some downtown locations, there are no unpaved areas between the curb and building faces. Therefore, under this exception, when installed in sidewalk or pavement, top of handhole cover shall be set flush with the sidewalk or pavement surface.

**3.** When installed in an earth shoulder away from the pavement edge, the top surface of the handhole shall be approximately 1 inch above the surface of ground. When constructed in unpaved driveways, the top surface of the handhole shall be approximately level with the surface of the driveway.

**4.** All conduit openings in the handholes shall be sealed with an approved sealing compound after the cables are in place.

**5.** Precast polymer concrete handholes shall have a minimum of four cable hooks installed in each handhole to support cables.

**C. Conduit.**

**1. Installation.**

**a.** Conduit shall be placed as shown on the plans.

**b.** Conduit depth of cover shall be 36 inches except where noted otherwise on the plans or at entrances to handholes or other structures require a different depth of cover.

**c.** Conduit shall be installed without change in direction directly from one structure to another, unless approved by the Engineer. Change in direction may be allowed for physical restriction such as right-of-way restrictions, utilities, location of roadway slopes, retrofitting existing conduit stubs, and certain short sections of conduits. Contractor shall pothole every utility crossing (including storm sewers) to confirm the new conduit will not hit or damage existing public and private utilities.

**d.** Nipples shall be used to eliminate cutting and threading where short lengths of conduit are required. Where it is necessary to cut and thread steel conduit, exposed threads will be field galvanized.

**e.** All conduit and fittings shall be free from burrs and rough places. Standard manufactured elbows, nipples, tees, reducers, bends, couplings, union, etc. of the same materials and treatment as the straight conduit pipe shall be tightly connected to the conduit.

**f.** All conduit ends shall be provided with a bushing to protect the cable from abrasion, except for open ends of conduit being placed for future use. Bushings shall have grounding fittings, which shall be connected to the grounding system by a No. 6 ground wire as contained in these specifications.

**g.** All conduits placed for future use shall be plugged with a push penny cap and secured by electrical tape before backfill.

**h.** GPS and depth measurements will be taken immediately following conduit installation and provided to the Engineer. The measurements shall be taken 50 linear feet from every handhole and 200 linear foot intervals thereafter until the next handhole is reached. This work is incidental to the conduit installation.

**2. Trenching and Backfilling.**

**a.** Secure written approval of the City Forester prior to any trenching or excavation within the drip line of any tree.

**b.** Trenches shall be excavated to such depth as necessary to provide a minimum 36 inches cover over the conduit except as otherwise noted in the plans. All cinders, broken concrete or other hard abrasive materials shall be removed and shall not be used for backfilling. The trench shall be free of such materials before the conduit is placed. No conduit shall be placed prior to inspection of the trench by the Engineer.

**c.** All trenches shall be backfilled as soon as possible after installation of conduit. Backfill material shall be deposited in the trench in layers not to exceed 6 inches in depth and each layer shall be thoroughly compacted before the next layer is placed. Hard materials shall not be placed within 6 inches of the conduit.

**d.** Whenever excavation is made across parkways, gravel driveways, or sodded areas, the sod, topsoil, crushed stone and gravel shall be replaced or restored as nearly as possible in its original position and the whole area involved shall be left in a neat and presentable condition. Concrete sidewalk pavements, and base courses and bituminous surfaces shall be replaced with new materials. All of these materials removed and replaced in excess of what is shown in the plans shall be incidental to the work.

**3. Pushed or Bored Conduit.**

**a.** When the term “pushed’ or “bored” is used in the plans, it is intended that all conduits be placed without disturbing the existing surface. Such conduit shall be placed by jacking, pushing, boring or any other means necessary to place the conduit without cutting or removing pavement or disturbing existing surfaces except at the bore pit or push equipment location. Note railroad crossings may have additional requirements. See plans.

**b.** Removal of pavement will require prior approval of the City. Replacement of removed pavement will be done according to plan details and no additional payment will be made unless otherwise noted in the plans.

**D. Fiber Optic Cable Installed in Ducts and Conduits.**

**1.** A suitable cable feeder guide 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 off the reel. It shall be carefully inspected for jacket defects. If defects are noticed, the pulling operation shall be stopped immediately and the Engineer notified. Precautions shall be taken during installation to prevent the cable from being "kinked" or "crushed". A pulling eye shall be attached to the cable and used to pull the cable through the duct and conduit system. A pulling swivel shall be used to eliminate twisting of the cable. As the cable is played off the reel into the cable feeder guide, it shall be sufficiently lubricated with a type of lubricant recommended by the cable manufacturer. Dynamometers or breakaway pulling swing shall be used to ensure that the pulling line tension does not exceed the installation tension value specified by the cable manufacturer. The mechanical stress placed on a cable during installation shall not be such that the cable is twisted or stretched. The cable shall not be crushed, kinked or forced around a sharp corner. Lubricant shall be used on all pulls except when pulling into a building or equipment enclosure that are pulled by hand. Lubricant shall be of water based type and approved by the cable manufacturer. Sufficient slack shall be left at each end of the cable to allow proper cable termination (by others), minimum of 30 feet. This slack shall be in addition to installation slack as hereinafter specified. Additional slack cable shall be left in each hub cabinet, handhole, and at the top of each conduit riser. Excess slack at hub cabinets shall be re-pulled into the nearest handhole to provide a neat and orderly installation. Unless otherwise specified in the plans, the minimum slack amounts shall be as follows:

- Hub cabinet – 100 feet
- Fiber Handhole – 100 feet
- Building Entrance – 100 feet

The Contractor shall be required to transport, deliver and install a minimum roll of 20,000 linear feet of fiber cables of the type specified in the contract documents.

**2.** Storage of slack cable shall be coiled. The slack coils shall be bound at a minimum of three points around the coil parameter and supported in their static storage positions. The binding material and installation shall not bind or kink the cable. Storage of additional slack cable adjacent to conduit risers and support poles shall be as visibly marked/tagged as "CAUTION – FIBER OPTIC CABLE". Maximum length of cable pulling tensions shall not exceed the cable manufacturer's recommendations.

**3.** All fiber cables shall be marked with a metallic identifier in the handhole adjacent to the traffic signal cabinet or hub cabinet and on the cable in the traffic signal cabinet or hub cabinet at the point of termination. The identifier, both in the cabinet and in the handhole, shall indicate the direction the cable is going, cable contents [SM or SM/MM], and the abbreviated location for the other end destination.

**4. Minimum Bend Radius.**
For static storage, the cable shall not be bent at any location to less than ten times the diameter of the cable outside diameter or as recommended by the manufacturer. During installation, the cable shall not be bent at any location to less than 20 times the diameter of the cable outside diameter or as recommended by the manufacturer.

**5. Cable Termination.**
All cable terminations shall be done by the City.

**6. Splices.**
All cable splices shall be done by the City.

**E. Fiber Optic Cable Testing.**

**1. Before the Fiber Optic Cable Installation.**

**a.** The fiber loss in dB/km and the length of each reel shall be tested at both 1310 nm and 1550 nm and recorded in the documentation that accompanies each delivery. The maximum attenuation of the cable shall be 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm (1 km = 0.3077 KF where KF is 1000 feet). This test does not require an electronic document; but is provided to insure that the fiber has been received in useable quality without shipment damage.

**b.** The test results of the received spools shall be provided to the City in a minimum of hard copy print, prior to receiving payment for the cable. Data documentation shall include for each test the length of fiber as measured by optical time domain reflectometer (OTDR), frequency used in on the OTDR by each fiber type, dB loss rating by manufacture from spool documentation, index of refraction by type of fiber in each spool, and the dB loss of each spool as measured in the final test for each fiber.

**c.** The launch attenuator shall be utilized for all OTDR tests. Only one launch cable shall be required when testing non-terminated fiber. The launch attenuator(s) shall be of the same fiber core size and type as the fiber under test. The attenuator shall emulate 900 feet length, minimum, for single mode fiber or as specified by the OTDR manufacturer for stabilization of the pulse generation. Launch cables shall be of identical length for incoming and outgoing light during tests. ST connectors shall be utilized with each attenuator to connect the device to the test device, OTDR.

**d.** The vendor shall provide all personnel, equipment, instrumentation and supplies necessary to perform all testing. All testing shall be performed in an accepted manner and in accordance with the testing equipment manufacturer's recommendations. All data shall be recorded and submitted to the City as hereinbefore specified. The City may perform or require supplemental testing at any time.

**e.** If the attenuation is found not to be within the acceptable nominal values, then vendor shall replace the damaged section of cable with no additional payment. Splices will not be allowed to repair the damaged section. A minimum of one fiber per tube per reel shall be tested.

**2. After the Fiber Optic Cable Installation.**

**a.** Each section of the cable shall be tested for continuity and attenuation as a minimum. All testing shall be performed by the Contractor. If the attenuation is found not to be within the acceptable nominal values, the Contractor shall use an OTDR to locate points of localized loss caused by bends or kinks. One random fiber per tube will be tested. The test shall be conducted on each strand for loss and reflection using an OTDR and optical power-loss meter. Calibrate an optical loss test set and provide evidence satisfactory to the Engineer that the set produces accurate results at both wavelengths. This can be a power meter that is set correctly to measure the loss of a test fiber whose loss is known. Use the test set to measure the loss of the link under test. Record the result at both 1310 nm and 1550 nm. Submit test results of post installation cable to Engineer prior to the City proceeding with splicing or termination. If this is not successful, the Contractor shall replace the damaged section of cable with no additional payment. Cost of a new cable will be at Contractor's expense. Splices will not be allowed to repair the damaged section.

**b.** The Contractor shall provide the City with a listing of the end to end cable jacket markings and the entry and exit jacket markings at all handholes for each fiber run. This information must be submitted with the application for payment for each completed run.

**150059.04 METHOD OF MEASUREMENT.**

**A.** Measurement for Permanent Fiber Optic System shall be on a linear foot basis for the plan quantity. No actual measurement will be made. This shall be the plan distance. Distance to account for vertical deviations underground to avoid obstructions or other vertical changes are incidental to the bid item.

**B.** Measurement for Temporary Fiber Optic System shall be on a linear foot basis for the plan quantity. No actual measurement will be made. This shall be the plan distance. Distance to account for sag, up and down risers and poles are incidental to the bid item.

**150059.05 BASIS OF PAYMENT.**

**A.** For the plan quantity of Permanent Fiber Optic System, the contractor shall be paid the bid unit price. This payment shall be full compensation for supplying and installing the fiber optic cable, conduit, handholes, tracer wire, pull tape, pulling lubricants, cleanup of any waste materials from the installation, and any other materials, labor or equipment necessary to install the fiber optic cable in place per the plans.

**B.** For the plan quantity of Temporary Fiber Optic System shall be paid on the bid unit price. This payment shall be full compensation for supplying and installing wooden poles, guy anchors, messenger cable, lashing the fiber optic cable to the messenger cable, conduit from the existing handholes to the nearest wood poles, modifying the existing handholes for temporary access, installing the fiber optic cable on the poles, and all hardware, lashing, labor, equipment and materials necessary to install the temporary fiber optic system in place. This payment also includes any maintenance of the system (reattaching cabling, or repairing any other wear and tear) during the course of the construction project. Payment also includes modifying the system as needed during construction at conflict points (such as relocating poles or holding poles as needed for any underground or at grade improvements, or any other improvements shown in the plans, and removal of the temporary fiber optic system at the end of the project when the permanent fiber optic system is installed.