SP-157020
(New)

SPECIAL PROVISIONS
FOR
TRAFFIC SIGNAL INTERCONNECT

Scott County
STP-A-1827(669)--86-82
STP-A-1827(670)--86-82
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Effective Date
March 21, 2017

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

1. GENERAL

1.1 This part of the specifications includes the furnishing of all material and equipment necessary to complete, in place and operational, a traffic signal interconnect fiber optic system as described in the project plans.

1.2 The installation of the traffic control signals and accessories shall be in conformance with the Manual on Uniform Traffic Control Devices, latest edition.

1.3 The Contractor shall be responsible for ONE-CALL locates of the fiber cables installed under this project until acceptance of the project by the City.

1.4 At the completion of the project, the Contractor shall provide the city with as-built drawings of the fiber optic system.

1.5 At the completion of the project, the Contractor shall mark the vertical and horizontal location of all conduits with paint and flags. The Engineer will use their GPS equipment to map the conduit, footing, and handhole locations.

1.6 Wiring Diagrams- Fiber optic wiring (Splicing & Terminations) diagrams are provided to define the fiber optic wiring of all traffic cabinets, hubs, and facilities. Discrepancies of any wiring diagrams shall be resolved with the Engineer prior to installation. Changes to the wiring diagrams may occur during the project based on user demand and other projects interacting with this project. The Contractor shall maintain accurate quantities of splices and termination at each location during the project. Wiring diagrams shall be red-lined as part of the “normal As-Built” records provided to the Engineer.

2. SYSTEM INTEGRATION

2.1 The Contractor shall coordinate with the City's Communications Coordinator/System Integrator, gba Systems Integrators, LLC (gbaSI), to facilitate with system integration of the project.

2.2 gbaSI shall install, program, network, connect, and test the complete communication system including all network switches, and any other component of the complete and functional system.

2.3 gbaSI shall supply the IP address Schema. The IP address schema will include a plan for all devices on the network, both supplied by this contract and devices supplied by other projects. The address inventory shall be provided to the City at project completion as part of "Normal As-built" records.

2.4 The coordination with gbaSI shall be considered incidental to the project and no additional compensation shall be provided for this effort.

3. EQUIPMENT AND MATERIALS

3.1 Fabrication and assembly process materials shall comply with the applicable parts of Section 2523 of the Standard Specifications with the additions as stated herein.

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

3.3 A PDF file of catalog cuts and manufacturer's specifications shall be furnished for all standard "off-the-shelf" items.

3.4 Engineer's review of shop drawings and catalog cuts shall not relieve the Contractor for any responsibility under the Contract documents.

3.5 All electrical equipment shall conform to the standards of the National Electrical Manufacturer's Association (NEMA), and all material and work shall conform to the requirements of the National Electrical Code (NEC), the Standards of the American Society for Testing Materials (ASTM), the American Standards Association (ASA), and local ordinances. Miscellaneous electrical equipment and materials shall be UL approved.

3.6 Wherever reference is made to these specifications or in the standard provision to the code, the safety orders, the general order, or the standards mentioned above, the reference shall be construed to mean the code, order, or standard that is in effect at the date of advertising of these Specifications.

3.7 Certification from the manufacturers of all electrical equipment, conduit, and cable shall be supplied by the Contractor stating said materials comply with these Specifications.

3.8 Any existing equipment designated to be removed on the project shall remain the property of the City of Davenport. The Contractor shall contact the City to coordinate pick-up of equipment by City forces.

4. TESTING AND MAINTENANCE OF SIGNAL EQUIPMENT

4.1 Notify the Engineer the date the signal or communication system will be ready for testing once the project is open to traffic.

4.2 Upon authorization of the Engineer, place the signal or communication system in operation for a consecutive 30 day test period. The signal(s) and communication network shall not be placed into operation without prior notification and authorization of the Engineer. Any failure or malfunction of the equipment furnished by the Contractor, exclusive of minor malfunctions (such as lamp burnouts or power outages) occurring during the test period, shall be corrected at the Contractor's expense and

the signal or communication system tested for an additional 30 consecutive day period. This procedure shall be repeated until all installed equipment has operated satisfactorily for 30 consecutive days.

4.3 A representative from the manufacturer and/or supplier of signal controller shall be at the project site when the signal controllers are ready to be turned on, to provide technical assistance including, as a minimum, programming of all necessary input data. All required signal timing data shall be provided by the Engineer.

4.4 After signal turn on and prior to the final acceptance of the completed traffic signal system, the Contractor shall respond, within 24 hours, to perform maintenance or repair of any failure or malfunction reported.

5. GUARANTEE

5.1 The Contractor shall transfer all required equipment warranties on the date of final acceptance to the City of Davenport.

6. FIBER OPTIC CABLE AND CONNECTIONS

6.1 All designed interconnect systems shall use single-mode fiber optic interconnect cable. All fiber optic components required to provide proper communication with the City traffic signal network shall be furnished and installed as part of this item. The work shall consist of furnishing and installing a fiber optic cable of the type, size, and number of fibers specified. All fiber optic materials and equipment procured and installed as part of this specification shall be OFS or Corning brand, or engineer approved equal.

6.2 General Requirements

6.2.1 Materials and Equipment
Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of the products. All materials and equipment furnished shall be completely free from defects and poor quality. The cable shall be rated for gigabyte data bandwidth. All fiber shall be loose tube construction for both indoor and outdoor installation. Indoor cabling shall use plenum rated conduit to within less than 50 foot of point of termination eliminating the requirement to convert to indoor cable.

6.2.2 Contractor Qualifications
Trained and experienced personnel shall supervise the fiber optic cable installation. Qualified technicians shall make the cable terminations and splices. The technicians performing terminations and splices shall be IMSA Fiber Optic Level 2 Certified, be a FOA (Fiber Optic Association) Certified Fiber Optic Technician, or hold an approved equal certification. 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.

6.2.3 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.

6.2.4 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.

6.2.5 General Considerations
The cable shall meet all requirements stated within this specification. The cable shall be new, unused, and of current design and manufacture.

6.3 Fiber Characteristics
All Fibers in the cable must be usable fibers and meet required specifications.

6.3.1 Single-Mode Fiber
Typical core diameter: 8.3um
Cladding Diameter: 125 +1.0um by fiber end measurement
Core-to-cladding offset: <1.0um
Coating Diameter: 250 +15um
Attenuation uniformity: No point discontinuity shall be greater than 0.1 dB, except terminations or patch cords, at either 1310nm or 1550nm. The coating shall be a layered UV cured acrylate applied by the fiber manufacturer. The coating shall be mechanically or chemically removable without damaging the fiber.

Factory cable rating shall be 0.35 dB/KM at 1310nm and 0.25 dB/KM at 1550nm. Installed tolerance shall be less than 0.44 dB/KM at 1310nm and less than 0.33 dB/KM at 1550nm, testing tolerance.

All fiber cables shall be Gigabyte rated, i.e. single mode shall be 28 KM for 1310nm and 40 KM for 1550nm based on a 10 dB power budget.

All Single mode fiber shall be rated for multi-frequency, four frequencies, equivalent to the AllWave OFS specification and shall be rated to withstand extended aging under water impregmentation conditions.

6.4 Fiber Specification Parameters

6.4.1 All fibers in the cable shall meet the requirements of this specification. The testing tolerance attenuation specification shall be the maximum attenuation for each fiber over the entire operating temperature range of the cable when installed.

6.4.2 The change in attenuation at extreme operational temperatures for single-mode fibers shall not be greater than 0.20 dB/km at 1550nm, with 80% of the measured values no greater than 0.10 dB/km at 1550nm.

6.4.3 Optical fibers shall be placed inside a loose buffer tube, with 12 fibers per tube.

6.4.4 The buffer tubes will meet EIA/TIA-598, “Color coding of fiber optic cables.”

6.4.5 Fillers shall be included in the cable core to lend symmetry to the cable cross-section where needed.

6.4.6 The central anti-buckling member shall consist of a glass reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.

6.4.7 The cable shall use a completely dry cable design without the use of gels or filling compounds. Dry water blocking material shall be used around the buffer tubes as well as internal to the tubes. Water blocking gels shall not be acceptable on this project.

6.4.8 Buffer tubes shall be stranded around a central member. Acceptable techniques include the use of the reverse oscillation, or “SZ”, stranding process.

6.4.9 All dielectric cables (with no armoring) shall be sheathed with medium density polyethylene. The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and flooding compound. Cable jacketing shall utilize the newer designs to provide maximum flexibility without loss or appreciable dB attenuation. Cable diameter shall not exceed 0.50 inch.

6.4.10 The jacket or sheath shall be marked with the manufacturer’s name, the words “optical cable”, the year of manufacture, number of fibers, type of fiber (SM) and sequential feet or meter marks. The markings shall be repeated every on-meter or three feet. The actual length of the cable shall be within -0/+1% of the length marking. The marking shall be in contrasting color to the cable jacket. The height of the marking shall be approximately 2.5 mm. A copy of the manufacturer fiber definition and shipping sheet identifying all tests, results and fiber indexes shall be provided to the Engineer on delivery of cable to the City or shall be included with the contractor’s list of place(s) of installation when installed by the Contractor.

6.4.11 The maximum pulling tension shall be 600 pounds during installation.

6.4.12 Two, four, six, or twelve buffer tubes with twelve fibers each, or subsets specified, shall be provided and designated as follows:

Buffer Tube/Fiber	Tube/Fiber Color
#1, 1st tube or fiber	blue
#2, 2nd tube or fiber	orange
#3, 3rd tube or fiber	green
#4, 4th tube or fiber	brown
#5, 5th tube or fiber	slate
#6, 6th tube or fiber	white
#7, 7th tube or fiber	red
#8, 8th tube or fiber	black
#9, 9th tube or fiber	yellow
#10, 10th tube or fiber	violet
#11, 11th tube or fiber	rose
#12, 12th tube or fiber	aqua

6.5 Quality Assurance Provisions

6.5.1 All optical fibers shall be proof tested by the fiber manufacturer at a minimum load of 100 kpsi.

6.5.2 All optical fibers shall be 100% attenuation tested by the manufacturer. The attenuation of each fiber shall be provided with each cable reel. The measured attenuation shall be for both 1310 and 1550 frequency. This documentation shall be provided with each spool. The Contractor shall designate on the Plans and document the location where each spool has been installed and provide this data to the engineer.

6.6 Cable Installed in Ducts and Conduits

6.6.1 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/conduit 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 swings 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 the cable during installation shall not be such that the cable is twisted or stretched. The pulling of cable shall be had assisted at each controller cabinet. The cable shall not be crushed, kinked, or forced around a sharp corner. If lubricant is used it shall be of water based type and approved by the cable manufacturer. Sufficient slack shall be left at each end of cable to allow for proper cable termination or splicing, minimum of 30 feet. This slack shall be in addition to installation slack as specified. Additional slack cable shall be left in each hub cabinet and handhole. Excess slack at hub cabinets shall be re-pulled into the nearest handhole to provide a neat and orderly installation. The slack amounts to be stored in each handhole are as noted in the plans.

6.6.2 Storage of minimum slack cable in controller cabinets and additional slack at pull boxes shall be coiled. The slack coils shall be bound at a minimum of three points around the coil perimeter and supported in their static storage positions. If stored in a handhole, fiber shall be stored along the outer most walls to allow unabated ingress and egress. 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. Along with the fiber optic cable, on No. 10 AWG THHN, 600-volt single conductor cable (trace wire), orange in color, shall be pulled with 10 feet of slack in each pull box or handhole. All fiber cables shall be marked with a metallic or preapproved identifier in the handhole adjacent to the traffic signal cabinet or hub cabinet and on the cable in the hub cabinet at point of termination. The identifier, both in the cabinet and in the handhole, shall indicate the direction the cable is going, cable contents (SM), and the abbreviated location for the other end destination.

6.7 Minimum Bend Radius

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

6.8 After the Fiber Optic Cable Installation

6.8.1 Each section of the cable shall be tested for continuity and attenuation as a minimum. If the attenuation is found not to be within the acceptable nominal values, the Contractor shall use an optical time domain reflectometer (OTDR) to locate points of localized loss caused by bends or kinks. If this is not successful the Contractor shall replace the damaged section of cable with no additional payment. Splices will not be allowed to repair the damaged section. After all fiber is installed, all fibers, whether terminated or non-terminated, shall be tested with an OTDR. All fibers terminated shall be tested with a power meter. Each OTDR trace, for documented test result submittal shall be displayed individually and not be combined with other fiber traces as overlays. Single mode fiber shall be tested at 1310 nm. The results of the OTDR test shall be provided on an electronic media (disk) and paper printout. The OTDR wave, pictorial diagram of dB loss over the length of fiber tested, shall be provided along with the measured data values. The printout shall contain the manufacturer’s fiber optic Index of Refraction to the third decimal point for the fiber provided. The Contractor shall provide the Engineer with a written report showing all the values measured compared to the calculated values for length and coupler/connector losses at the completion of these tests.

6.8.2 Documentation provided to the Engineer shall include written indication of every splice termination, patch cord, etc. for cable being measured. Power meter measurement recordings shall indicate the exact measured distance (OTDR or field measurement with cross reference for oscillation multiplier) on the sheet showing the power meter readings. Any deviations between fiber readings in the same tube shall be notated for OTDR graphs as well as deviations greater than 5% on power meter readings. Rated values for acceptable installation shall be based on the following parameters:

Patch cords/Pigtails	0.15 dB each (SM)
Terminations	1.0 dB set of two (In and Out)
Splices	0.08 dB each

1 KM = 0.3077 KF where KF is 1000 feet

6.8.3 Data documentation for each test between buildings, hubs, or cabinets shall include, the length of fiber as measured by OTDR, frequency used in test on OTDR by each fiber type, distance to each splice, termination, or patch cord jumper, dB loss rating by manufacture from spool documentation index of refraction by type of fiber in section, and the dB loss of each section as measured in the final test for each fiber. A special test shall be made on all continuous spliced fiber from start to end that includes the total dB loss measured and the OTDR plot on electronic disk. Splice points shall be identified on the trace.

6.9 Fiber Optic Termination

6.9.1 Terminations shall be made using the method recommended by the connector manufacturer.

6.9.2 All fibers shall utilize a fan-out kit of the size and type recommended by the manufacturer and of the number of fibers provided in each fiber tube.

6.9.3 All fibers terminated shall utilize a ceramic ferrule (outdoor connections), SC, mechanical termination with a wide temperature (-40°F to +170°F) epoxy. Heat cured or epoxy type connections meeting the full temperature ratings are acceptable for this Project, including factory manufactured pigtails.

6.9.4 The Contractor shall be required to provide proof of purchase of sufficient quantities of ceramic terminations for outdoor terminations to verify ceramic connector usage or temperature ratings on epoxy or heat cured processes prior to terminating any fibers.

6.9.5 The Contractor may terminate fibers by splicing factory pigtails to the fiber ends and then connecting the pigtail to the fiber coupler in the fiber tray. When splicing pigtails to terminate, all splices shall be provided with metal reinforced shrink tube protector.

6.9.6 All termination couplers shall be rated for SM fiber application.

6.10 Fiber Termination Panels

6.10.1 The Contractor shall provide and install termination panels with 144, 72, 48 and 24 position capacity as indicated in the Tabulation of Equipment at each traffic signal cabinet or fiber hub.

6.10.2 The Fiber Termination Panel shall include all required equipment to provide a fully functional panel; this includes breakout kits, fiber distribution units, housing, etc.

6.10.3 The breakout kits, fiber distribution units, or termination boxes used to terminate each fiber cable in the cabinet shall provide for the separation and protection of the individual fibers with the buffer tubing and jacketing materials.

6.10.4 The termination housing shall be installed within a wall interconnect housing which shall provide for storing fibers, ample room for feed through cables, strain relief for multiple cables within the unit, and accommodate SC compatible connectors.

6.10.5 All fiber pigtails shall be terminated through SC connectors on the wall interconnect panel. All terminations shall be either SC type, ceramic core (outdoor connections).

6.10.6 Splices to pigtail fiber, where used shall utilize fan out kit protection to the fiber, heat shrink tubing with metal bar reinforcement and 900 micron rated pigtail insulation. Splices to factory pigtails shall use pigtails that are rated for a minimum temperature range of 0°F to +150°F. In the absence of pigtails meeting this temperature rating, fibers shall utilize loose tube fiber in fan-out kit tubes and SC connectors.

6.11 Connectors

Connectors shall be either SC (ceramic ferrule-outdoor connections) type, field installable, and self-aligning and centering or factory fabricated pigtails. Fiber optic equipment used for terminating fibers shall be rated for the type of connectors used. Connectors shall be NEMA temperature rated epoxy type or Engineer approved equal.

6.12 Duplex Patch Cords

Patch cords shall have connectors on each end and shall contain a pair of fibers per cord (Duplex). The patch cords shall be factory made, buffered, and strengthened with aramid yarn to reduce the possibility that accidental mishandling will damage the fibers or connection. The patch cords shall be yellow. The connectors on each end shall be of the same type as indicated in Sec 6.11 of this provision, except where the second connector is required to be different for compatibility with the equipment to which the patch cord connects. Length of the patch cord shall suffice to provide approximately 5 feet of slack after installation. Patch cords to be installed in the Fiber Hub cabinets and other locations where the fiber terminations already exist, shall be supplied and installed by the City as indicated in the plans.

6.13 Splice Enclosure (In-Ground)

6.13.1 Splice Enclosures shall provide capacity of 144 fiber splices

6.13.2 The Enclosure shall be: suitable for outdoor applications with a temperature range of -30° C to 60° C (-22° F to 140° F), protect splices from moisture and damage, non-reactive and not support galvanic cell action, waterproof, re-enterable, sealed with a gasket, permit selective splicing to allow one or more fiber strands to be cut and spliced without disrupting other fibers, equipped with a basket to accommodate the slack from all fibers routed into the enclosure, capable of holding splice trays from various manufacturers, input/output capacity of four 18mm cables, equipped with a termination block to terminate the central strength members of the fiber optic cables.

6.13.3 Splice trays shall be: compatible with fiber splices and splice enclosure, equipped with polyethylene tubes to protect exposed individual fibers within the enclosure, stackable within the splice enclosure. Vinyl markers shall be supplied to identify each fiber to be spliced. Each splice shall be individually mounted and mechanically protected on the splice tray. Loose tube buffers shall be secured with a tube guide or channel snap. Slack fiber shall be placed in an oval shape along an inside wall of the tray.

6.14 Fiber Optic Fusion Splice

Splice all optical fibers as shown in the plans or as directed by the Engineer.

6.14.1 Make all splices using a fusion splicer that automatically positions the fibers using either the Light Injection and Detection (LID) system or the High-resolution Direct Core Mounting (HDCM) system. Provide all equipment and consumable supplies.

6.14.2 Secure each spliced fiber in a protective groove. Completely re-coat bare fibers with a protective room temperature vulcanizing (RTV) coating, gel, or similar substance, prior to insertion in the groove, so as to protect the fiber from scoring, dirt or micro bending.

6.14.3 Prior to splicing to fiber installed by others, measure and record the optical loss over that fiber. Utilize the same methods as shown in Sec 6.8 of this provision.

6.14.4 Use a different splice tray for each buffer tube color. If an enclosure contains multiple buffer tubes of the same color, but none of the tubes are spliced to fibers in the other tubes of the same color, use a separate splice tray for that tube.

6.14.5 All splices shall be nominally 0.03 to 0.05 dB loss but shall be less than a 0.08 dB loss.

6.15 Light Source and Power Meter

6.15.1 An LED light source with a wavelength that is the system wavelength, 1310 and 1550 nm for single mode shall be used. The LED shall be stable within 0.1 dB in intensity over a time period sufficiently long to perform measurement. The output of the LED shall overfill the input end of the launch fiber/cable in both numerical apertures (NA) and core diameter. The accuracy of the combined light source and power meter shall be less than 0.05 dB and be temperature compensated stabilized to 0.01 dB over the operating range of the meter(s).

6.15.2 The contractor shall provide one each Light Source and Power Meter and/or one each 650 nM visible light source, to the Fiber Optic Coordinator or City technician complete with all attachments for measuring individual fibers of single mode at both 1310 and 1550 nm for spot testing/inspecting of installed and terminated fibers. This test kit shall include one each 200X power zoom scope for observing fiber ends for smoothness and fractures. AC power adapters shall be provided with all light and power meters as well as battery operation. This test kit shall remain the property of the Contractor. This test kit shall be made available from the beginning to completion of the project and be on-site at all times.

6.15.3 Power Meter
The detector in the power meter shall have an effective numerical aperture and active region that is larger than the receive reference cable and/or the fiber under test. The power meter shall have a minimum range from +3 DBMS to -40 DBMS. The power meter shall have an accuracy of +/- 0.5 dB through the operating temperature and minimum resolution of 0.1 dB.

6.16 Launch Reference Attenuator

6.16.1 The launch attenuator, two for single mode fiber testing, shall be utilized for all OTDR tests such that one launch cable shall be at the beginning of the fiber being tested and the second launch cable shall be on the end of the fiber being tested past the final connector. 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 foot fiber 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. SC/LC connectors shall be utilized with each attenuator to connect the device to the test

device, OTDR. One launch cable shall be installed on the start of the fiber being tested and one launch cable shall be installed on the end of each terminated to view the dB loss of the final connector.

6.16.2 The OTDR shall have the Threshold Loss set at a value to show each splice or termination junction of a single fiber in each tube without showing the extraneous noise caused by handhole coils or turs into the cabinets. This level is normally a value (Threshold Loss) between 0.3 and 0.8 on the OTDR. This trace shall be provided for one fiber in each tube tested and each “event” shall be marked as splice, jumper or patch cord. The Threshold Loss shall then be set to a value of 0.10 for single mode fiber tests. The test of each fiber installed shall be conducted and any recorded events above the threshold shall be identified, such as jumper or patch cord. Events that are in excess of the provided values shall be corrected prior to documentation submittal, such as terminations in excess of the rated value or bends in the fiber at the point of a splice entering or leaving a splice tray (See Testing). For measured values recorded in excess of the above (0.10 for SM) listed values, refer to the fiber parameters specification as hereinbefore defined. The Engineer reserves the right to spot test fiber terminations, splices, or re-testing of all fibers in a section to insure proper quality assurance both during and after installation and testing. Deviations from Engineer testing and report documentation shall be reviewed and the Contractor shall be able to retest any or all challenged measurements to verify a valid test. Inconsistent test results, in the sole opinion of the Engineer, shall cause the Contractor to retest the entire fiver installation.

6.17 Testing

6.17.1 General

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing and is considered incidental to the project. All testing shall be performed in the accepted manner and in accordance with the testing equipment manufacturer’s recommendations. All data shall be recorded and submitted to the Engineer as hereinbefore specified. The Contractor shall provide one copy of operating software to read and view all OTDR traces.

6.17.2 Attenuation

The end-to-end attenuation shall be measured for each fiber for each link after installation and termination. A patch cord jumper cable shall be connected to both the light source and the receive cable to the power meter by the use of a connector (barrel). The two reference cables shall then be connected via a termination coupler and power meter “zeroed” to eliminate the line loss. This process results in a reading of the actual line loss (dB) of the input connector, fiber cable, exiting connector, and any other splices or jumpers installed in the measured test link. The calculated “loss” shall not include the input or departing cables in the loss calculation. The calculated fiber loss measured shall list the number of terminations, including the input and departing connectors, the number of splices and the number of patch cords used to jumper the link(s) into the measured final link. The measured values for each terminated fiber in each tube shall include the Tube number, fiber number, number of feet in the link, the number of splices, the number of patch cords, and the number of connectors, if any. The length of the optical cable shall be as measured by the OTDR rather than the fiber cable jacket as the fiber is in reverse oscillation process resulting in a greater optical distance than the fiber cable jacket. The value for both the OTDR length and the cable jacket length shall be provided in the recorded documentation for each link distance. All distances shall be recorded in feet rather than meters for both recorded lengths.

Fibers that are not continuous from beginning of the link to the end of the link shall be noted in the documentation; otherwise all fibers in a single tube may be listed in a single data entry for all required data listed above for all fibers in the tube. The fiber

documentation for each fiber shall identify the fiber being tested by either fiber number or fiber coating color and be recorded by complete tube, Tube 1 through Tube 12, fiber 1 through fiber 12. The direction of the test shall be recorded for information purposes only to resolve discrepancies in replicating the test during inspections of the final installation. The power meter reading recordings shall log total dB loss over the length of the fiber measured, equivalent to the dB loss budget.

The output power levels at the network hardware transmitters or receivers shall be measured and recorded for system documentation. The power meter shall be connected to the transmitter side do the equipment with a system jumper. The transmit power level shall then be read and recorded.

Each tube of the cable shall be in the same file divider where the tube cover OTDR page shows the overview of all splices, patch cords, terminations from start to end. The second section shall include all Power Meter readings and the mandated documentation to show the calculated line loss (losses). The third section shall contain all OTDR traces, one trace per screen. The fourth section shall include the spool sheet for the fiber installed on the test section. An “explanation” sheet may be included where required to clarify an unusual reading that is valid but difficult to be explained through traditional data presentation, such as a video feed fiber that is attached to a jumper to provide continuous feed from the start to end of the tube length where other fibers in the same tube are simply spliced. The above format shall be repeated for each tube of the cable.

6.17.3 Continuity

Continuity tests shall be used to determine whether a test or system jumper does or does not pass light. A continuity test shall also be used to assure the fibers have not been crossed over in the jumper and that the transmit fiber goes to the receiver fiber. The visible light tester shall be utilized to illuminate faulty terminations or fibers with excessive bends failing to pass light.

To perform continuity test, a high-intensity red light (Visible Fault Identifier) light source shall be aimed into the connector at one end, while an observer watches for a flicker of light at the other end. One each 650 nm red VFL (Visual Fault Locater) light source shall be furnished to the Engineer by the Contractor on request during the testing of the fiber by the Contractor for spot testing. This device shall be made available during testing of continuity to the Engineer to assist in verifying fault locations and connector bleeding.

6.17.4 OTDR Testing

An OTDR shall be used to evaluate the quality and length of cable reels prior to their use on the project. A minimum of one fiber per tube per reel shall be tested if payment for stored goods is requested. The fiber loss in dB/km and the length of each reel shall be recorded in the documentation. The maximum attenuation of the cable shall be as hereinbefore specified. 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. The test results of the Contractor OTDR tests of received spools shall be provided to the Engineer, in a minimum of hard copy print, prior to receiving payment for stored goods.

An OTDR shall be used to evaluate the quality and length of cable installed on the project. This test shall be conducted on all fibers, terminated and not terminated, and shall be conducted after all termination on the fibers for a link have been completed. The fiber loss in dB/km and length of each reel shall be recorded in the documentation. The index of refraction, minimum of three decimal points, provided by the manufacturer on the spool documentation shall be used for the test on the OTDR. The maximum attenuation of the cable shall be as hereinbefore specified. A hard copy of OTDR signature traces, electronically and in printed form, for all fiber links shall be made and provided in the

documentation as specified. The data provided shall be in easy to understand format and of sufficient detail to verify the results. Fiber testing shall include only one fiber trace per graph. One copy of the operating system software to view the fiber graphs shall be provided with the final documentation.

6.17.5 Documentation

The result of all testing shall be recorded along with date of test, name of person performing test, brand name, model number, serial number of equipment used during testing, and any other pertinent information and data. The Contractor shall be responsible to provide input to the Engineer reviewing the recorded data documentation to resolve all questions or data discrepancies. A copy of the evaluation calculation equations to be used may be obtained by the Contractor by request and by supplying an electronic copy. (The evaluation FO Calculator is an EXCEL program worksheet that calculates design dB Loss based on required inputs.) Documentation shall be considered incidental to bid items and no additional compensation shall be provided. Fiber optic cable test results shall be provided to the Engineer, and the City of Davenport Public Works Director.

6.18 Basis of Payment

Measurement and payment for items covered by this specification include the documentation and acceptance testing, in addition to all materials and equipment necessary for a fully operational system.

Payment for the following bid items will be made as follows:

Unit	Item
LF	FIBER – 144 CT SM
LF	FIBER – 48 CT SM
LF	FIBER – 24 CT SM
LF	FIBER – 12 CT SM
EA	FIBER OPTIC FUSION SPLICE
EA	FIBER OPTIC TERMINATION
EA	DUPLEX PATCH CORD
EA	FIBER TERMINATION PANEL – 144 POSITION
EA	FIBER TERMINATION PANEL – 72 POSITION
EA	FIBER TERMINATION PANEL – 48 POSITION
EA	FIBER TERMINATION PANEL – 24 POSITION
EA	FIBER SPLICE ENCLOSURE (IN-GROUND)

7. Ethernet Communication System

7.1 This specification sets forth the minimum requirements for an Ethernet based traffic signal interconnect and communications system. All equipment and materials to provide a properly functioning Ethernet communications system is included.

7.2 The Contractor will procure and supply all Ethernet Communication System switches, SFPs, and switch appurtenances to the City's system integrator for this project, gba Systems Integrators, LLC (gbaSI), for integration, testing, programming, and installation. All items shall be delivered to gbaSI, a minimum of 60 days prior to scheduled installation to allow time for programming and initial testing. Ship or deliver to:

gba Systems Integrators, LLC
1701 River Drive, Suite 100
Moline, IL 61265

7.3 The fiber optic Ethernet communications equipment shall include:

7.3.1 Harsh environment Layer 3 Switch shall be configured with minimum 12 Gigabit SFP uplink/downlink ports and eight copper 10/100/1000 Mbps Ethernet ports with dual power supplies. The Ethernet layer 3 switches shall meet the following minimum requirements or equivalent approved by the Engineer.

7.3.1.1 Minimum Non-blocking forwarding bandwidth of 28Gbps

7.3.1.2 Over all minimum switching bandwidth of 56Gbps

7.3.1.3 IP network protocols: OSPFv1 and OSPFv2, RIPv2, VRRP (Virtual Router Redundancy Protocol), Multicast routing protocol PIM-SM (Protocol Independent Multicast – Sparse Mode), and IPv6 OSPF routing protocol.

7.3.1.4 Support Layer 2 technology for VLANs, RSTP, SNMPv1-3, IGMPv1,v2,v3 snooping, NTP and LACP

7.3.1.5 Operating temperature -40° C to 75° C (-40° F to 167° F)

7.3.2 Harsh environment Layer 2 Switch shall configured with minimum of four Gigabit Ethernet RJ45/SFP combo uplink ports and twelve (12) 10/100-TX RJ-45 fast Ethernet ports and power supply. The Ethernet switch shall meet the following minimum requirements or equivalent approved by the Engineer.

7.3.2.1 Minimum Non-blocking forwarding bandwidth of 11 Gbps

7.3.2.2 8K Unicast MAC addresses, and IGMPv1,v2,v3 snooping

7.3.2.3 Management via console CLI, Web, SNMP, RMON, HTTPS, and SSH

7.3.2.4 7.3.2.4 Operating temperature -40° C to 74° C (-40° F to 165° F) for extreme environment

7.3.2.5 1K VLANs, VLANs, GVRP, QoS, LACP, RSTP, LLDP, NTP, SNMPv1-3, Port-Security, Storm Control.

7.3.2.6 Event notification by e-mail, SNMP trap, syslog, digital input and relay output

7.3.3 Single Mode (SM) SFP transceivers
The provided SFP transceivers shall operate on both the Layer 2 and Layer 3 switches in the traffic signal cabinets or other Layer 3 locations shown in the plans. The SFP transceivers are considered subsidiary to the Layer 2 and Layer 3 switches, and no direct payment will be made.

7.3.3.1 1000Base-LX/LH (LC) Single Mode SFP transceivers shall support EXT temperature and 1310 nm 10KM distance. The number of SFPs for each Layer 2 and Layer 3 switch as indicated in the Tabulation of Equipment shown in the plans.

7.3.3.2 1000Base-EX (LC) Single Mode SFP transceivers shall support EXT temperature and 1310nm 40km distance. The number of SFPs for each Layer 2 & Layer 3 switch as indicated in the Tabulation of Equipment shown in the plans.

7.4 The system shall be primarily fiber optic based. The system shall also include interface equipment and cabling for CAT-5 communications, except cable installed in conduit external to a controller cabinet shall be CAT-6E.

7.5 All equipment, terminations, connectors, terminal blocks, and any other hardware to construct the system shall be designed for outdoor use in typical traffic signal system conditions. All equipment shall include mounting brackets to secure the equipment in the cabinet.

7.6 Basis of Payment
Payment shall be made upon network equipment delivery, installation, and successful operational testing. Measurement and payment for items covered by this specification are as follows:

Unit	Item
EA	HARSH ENVIRONMENT LAYER 2 SWITCH
EA	HARSH ENVIRONMENT LAYER 3 SWITCH

8 Replacing Damaged Improvements/Site Restoration

8.1 The contractor is to restore to its original condition any disturbed areas at sites including, but not limited to; pull box/handhole, conduit, pole base installations, and relocated signs. Restoration shall be accomplished by placing material equivalent to that of the adjacent undisturbed area. Disturbed unpaved areas shall be fertilized, seeded, and mulched.

8.2 The Contractor shall take special care to minimize the disturbance of the existing ground.

8.3 Improvements such as sidewalks, curbs, driveways, roadway pavement, and any other improvements removed, broke, or damaged by the Contractor shall be replaced or reconstructed with the same kind of materials found on the work or with materials of equal quality. The new work shall be left in serviceable condition satisfactory to the Engineer. Whenever a part of a square or slab of existing concrete sidewalk, driveway, or pavement is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed.

8.4 **Basis of Payment**
The cost of replacing damaged improvements and/or restoration of disturbed areas, including erosion control during construction, will be incidental to the bid items of the project. No direct payment will be made for any materials or labor, which is performed under this provision.

9 Traffic Signal Controller

This specification includes all work by the contractor to provide installation of city furnished traffic signal controllers and installation of traffic signal controllers to be procured by the Contractor.

9.1 **Install Only**
The Contractor to install City furnished, Econolite ASC-3 traffic signal controllers at locations as shown in Tabulation of Equipment in the plans (Sheet C.04).

9.2 **Furnish and Install**
The Contractor shall furnish and install new Cobalt by Econolite traffic signal controllers at locations as shown in the Tabulation of Equipment in the plans (Sheet C.04). The Cobalt is the natural replacement for the now discontinued Econolite ASC-3 Controller being used throughout the City of Davenport.

9.2.1 The controller equipment furnished shall be new, of the latest model, fabricated in a first-class quality manner from good quality material. The manufacturer shall replace free of charge to the Contractor and/or City of Davenport any part that fails in any manner by reason of defective material or quality within a period of 12 months from the date the equipment was placed into operation following installation.

9.2.2 Certification of the manufacturer's controller assembly by an independent testing laboratory shall be provided to the Engineer. This certification shall indicate that the manufacturer's controller assembly is in accordance with the test procedures as specified in the NEMA Standard No. TS1-1983. Certification to NEMA Standard No. TS-2, current edition at the time of bid shall be acceptable.

9.2.3 All components shall be amply de-rated with regard to heat dissipating capacity and rated voltage so that, with maximum ambient temperatures and maximum applied voltage, a material shortening of life or shift in values shall not occur.

9.3 **Basis of Payment**

Measurement and payment for items covered by this specification are as follows:

Unit	Item
EA	TRAFFIC SIGNAL CONTROLLER, INSTALL ONLY
EA	TRAFFIC SIGNAL CONTROLLER, FURNISH & INSTALL

10 Traffic Signal Cabinet Modifications

10.1 PURPOSE. It is the purpose of these specifications to set forth the general requirements and administrative details governing the purchase and installation of traffic signal equipment and materials. All equipment and materials shall be furnished and installed in accordance with the contract documents.

10.2 COMPLIANCE WITH CONTRACT DOCUMENTS. The requirements of the Standard Specifications shall apply to work on this project when such work is not otherwise defined by the contract documents. For estimated quantities, see exhibit A of these special provisions.

10.3 TECHNICAL CERTIFICATION. A minimum of one contractor technician or craftsman on the job at any time must be certified by the International Municipal Signal Association (IMSA) as a Level I and Level II Traffic Signal Technician/Electrician. Proof of certification must be provided prior to notice to proceed.

10.4 WORK ZONE TRAFFIC CONTROL. The Signal Contractor shall prepare a traffic control plan. This plan must be approved by the Traffic Engineering Division one month prior to beginning work. All signs, barricades and their placement and use shall be in accordance with the Manual on Uniform Traffic Control Devices.

10.5 WORK SITE. The Contractor shall maintain the worksite in a neat and orderly manner. All operations and storage of materials shall be limited to the right-of-way. Operations that interfere with traffic movement will be kept to a minimum. The Contractor shall remove all excavated earth and debris from the worksite in a timely manner. All surfaces shall be restored to their original or improved state upon completion of the project. Any existing traffic signals shall remain in operation at all times during construction. The existing traffic signals shall be turned off and removed only at the direction of the Traffic Engineering Division.

10.6 INSPECTION. A project inspector will visit the site daily. Any actions in conflict with the Specifications or Plans shall be cause for the issuance of a "Stop Work Order" until such time that any discrepancies are corrected.

10.7 EQUIPMENT AND MATERIALS. The equipment and materials required in this specification are intended to be those which are standard items from reputable manufacturers of these products. When it is necessary to modify requirements for these items to fit the proposed traffic signal installation, the modified requirements will be noted in the Special Provisions. Equipment and materials shall be of new stock unless the contract provides for the relocation or the use of fixtures furnished by others. New equipment and materials shall be the product of reputable manufacturers of electrical equipment, and shall meet the approval of the Traffic Engineering Division.

10.7.1 Equipment List. The Contractor shall submit to the Traffic Engineering Division a list of equipment and materials to be furnished. This list shall include equipment manufacturer and catalog number for each item listed that the Contractor proposes to install. The list and catalog cut sheets shall be submitted in duplicate to the Traffic Engineering Division for written concurrence before any equipment or materials are ordered. No construction work of any nature will be permitted on the signal project until concurrence has been received.

10.7.2 Operating Instructions. Before acceptance of the work, the Contractor shall furnish the Traffic Engineering Division with two copies of the manufacturer's instructions for maintenance and operation of all signal equipment, wiring diagrams of the installation or system and a parts list sufficient for the ordering of any parts.

10.7.3 Guarantee. The Contractor shall guarantee all equipment and work against defective quality or workmanship, for a period of 6 months from date of final acceptance of the work by the Traffic Engineering Division. A manufacturer's guarantee may be required for a longer period if so required by other sections of this specification.

10.8 ELECTRICAL UNDERGROUND MATERIAL.

10.8.1 Description. The work under this section shall consist of furnishing and installing electrical conduit, conductors, and pull boxes for traffic signals and highway lighting including pushing, drilling, excavating, backfilling, and compacting at locations designated on the project plans and in accordance with the requirements of these specifications.

10.8.2 Materials:

10.8.2.1 Electrical Conductors. All conductors shall conform to the National Electric Code (NEC) and Underwriters Laboratories (UL) standards and other applicable industry standards.

a) Power and Highway Lighting Cable. Power cable shall comply with Article 4185.12 of the Iowa DOT Standard Specifications and shall be UL listed for type THHN. Insulation colors shall be as follows:

Street Lighting Hot: Black
Street Lighting Common: White
Power Hot: Black
Power Common: White

b) Signal Cable. Signal cable shall meet the requirements of the International Municipal Signal Association (IMSA) 19-1, or latest revision thereof. The number and size of conductors shall be as specified on the Plans. All signal cable shall utilize stranded conductors.

c) Tracer Wire. A tracer wire shall be installed in all conduits as shown on the plans. The tracer wire shall be a No. 8 AWG conductor, stranded copper, Type THHN, UL with orange colored insulation. The tracer wire shall be identified in the controller cabinet, pull boxes, and poles by means of nylon "ty-wrap" identification tags and indelible ink. The tracer wire shall be spliced in the pull boxes to form a continuous network. Splices shall be protected with a wire nut spring connector. A signal generated at the cabinet end of the network shall be capable of being traced through the entire conduit system which contains the tracer wire.

d) Preemption Cable. Preemption cable shall be per Section 2525 of the Standard Specifications.

10.8.2.2 Electrical Conduit. All conduit and fittings shall be listed by UL, and conform to NEC standards. All conduits to be installed underground or in concrete structures shall be galvanized rigid steel, PVC, or HDPE as shown on Plans. All non-metallic conduit used must conform to the requirements of UL 651 for Rigid Non-Metallic Conduit. All non-metallic conduit and fittings installed under roadways shall be schedule 80, heavy wall, manufactured from high impact material. Schedule 40 PVC may be used in other areas as directed. All exposed conduit and fittings to be installed above ground shall be the rigid metal type manufactured of galvanized shell conforming to requirements of UL 6 for Rigid Metallic Conduit. Non-threaded couplings shall not be used. Intermediate metal conduit may be used in place of rigid metal conduit except for service risers. Galvanized intermediate metal conduit shall conform to requirements of UL 1242. Intermediate metal conduit and fittings shall be manufactured from steel and work hardened to provide high strength. The exterior wall shall be hot-dip galvanized. Threads shall be fully cut and galvanized after cutting. All threaded fittings shall be the same as fittings approved for galvanized rigid steel conduit.

Sampling and testing procedures shall conform to UL Standards. Samples for testing, when requested by the Traffic Engineering Division, shall be furnished at the contractor's expense. Samples of conduit shall be tested by UL standards and be approved for use by the Traffic Engineering Division prior to installation on the project.

10.8.2.3 Pull Boxes. Pull boxes, as shown on the plans, may be one of two designs: Precast reinforced concrete or precast fiberglass reinforced polymer concrete.

a) Precast Reinforced Concrete Pull Boxes. Precast reinforced concrete pull boxes 18 inch diameter or 24 inch diameter, extensions and steel covers shall be installed and located as shown on the project plans.

b) Precast Fiberglass Pull Boxes. Precast fiberglass reinforced polymer concrete pull boxes, extensions and covers 12 inch by 12 inch or 13 inch by 24 inch shall be installed as shown on the project plans. Chipped or cracked pull boxes, covers or extensions will not be accepted.

10.8.3 Construction Requirements.

10.8.3.1 Installation of Electrical Conduit and Pull Boxes. Conduit runs shown on the plans shall be changed to avoid underground obstructions as directed by the Traffic Engineering Division.

The contractor may at his option and expense, use a larger size conduit than specified provided the larger size is continuous for the entire length of the run from outlet to outlet. Reducing couplings will not be permitted. Changes in the location and/or size shown on the project plans shall be documented by the contractor and submitted to the Traffic Engineering Division. All conduit runs shall be of the same material from outlet to outlet. No transitional couplings will be allowed. When PVC conduit is used, it shall be cut square and trimmed to remove all rough edges. Conduit connections shall be of the solvent weld type. The joint cement shall be the gray PVC cement conforming to the requirements of ASTM D 2564.

Back fill containing large rock, paving materials, cinders, large or sharply angular substance, or corrosive material, shall not be placed in an excavation where materials may damage raceways, cable or other substructures or prevent adequate compaction of fill or contribute to corrosion of raceways, cables or other substructures. Where necessary to prevent physical damage to the raceway or cable, protection shall be provided in the form of granular or selected material, suitable running boards, suitable sleeves, or other approved means.

All PVC conduits shall be stored and handled in an approved manner to minimize deterioration due to exposure to sunlight. Conduits in protected areas such as behind curbs, in sidewalks and other areas that are not subject to vehicular traffic shall be at a minimum depth of 24 inches. Conduits installed under roadways, driveways or any open areas where it is possible for vehicles to drive and conduits with conductors that have voltages over 250 volts shall be at a minimum depth of 30 inches. When conduit in open areas cannot be installed at the minimum depths, it shall be encased in concrete.

Where specified due to shallow trenching depths, the conduit shall be encased in a minimum of 3 inches of concrete. The conduit shall be supported with masonry block or brick on 10 foot centers during encasement, so the conduit will be completely encased.

Installation of conduit for underground electrical distribution service shall conform to utility company requirements, local codes and these specifications.

Conduit installed in railroad right-of-way shall be to the depth specified by the railroad company.

Except for factory bends, conduit bends shall have a radius of not less than that specified in the NEC. Conduit shall be bent without crimping or flattening, using the longest workable radius.

Existing underground conduit to be incorporated into a new system shall be cleaned with a swab and blown out with compressed air.

Conduit entering pull boxes shall terminate a minimum of 3 inches inside the box wall. The conduit entering through the bottom of a pull box shall extend 3 inches above the drain material.

All conduit bends used for entering pull boxes shall be of the same diameter as the connecting conduit. All 90 degree bends shall be factory made.

Approved insulated grounding bushings shall be used on all steel conduit ends.

Conduit shall be installed under existing pavement by pushing or drilling methods approved by the Traffic Engineering Division. Open trench excavation across an existing roadway shall not be permitted without written permission from the Traffic Engineering Division. Pushing and drilling pits shall be kept 2 feet clear of the edge of the pavement when possible.

Pull boxes shall be installed in accordance with the details shown on the project plans. Pull boxes shall be installed flush with the finished grade.

10.8.3.2 Wiring Procedures.

a) General. Wiring shall conform to the regulations listed in the National Electrical Code, latest revision. The conductors and cables shall be pulled into runs in a smooth continuous manner, avoiding contact with sharp objects that might damage the insulation. Only approved lubricants may be used for inserting conductors in conduit. Before installation, conductor ends shall be taped for moisture protection until connections are made. Conductors shall be spliced only in terminal compartments, pole bases or cabinets.

b) Splices. In circuits where the voltage does not exceed 600 volts AC, splices shall be made utilizing approved spring-type wire connectors. Soldered connections will be permitted on loop splices only. Cable used for detector lead-in, preemption devices and communications circuits shall be run continuous and un-spliced to the controller cabinet. Conductors for each signal assembly shall be continuous without splicing from the signal head to the pole base and pole base to controller cabinet.

10.8.3.3 Bonding and Grounding. All metallic enclosures such as cabinets, pedestals, poles, and conduit shall be bonded to form a continuous grounded system. Non-metallic portions of the system such as PVC conduit shall have a bare copper bond wire or a green insulated copper bond wire installed with suitable connections to form a continuous grounded system. The insulation shall be removed from the bond wire in pull boxes from the point at which the wire leaves the end of the conduit. At each service disconnect, cabinet foundation, or where otherwise specified, an approved copper-plated ground rod shall be installed. Each ground shall be a one piece solid rod of copper weld type or approved equal and shall be a minimum of 5/8 inch in diameter and ten feet in length. The rod shall be driven vertically into the ground to a minimum of nine feet below the surface. The neutral and system grounding bond shall be connected to the grounding rod with a copper plated bolt or a brass bolt on the ground clamp.

Pole foundations shall have a one-piece solid rod of copper weld type or approved equal and shall be a minimum of 5/8 inch in diameter and two feet longer than the depth of the foundation. The conductor shall be connected to the pole grounding screw in the hand hole with an approved lug connector.

10.8.3.4 Service. Electrical Service components and their installation shall conform to regulations and codes listed in NEC, UL, Davenport Electrical Code and the requirements of Iowa-Illinois Electric Company. Service risers shall be galvanized steel. Fastening of service risers shall be done through the use of suitable straps and wood screws a minimum of 1 1/2 inches in length. Tape, nails or other means of attachment shall not be used. All safety switch and multi-breaker enclosures shall be provided with a means to padlock to prevent unauthorized persons from operating disconnect equipment. Meter sockets shall be approved by the serving utility company. These shall be furnished and installed by the contractor. The meter socket shall be located as shown on the project plans.

Construction shall be such that all conductors are concealed within assemblies. Cable guides or grommets shall be used to support and protect conductors entering through poles. All threads shall be coated with rust-preventative paint during assembly.

Materials removed and not designated to be salvaged or incorporated into the work shall become the property of the contractor.

10.9 TRAFFIC CONTROLLER ASSEMBLY.

10.9.1 Description. The work under this section shall consist of furnishing traffic controller assemblies at the locations shown on the project plans and in accordance with the details and requirements of these specifications.

A traffic controller assembly shall consist of a complete assemblage of electrical equipment and components for controlling the operation and timing of traffic control signals

10.9.2 Materials. The controller assembly shall include the controller unit, all necessary auxiliary equipment, the controller cabinet, concrete foundation, conduits and anchor bolts.

The auxiliary equipment shall include all appurtenances such as flasher controls, loop detector amplifiers, power assemblies, signal load switches, conflict monitors and preemption units.

The entire surface area of each circuit board shall be sealed to protect against moisture. The following equipment shall be furnished with the wired traffic controller assemblies:

- Power Panel
- Signal Load Switches-(eight ea. in type M)
- Signal Conflict Monitor
- Detectors (if used, four ea. in type M)
- EV Phase Selectors-(M cabinets only)
- Controller Flasher Assembly
- Flash Transfer Relays
- Surge Protectors-Power and Communications
- Lightning Arrestor
- Radio Interference Suppressor
- Cabinet Ventilation Fan
- Terminal Tie Points
- Field Terminals
- UPS System

10.9.2.1 General Requirements. The traffic controller assembly equipment shall conform to the requirements of the current edition of NEMA Publication TS-1 at the date of advertisement of the project.

10.9.2.2 Documentation. The contractor's material proposal shall include complete technical information, shop drawings, photographs, circuit diagrams, instructional manuals, or any other necessary documents to fully describe the proposed traffic controller assembly items.

At the time of delivery, the contractor shall furnish three sets of instruction books and an itemized price list for each type of equipment, their sub-assemblies, and their replacement parts.

The instruction books shall include the following information:

- Table of contents
- Operating procedure
- Theory of operation
- Step by step maintenance and trouble-shooting information for the entire assembly and for all adjustable components.
- Circuit Wiring Diagrams
- Pictorial diagrams of parts locations
- Parts Numbers

The instructional manuals shall include itemized parts lists. The itemized parts list shall include the manufacturer's name and part number for all components (such as transistors, integrated circuits, diodes, switches, resistors, capacitors, relays, etc.) used in each circuit module. The list shall also include cross-references to parts numbers of other manufacturers who make the same replacement part.

10.9.2.3 Warranties. Each controller unit and all of its auxiliary equipment shall be warranted by the supplier against all defects in materials and workmanship.

The warranty for the controller unit and its auxiliary equipment shall provide that in the event of malfunction during the warranty period, a like controller unit, module, or auxiliary equipment shall be furnished, within three working days, for use while the warranted unit is being repaired. The isolation of any malfunction and the repair and/or replacement of any device within the warranty period shall be the responsibility of the supplier.

The City reserves the right to reject equipment of a specific model type in which the Department has determined that it’s past field performance has been unsatisfactory. The City's rejection of an item shall be final.

10.9.2.4 Certificate of Analysis. The contractor or supplier shall submit a Certificate of Analysis for each NEMA specified component stating that all applicable NEMA tests have been performed and results comply with the requirements of NEMA Standards. The Certificate of Analysis shall be signed by an agent having the legal authority to bind the manufacturer or supplier.

The City reserves the right to perform tests on any equipment supplied by the contractor in the City's designated testing facilities.

10.9.2.5 Controller Cabinet Wiring. The cabinet shall be wired for call to non-actuated mode I for the main street and mode II for cross street, unless otherwise specified the Project Plans.

10.9.2.6 Control Cabinets.

a) General. The control cabinets covered in this section shall be used to house all traffic actuated signal controller assemblies. The cabinets shall be wired for all additional future phases and all associated equipment for the future phases shall be furnished and installed.

The following cabinet types shall be supplied, as shown on the plans:

- Type "M" (W30 inches by D17 inches by H52 inches nominal dimension).

The controller cabinet housing shall be of a NEMA 3 weather resistant construction. The Type "M" cabinet shall be reinforced sufficiently to support the cabinet in side of pole installation or to support the cabinet in a pad mount installation as required on the plans.

The cabinet housings shall be constructed with No. 10 gauge welded sheet aluminum. The cabinet finish shall be clean and not painted.

b) Hardware.

1. Doors. The door shall have a neoprene gasket around the perimeter of each door frame. The door hinge pins shall be stainless steel. The main controller cabinet door shall have a two position steel bar type door stop. The main door of the type M controller cabinet shall be secured by a three point locking device.

2. Locks. The main door of controller cabinet shall have a standard traffic signal self-locking tumbler lock. The three point door latch cam shall be steel.
The police panel door shall have a standard police type lock. The police type lock key shaft shall be a minimum of 1 3/4 inches in length. A minimum of two keys per lock shall be furnished with each cabinet.

3. Shelves. Each controller cabinet shall be furnished with metal shelves capable of supporting all shelf mounted equipment without bending or sagging. The shelves shall not restrict the free flow of air. The cabinets shall contain adjustable support brackets. A minimum shelf height of 15 inches shall be provided for eight phase NEMA controllers.

c) Cabinet Accessories. The following accessories shall be provided with each controller cabinet as specified herein:

1. Cabinet Light. The controller cabinet shall contain an incandescent light fixture and lamp. The fixture shall be mounted in the lower half of the cabinet on either side of the cabinet.

2. Switches. The switches described in this section shall be provided for all controller cabinets. Each switch shall be a commercial grade switch properly rated for the circuit it controls. Each switch shall be individually labeled to identify its function.

The following switches shall be mounted on the cabinet switch panel inside the controller cabinet housing:

- Auto/Flash Switch. A toggle switch to transfer to flashing operation. During the flash operation the AC power shall be maintained to the controller.
- Detector Call Test Switches. A test switch shall be furnished to simulate a vehicle and pedestrian actuation. Each switch shall be a momentary contact push button. Each switch shall be labeled to identify its function and phase.
- Stop Time/Run/Normal Switch. A separate three position toggle switch shall be provided to permit stop timing/automatic mode of the controller's stop time function.

The following switch shall be mounted in the police panel:

- Auto/Flash Switch - shall be a toggle switch to transfer from automatic control to flashing operation. During the flash operation the controller goes to stop time, unless the Stop/Run/Normal Switch is in the run position.

3. Convenience Outlet. A 120 volt AC, 15 Amp NEMA 5-15 G.F.I. convenience duplex outlet shall be mounted in each cabinet for energizing test equipment or tools. The outlet shall be fuse protected.

d) Cabinet Ventilation Equipment.

Controller cabinets shall be ventilated by means of a 120 VAC, 60 HZ, tube axial compact type fan. The fan's free delivery air flow shall be not less than 100 cubic feet per minute.

The fan housing shall be approximately 4 inches square by 1 1/2 inches deep.

The magnetic field of the fan motor shall not affect the performance of the control equipment.

The fan bearings shall operate freely within the environmental standards specified herein.

The fan unit shall not crack, creep, warp, or have bearing failure within a 5 year rated duty cycle. The maximum noise level shall be 40 decibels. The fan unit shall be corrosion resistant.

The cabinet fan shall be controlled by an adjustable snap action thermostat. The thermostat's turn-on setting shall be adjustable from 90°F to 120°F. The fan shall run until the cabinet temperature decreases to approximately 29°F below the turn-on temperature setting. The fan shall be fused.

The cabinet fan assembly shall be mounted either inside the control cabinet or inside a rainproof housing on the top of the control cabinet.

The cabinet shall have louvered air inlets in the lower portion of the main door. A standard furnace filter shall be mounted behind all the louvered air inlets.

The air outlets shall be screened on the exhaust side unit.

e) Electrical Devices.

1. Legend Plates. Each fuse and circuit breaker shall be labeled to identify its rating and circuit function.

2. Power Panel. The power supplied to the controller cabinet shall be 120 VAC, 2 wire, 60HZ single-phase unless otherwise specified. The power leg to the controller and the signal load circuits shall be protected by a single pole, 120 VAC, circuit breaker. The breaker shall have a 10,000 amp. interruption rating, a trip indicator, and shall be the bolt-on type. The ampere rating shall be properly sized for the traffic signal intersection's load Radio Interference Suppressor. Each control cabinet shall be equipped with a single radio interference suppressor of sufficient ampere rating to handle the load requirements. The RIS shall be

installed at the input power point. It shall minimize interference in both the broadcast and the aircraft frequencies, and shall provide a minimum attenuation of 50 decibels over a frequency range of from 200 kilohertz to 75 megahertz, when used in connection with normal installations.

The RIS shall be hermetically sealed in a substantial metal case with brass studs of sufficient external length to provide space to connect on No. 8 AWG wires, and shall be so mounted that they cannot be turned in the case. Ungrounded terminals shall be properly insulated from each other, and shall maintain a surface leakage distance of not less than 1/4 inch between any exposed current conductor and any other metallic parts. The terminals shall have an insulation factor of 100 to 200 megohms dependent upon external circuit conditions. The RIS shall not be rated less than 50 amperes.

The RIS shall be designed for operation on 120 VAC 60HZ, single phase circuits, and shall meet the standards of UL and the Radio Manufacturers Association.

3. Surge Protector. Each controller cabinet shall be provided with a 350 volt surge protector at the input power point.

   The surge protector shall reduce the effects of power line voltage transients and shall have ratings as follows:
   - Impulse Breakdown of less than 1000 volts in less than 0.1 microseconds at 10 kilovolts per microsecond.
   - Standby Current of less than 1.0 milliampere.
   - Striking Voltage of 350 Volts D.C.

   The unit shall be capable of withstanding 15 pulses of peak current each of which will rise in 8.0 microseconds to one half the peak voltage at 3 minute intervals. The peak current rating shall be 20,000 amperes.

   The communications termination shall also be provided with lightning protection.

4. Inductive Suppressors. Each 120 VAC circuit that serves an inductive device, such as a fan motor, cabinet light, or a mechanical relay, shall have a suppressor to protect the controller's solid state devices from excessive voltage surges. Such suppressors shall be in addition to the surge protector at the main input power point.

f) Cabinet Wiring Standards.

1. Conductors. All conductors used in controller cabinet wiring shall be No. 22 AWG or larger, with a minimum 19 copper strands. Conductors shall conform to Military Specification MIL-W-16878D, Type B or better. The insulation shall have a minimum thickness of 10 mils and shall be nylon jacketed polyvinyl chloride or irradiated cross-link polyvinyl chloride, polyhalocarbon, or polychlor-alkene.

2. Lead-in Wires and Cable. Lead-in wires, from the loop detector field terminals in the cabinet to the amplifier unit inside the cabinet, shall conform to one of the following:
   - A twisted pair of No. 22 AWG or larger conductors.

- A cable containing two No. 22 AWG, or larger conductors with each conductor insulated with either (1) a minimum of 10 mils of polyvinyl chloride and 2 mils of nylon, or (2) a minimum of 14 mils of polyethylene or polypropylene. The conductors shall be twisted pairs with 3 to 6 turns per foot. The cable shall be provided with a polyethylene or polyvinyl chloride outer jacket with a minimum thickness of 20 mils or with a chrome vinyl outer jacket with a minimum thickness of 25 mils. All conductors used in controller cabinet wiring shall conform to the following color code requirements:
  - The AC common conductors shall be identified by a continuous white or natural gray.
  - The chassis ground conductors shall be identified by a continuous green color.
  - The non-ground conductors shall be identified by any color not specified above.

3. Load Switch and Flasher Wiring. Each of the load switch outputs (120 VAC) and the flash transfer relay load base terminals shall be hard-wired with a minimum No. 14 copper conductor with a 90° C (194° F) rated jacket, or No.16 copper conductor with a 105° C (221° F) rated jacket. The 120 VAC load switch and flash relay terminals shall be soldered to each base terminal.

4. Signal Load Switch Bus. The AC+ signal load switch buss shall be controlled by a signal pole 120 VAC mercury contactor or an auxiliary control relay. The minimum contactor size per switch buss shall be 50 ampere.

5. Signal Load Panels. All load switches, flashers, and flash transfer relays shall be mounted on a load bay panel or back panel assembly of the appropriate size.

   Detector amplifier modules shall be mounted in a detector rack.

   The signal load panel or back panel shall be easily removable from the cabinet for repair in the field.

   The load bay or back panel in an "M" type cabinet shall be wired to include all future signal phases and operations for a four phase with full pedestrian installation.

6. Preemption. The type "M" controller cabinet shall include the cabinet wiring provisions for a two position card rack capable of supporting four preemption channels.

g) Cabinet Foundations. Concrete for cabinet foundations shall be 3000 psi Portland cement concrete.

10.9.2.7 Auxiliary Control Equipment. The auxiliary equipment described in this section shall be supplied and installed as required inside the controller cabinet.

All auxiliary equipment shall conform to current published NEMA Standards pertaining to that device.

a) Flasher Control Assembly. The Flasher control equipment shall consist of a complete electrical assembly which shall provide flashing traffic signals by

enabling flash relays when the auto/flash switch or conflict monitor is activated. The relays shall be the flash load relay type as specified herein.

b) Solid State Flashers. The flasher unit shall be a solid state NEMA type flasher. All flashers for signalized intersections shall be the dual circuit type. All the flashers shall be constructed of replaceable, molded relay modules. Each relay module shall have the specified current capacity and shall operate with zero point switching.

Solid state Flashers shall be 20 amperes per circuit, dual circuit.

c) Solid State Load Switches. Load switches shall meet the requirements of NEMA for three circuit load switches.

Each load switch shall contain three individually replaceable, solid state relay modules. Each relay module shall utilize optical isolation between the input and the output.

The load switch unit shall have three indicators to designate when the AC output circuits are activated. Each indicator shall monitor the outputs and shall be labeled top to bottom "R" Red, "Y" Yellow, and "G" Green, on the front panel of the load switch.

d) Flash Load Relays. Flash load relays shall be for the purpose of providing special circuitry or operational requirements. The relays shall be the double pole, double throw type.

Flash relays shall interconnect with a Cinch-Jones eight pin socket or an approved equal. The relay shall be covered with a clear dust cover which shall be secured to the relay base with a fastening device.

The relay contact points shall be of fine silver or silver alloy, or a superior alternate material, and shall be capable of carrying a load of 20 amperes per contact at 120 Volts AC.

The relay shall show no failure while making, carrying and breaking a 10 ampere, 120 volt, traffic signal lamp load through 10,000 cycles at the rate of 10 cycles per minute and a 50% duty cycle. Each relay shall be capable of making, breaking and carrying all the current for a 1000 watt tungsten lamp load without burning, pitting, or otherwise failing for at least one million operations.

The relay shall withstand 1500 volts at 60 HZ between insulated parts and between current carrying parts and grounded or non-current carrying parts.

e) Conflict Monitors. The conflict monitor shall conform to the current NEMA specifications.

Fully programmable monitors shall be programmed with soldered wire jumpers on a NEMA interchangeable programming card. Jumpered channels shall represent non-conflicting phases. Non-jumpered channels shall be in conflict with any other channel.

When a malfunctioning monitor is replaced in the field, the replacement monitor shall be field programmable without the use of tools.

The jumper numerical sequence shall be standard NEMA matrix. The monitor shall have an active indicator for each channel.

f) Detector Amplifiers.

1. General. The correct type and quantity of detector amplifiers shall be furnished as specified herein. All detector amplifiers shall be rack mounted.

   Each detector card shall be edge connected type. The detector edge connector shall be a 44 pin double read-out contact. The connector shall have 0.128 inch diameter mounting holes on each end, MIL-M-14 insulation material, and MIL-C-21097 contacts.

   The edge connector terminals shall be wired as specified herein. All of the detector channel inputs and outputs, including those channels specified for future use, shall be wired from the mounting rack to the tie points and the field terminals of the controller cabinet.

   Each amplifier rack assembly shall include power supplies capable of operating 12 dual channel detector cards in an eight phase back panel or four dual channel detector cards in a four phase back panel.

   The quantity of four amplifier units shall be furnished with each Type "M" control cabinet assembly.

   The amplifier rack positions shall be mechanically and electrically interchangeable such that amplifier modules of different manufacturers can be installed into any amplifier module position. The rack spacing shall be for NEMA 2.31 inch wide front panels on all card rack units. A separate two slot card rack unit for emergency vehicle (EV) detector units shall be provided and wired for four EV inputs.

2. Detector Amplifier Power Supply. A rack mounted power supply shall be furnished with each type "M" control cabinet assembly.

3. Loop Detector Amplifiers.
   - General Requirements. The loop detector amplifiers shall detect all licensed motor vehicles when using the existing loop configurations.
   - Loop Detector. The loop detector amplifier unit shall contain two channels per unit and shall have timing functions. No single channel amplifier shall be utilized. All loop detector card units shall be mechanically and electrically interchangeable with other card units of the same type and function from different manufacturers. The amplifier unit shall utilize digital solid state circuitry. The detection, frequency counting and inductance measuring circuitry shall utilize crystal controlled MOS-LSI electronic circuits.
   - Amplifier Requirements. Each amplifier channel shall have a front panel mounted indicator to provide a visual indication of each vehicle detection. The indicator shall be visible in bright sunlight from three feet directly in front of the unit. The amplifier shall operate in compliance with all the requirements herein specified when connected to an inductance loop plus lead-in of 50 to 500 microhenries with a loop Q parameter as low as 5.0 at the amplifier's operating frequency.

- Each channel's call output shall be an optically isolated solid state type. Each amplifier channel shall conform to the following requirements:
  - Amplifier Tuning. Each channel shall be self-tuning and shall be fully operational within three minutes after power up. After a power interruption, the channel shall automatically return to normal operation.
  - Tracking. Each channel's circuits shall be designed so that changes due to environmental drift and applied power fluctuations shall not cause an actuation. It shall be capable of compensating for environmental changes of up to 0.001% per second. The requirement must be met within two hours after initial power up. The channel shall be capable of normal operation as the input inductance is changed +/-5.0% from the quiescent turning point regardless of initial circuit drift.
  - Detection Modes. Each channel shall have a mode selection switch on the front panel which shall permit the selection of either the presence mode or the pulse mode of operation. In the pulse mode, the pulse width shall be 100 milliseconds unless otherwise specified. Each module shall have an off switch position for disabling unused channels.
- Special Timing Functions. The following special timing functions shall be furnished for each channel of the amplifier module. *Delay Timing Function. This timing function shall delay the call output up to 15 seconds after the vehicle enters the loop sensor. The timer shall be adjustable, from 0 to 15 seconds, in no greater than 1.0 second increments. * Extension Timing Function. This timing function shall extend the call output up to 7 seconds after the vehicle leaves the loop sensor. The timer shall be adjustable, from 0 to 7 seconds, in no greater than 0.5 second increments.
- Amplifier Sensitivity. Each of the amplifier channels shall have a minimum of three sensitivity settings per detection mode. The settings shall be selectable from the front panel by means of a thumb wheel type switch. The highest sensitivity setting shall consistently respond to a loop inductance change of 0.02%. The lowest sensitivity setting shall respond to nominal loop inductance changes of from 0.15 to 0.4%. All modules must have sensitivities which differ by not more than +/- 0.05% change in inductance from the nominal value chosen. A channel shall not respond to loop inductance changes less than 0.1% in the lowest sensitivity setting.
- Amplifier Response Time. The Amplifier channel response time in the lowest sensitivity setting shall be less than 20 milliseconds. For any negative inductive change which exceeds the sensitivity threshold, the channel shall output a ground true logic level within 20 milliseconds. When such inductance change is removed, the output shall become an open circuit within 20 milliseconds.

  For test purposes, a negative change of inductance shall be maintained for a minimum of 100 milliseconds and a maximum of 600 milliseconds after it is applied. When the response time differences are averaged over ten trials, the value of that average difference shall not exceed 10 milliseconds.

  The response time of the detector channel for the highest sensitivity setting shall be less than 250 milliseconds for a 1.0% inductance change.

- Operating Frequency. Each channel shall have a minimum of three operating frequencies. The frequency switch may be either on the front panel or on the circuit board. Frequency selection shall be possible without the use of tools.
- Detection Holding Time. The detector channel, in the least sensitive position, shall maintain the presence detection of a vehicle for a minimum of four minutes while the vehicle is over the loop sensor and is causing an inductance change of 1.0% or greater.

  The channel, in the highest sensitivity position, shall maintain the presence detection of a vehicle for a minimum of three minutes while the vehicle is over the loop sensor and is causing an inductance changed of 0.02% or greater.
- Temperature Changes. The operation of the amplifier shall not be affected by environmental temperature changes at the rate of 1.5°F per 3 minutes.
- Interference. Each channel shall not cause crosstalk with any other channel within any other amplifier that is mounted in the same cabinet assembly. An amplifier channel shall not detect vehicles, moving or stopped, at distances of 3 feet or more from the loop perimeter to which it is connected.
- Lightning Protection. Each amplifier shall have lightning protection as an integral part of its own circuitry.
- Failsafe Operation. Each channel shall have a failsafe design such that if the loop sensor circuit is open, the channel shall output a continuous vehicle call.
- Isolation Transformers. Each loop sensor shall be coupled to the channel input by isolated transformers. The isolated input shall provide continued operation of the channel if the loop sensor in the street becomes grounded or has resistive leakage to ground.
- Emergency Vehicle Preemption Equipment. Shall be per Section 2525 of the Standard Specifications.

10.9.3 Construction Requirements.

10.9.3.1 General Requirements. All traffic controller assembly equipment shall be furnished in accordance with these specifications. Cabinet wiring, connecting cables, support bases, and shelves shall be provided to allow for future installation and use.

10.9.3.2 Test Requirements. All specified traffic controller assembly items shall meet the applicable environmental and testing standards of NEMA Publication TS-1.

10.9.3.3 Wiring and Grounding Requirements,

a) Cabinet Wiring. All cabinet wiring shall be neatly arranged and made tight by the use of wiring harnesses, cable sheaths, cable wraps, or raceways. All wires in a harness shall be laced or bound together. Harnesses shall be routed to minimize crosstalk and electrical interference.

   Cabling shall be routed to prevent conductors from being in contact with metal edges. Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.

All pin assignments shall be wired to the controller cabinet terminal for future use.

b) Conflict Monitor Wiring. The conflict monitor unit cable shall be wired to perform the following functions:

1. To monitor conflicts of green, yellow, and walk signal for each applicable phase.

2. To monitor absence of red voltage. Any phase specified for future use shall have a removable jumper so as to permit future implementation of that phase without rewiring the controller cabinet.

3. To monitor +24VDC source of the controller unit.

4. To start-delay the controller unit per NEMA Standards.

c) Cabinet Grounding. All controller cabinets shall have the AC common, the logic ground, and the chassis ground isolated from each other as detailed in the current NEMA Standards.

d) Field and Tie point Terminal/Wiring.

1. Controller Cabinet. All field terminals shall be installed on a terminal support which shall be located at the rear of the lower portion of the controller cabinet and not less than 10 inches from the base of the cabinet.

10.9.3.4 Cabinet Wiring Diagrams. Each controller cabinet assembly shall have a complete set of wiring diagrams which shall show the intersection plan, signal phasing layout, and all control device connections. Two sets of the final wiring diagrams shall be required with delivery of each control cabinet assembly.

10.10 METHOD OF MEASUREMENT. Plan quantities listed in the following exhibit and in the plans are for estimating purposes only, and these quantities will not be measured for payment separately.

10.11 BASIS OF PAYMENT. Payment will be made on a lump sum basis under the item Traffic Signal Cabinet Modifications. No direct payment will be made for any incidental materials or work required to complete the traffic signal installation unless specifically provided for in the contract documents. Any other incidental work or materials for which no basis of payment is specifically provided will be considered incidental to the cost of the Traffic Signal Cabinet Modifications bid item.

EXHIBIT A

SPECIAL PROVISIONS
FOR
CITY OF DAVENPORT
TRAFFIC ENGINEERING DIVISION

Traffic Signal Cabinet Modifications
at
Locust Street at Iowa Street
Locust Street at Grand Avenue
Locust Street at Washington Street
STP-A-1824(670)--86-82
Estimate of Materials and Equipment

No.	Item	Qty	Unit
1	Precast Reinf. Concrete Handhole--24 inch	1	Each
2	Power Distribution Cable (2 x 1c #6 THHN)	97	Lin Ft
3	2" PVC Conduit	46	Lin Ft
4	Traffic Signal Cable (5c #14 IMSA 19-1)	2449	Lin Ft
5	Traffic Signal Cable (16c #14 IMSA 19-1)	857	Lin Ft
6	Pedestrian Push Button Cable (2c #14 IMSA 50-2)	1706	Lin Ft
7	Preemption Cable (3M "138")	1112	Lin Ft
8	Tracer Wire (#8 THHN-Orange)	46	Lin Ft
9	Remove Pad Mount Controller and Foundation	1	Each
10	Traffic Controller Assembly Type "M" Pad Mount	1	Each
11	Traffic Controller Cabinet Type “M” (Locust Street at Washington Street)	1	Each
12	Traffic Controller Assembly Type “M” Side of Pole Mount	1	Each
13	39" x 56" x 36" Concrete Controller Foundation	1	Each
14	Remove Side of Pole Mount Controller	1	Each

All items are to be provided and installed by Contractor