SP-152040
(New)

SPECIAL PROVISIONS
FOR
TRAFFIC SIGNALIZATION

Black Hawk County
STBG-SWAP-8155(769)--SG-07

Effective Date
May 18, 2021

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

A. GENERAL

1. Scope

These Special Provisions cover the work described in the contract documents. It covers furnishing all labor, equipment and materials, and performing all required operations to complete the work as per contract documents and to provide a completely operational and working system. Unless otherwise modified by these Signalization Special Provisions, all work including equipment, material and installation shall be in accordance with the appropriate Standard Specifications. Where reference is made to the codes, standard specifications, supplemental specifications, the safety orders, the general orders, the standards, laws, and ordinances, it shall mean the version of the reference that is in effect on the bid advertising date.

2. Definitions

Terms used in this document shall have the meanings defined below:

- City means City of Waterloo, Iowa, or its representatives.
- WTOD means City of Waterloo Traffic Operations Department.
- Punch List means a list of items that need to be corrected by the Contractor on the project before the final acceptance can be made.
- Response Time means the elapsed time from when the Contractor is given a notice to take certain actions to the time the Contractor actually starts the action.
- LED means light emitting diode.
- IP means Internet Protocol.
- APS means Accessible Pedestrian Signals.

3. Related Specifications and Standards

The Contractor shall comply with all the standards listed below unless otherwise modified by contract documents or Special Provisions:

- ANSI (American National Standards Institute) Standards.

- ASTM (American Society for Testing Materials) Standards.
- EIA (Electronics Industries Associations) Standards
- IMSA (International Municipal Signal Association) Standards.
- ITE (Institute of Transportation Engineers) Standards.
- MUTCD - Manual on Uniform Traffic Control Devices.
- National Electrical Code.
- National Electrical Safety Code.
- NEMA (National Electrical Manufacturers Association) Standards.
- Specifications of the Underwriters Laboratories, Inc.
- TIA (Telecommunications Industries Association) Standards.
- TIA/EIA (Telecommunications Industry Association/Electronic Industries Alliance) 568
- NTCIP (The National Transportation Communications for Intelligent Transportation System Protocol).
- All pertinent local, state and federal laws and regulations covering installation, material, design, construction, and operation.

The Contractor shall notify WTOD in writing of any discrepancy or ambiguity as to the intent or meaning of the Contract Documents or Signalization Specification before starting to work on that area. WTOD will supply the Contractor in writing with the intent. The decision of WTOD shall be final and conclusive.

B. MATERIALS AND CONSTRUCTION

The contract work shall comply with the applicable requirements of the Standard Specifications, in particular the following parts:

- Section 2525: Traffic Signalization
- Section 4189: Traffic Signal Equipment

Materials shall be of new stock unless the plans provide for the relocation or the use of materials furnished by others. New materials shall be the products of approved suppliers and manufacturers, approved by the Engineer. Miscellaneous electrical equipment and materials shall be UL approved.

1. Solid State ATC (NEMA) Actuated Traffic Signal Controller

The controller shall be fully compatible with the City's Intelight MaxView system and shall be capable of communication with MaxView such as functioning with full upload and download of signal timing and operation database, critical alarms, monitoring, etc. The following is the list of acceptable manufacturers/brands provided the controller comes fully functional with MaxView compatibility and meets full NTCIP requirement: Intelight, Econolite, McCain, Siemens.

The Contractor is required to provide a controller to be tested by WTOD for compatibility with MaxView. The controller will be tested by WTOD before controller can be approved. The controller will be returned to the Contractor after being tested.

All electronic components, quality, and functionality of the traffic signal controller shall conform to the applicable standards for TS-2 Type 1 traffic signal controllers mandated by the National Electrical Manufacturers Association's (NEMA) current edition NEMA Standards Publication TS2-2003 v02.06 for Traffic Controller Assemblies with National Transportation Communications for ITS Protocol (NTCIP) Requirements. Controller engine board and operating system shall support open architecture and be compliant with current ITE, AASHTO, and NEMA Standard Publication for Advanced Transportation Controllers (ATC) 5201.

All major components shall meet the environmental, design, and operating standards outlined in NEMA Standards Publication TS2-2003 v02.06, Section 2.

Direct human interface shall be through menus or graphics user interface.

Engine Board and CPU shall be compliant with the ATC 5201 Standard and shall have no batteries or moving parts such as fans or memory storage devices with rotating parts on the controller unit.

Menu display clearly visible and legible.

Readily be installed and operate in TS-2 Type 1 traffic signal control cabinets.

Each local controller shall have a USB slot for copying controller data for either backup or for transferring to another controller.

Shall readily connect to fiber optic traffic interconnect communication network to connect to MaxView.

The traffic signal controller shall be capable of being accessed through a web browser.

In addition to standard operations specified in the NEMA TS-2 for NTCIP v02.06 Standard, the intersection control software shall have a logic processor where the user can develop advanced logic statements and operations to be used as custom solutions or for feature development.

2. Controller Cabinet

The controller cabinet shall be a fully operational and functional NEMA TS-2 Type 1 cabinet that is fiber optics ready and NTCIP ready and shall meet or exceed all the requirements of the Specifications. The controller cabinet shall include everything for TS-2 operations, such as bus interface units (BIU), power supplies, MMU, necessary 2-channel detector cards, and all other necessary components. Cabinet shall come with mounted 110 V power strip with at least four outlets and mounted hardened managed layer 2 Ethernet switch. All external communications to the cabinet's components shall be through the Ethernet switch. Controller cabinet design may be affected by battery backup system. Pretimed controller cabinets do not require detector card racks and shall only be equipped for pretimed operation.

Fiber Optic Patch Panel shall not block access to internal components of the control cabinet.

All conduit openings in the controller cabinet shall be sealed with a sealing compound. This compound shall be a readily workable soft plastic, except those provided for drains. It shall be workable at temperatures as low as 30°F and shall not melt or run at temperatures as high as 300°F.

Controller cabinets shall be dust-proof, weatherproof and made from high-grade aluminum to furnish housing for the control equipment and terminal facilities. Anchor bolts shall be included. A gasketed panel police door shall be provided with police lock, two keys, flash switch and signal shutdown switch. A 15 AMP GFCI duplex receptacle and lamp base with on-off toggle switch shall be provided. Outlet and lamp shall be fused ahead of the cabinet circuit breaker. The detector rack(s) shall be capable of 8-phase operation plus four pre-emption channels. The 12-bay load switch shall be provided and loaded appropriately.

The lowest field connection shall be at least 3 inches from the bottom of the cabinet. The anchor bolts shall be secured with nuts which will not have more than three full threads exposed or interfere with field connections. The field terminals shall attach to the controller cabinet with color coded Y, R, G and B electrical spring wire connectors. Connectors shall be designed flexible and durable with an outer insulator providing a compact, fully insulated connection without cutting or abrading wires. The four spring connectors shall have a corrosion-resistant steel inner shell to strengthen them while permitting spring expansion and contraction due to temperature changes. The connector shall have a deep, flared skirt to protect against shorts and shiners. The connector shall have a flexible base to allow the connector to bend with wires.

The field terminals shall connect to the controller cabinet with standard screws. Lug terminals will not

be accepted.

No hardware or terminal facilities shall be attached to the cabinet door, excluding an intersection call/display panel and test switches as required.

Two hard copies and an electronic copy (PDF) of cabinet electrical prints shall be provided for each cabinet.

The bottom edge of the cabinet shall be waterproofed where the cabinet seats on the concrete base. Appropriate silicone sealing caulk shall be applied to the mating surface of concrete at a minimum bead diameter of 1/2 inch to 3/4 inch before installing the cabinet so that when the cabinet is being installed, securing anchor bolts provide for even and uniform spreading of the sealing material. The underside of the cabinet flange shall be free from any foreign objects, washers, spacers, etc., before caulking procedure.

All cabinet and police door locks shall use a standard key and standard skeleton key. The police panel flash switch shall be wired such that when it is switched to “flash” the controller will return to its initialization point and remain there until turned off flash.

All load switches shall conform to the triple-circuit solid-state type load switch as specified in the NEMA standard “TS2-6.2 Three-Circuit Solid State Load Switches”. Load switches shall have LED input and output indications. LED indications shall be provided to reflect the DC driver state for red, yellow and green. The closing or opening of signal circuits shall be positive without objectionable dark intervals, flickering of lights or conflicting signal indications. All internal components shall be accessible without encapsulation.

Power supply loads shall be metered.

Each circuit shall be a 10 ampere rated driver, LED lamp load at 120 VAC.

Provide an AC power surge protective device (SPD) on the load side of the cabinet circuit breaker. The SPD shall be a UL 1449 3rd (or latest revision) Edition Recognized device that is rated for a maximum operating current of 15A or greater. The SPD must be equipped with a maximum continuous operating voltage (MCOV) of 150V, L-N, L-G, and N-G modes of protection, voltage protection rating (VPR) of 700V or less, nominal discharge current rating (In) of 20kA, a short circuit current rating (SCCR) of at least 50kA, visual indication (LED) of operational status, and Form C dry contacts.

Provide modular type surge protective devices comprised of a silicon breakover device for all loop detector signal inputs. The device shall be rated for a nominal voltage of 75VDC and equipped with a minimum surge current rating of 250A.

Provide surge protective devices comprised of metal oxide varistors (MOV) for all load relay outputs. The SPDs shall be rated for a nominal voltage of 120VAC, equipped with a surge current rating of 39kA.

Provide modular type surge protective devices comprised of three-stage hybrid technology protection consisting of gas discharge tubes (GDT), silicon avalanche diodes (SAD) and positive temperature coefficients (PTC) for all low voltage communication inputs. The SPDs shall be UL 497B Listed and equipped with a surge current rating of 10kA

Provide surge protective devices comprised of gas discharge tubes (GDT) for all 120VAC interconnect signal lines. The SPDs shall be equipped with a surge current rating of 10kA.

Provide modular type surge protective devices comprised of three-stage hybrid technology protection consisting of metal oxide varistors (MOV), silicon avalanche diodes (SAD) and series inductor for all

low voltage (DC Power) input circuits. The SPDs shall be UL 497B Listed, equipped with a surge current rating of 10kA, and a continuous current rating of 5A.

Provide surge protective devices consisting of gas discharge tubes (GDT), silicon avalanche diodes (SAD) and positive temperature coefficients (PTC) on all coax video cables. The SPD shall be equipped with s surge current rating of 20kA, and an isolated ground.

Isolation transformer shall allow operation with a single point short between loop and ground.

The MSD harness wiring shall all be terminated on a separate dedicated termination panel.

All incoming service voltage connections (including breakers) shall have clear plastic protective shielding covers.

Unless otherwise shown on the plans, the supplier shall install one 20 AMP breaker, 1-pole for traffic signals, one 30 AMP, 2-pole breaker for lighting, one 60 AMP, 2-pole breaker for main conductors inside each cabinet.

The controller cabinet shall have installed a disconnect panel box, which will shut power off to all circuits inside the cabinet. The disconnect panel box shall be wired as shown on the plans. The cabinet shall come with an installed disconnect breaker panel and shall be connect as per the traffic signal schematic on the project plans. Disconnect breaker panels shall be G.E. model TL412C metal, 4-circuit (9 inch by 7 1/2 inch by 3 inch); Square D model 1-Q06-12L100S metal, 6-circuit (13 inch by 9 inch by 4 inch); Cutler Hammer BR48L1258P (13 inch by 11 inch by 3.5 inch) or approved equal.

Installations inside traffic control cabinet shall also meet the following requirements:

- Street Lighting Equipment. Electric contactors shall be installed in an auxiliary box or behind a transparent protective cover to prevent personnel from coming into contact with live parts. Contactors shall be mounted away from the door where they are protected against rain and snow fall.
- Wall Mounted Fiber Termination Center. The fiber jumpers connected to the termination center shall be mounted so that they do not contact the cabinet door when the door is closed.
- Detector Rack. The components installed in the detector rack should be easily and readily accessible. Nothing should be mounted directly in front of the detector rack. Changing rack components should not require moving or un-mounting other equipment.
- Programming. All components shall be programmed in order to produce a fully functional traffic control system. Programming, as a minimum and where applicable, shall include signal controller basic timing, detection cameras, emergency vehicle preemption, and network connection.
- IP Addressing and Ethernet Switch Programming. The Contractor shall program IP address of all components according to City of Waterloo's IP. City of Waterloo IT Department will program the Ethernet switch. The Contractor shall contact City IT Director to obtain a copy of the IP addressing scheme and to coordinate programming of the Ethernet switch.

3. <u>Ethernet Switches</u>

Ethernet switch shall be hardened managed industrial layer 2 switch suitable for traffic signal installation application. Acceptable brands are CISCO, Comtrol Rocketlinx, and Schneider Electric. The Ethernet Switch shall meet or exceed the following requirements.

- Seven Ports 10/100BASE-TX
- Three Ports 10/100/1000BASE-TX
- Three Fiber Ports Combo RJ45/SFP (Giga and 100BASE-FX)
- 2KM Multimode Fiber Support
- Duplex LC Fiber Connector
- 12-48VDC DC Power Input

- Max. 20 Watts Power Consumption
- 1A, 24VDC Alarm Relay Output
- 2DI, 2 DO (Alarm Relay Output) DI/DO
- Operating Temperature -40°C to 74°C
- Mean Time Between Failures 40 Years
- DIN Rail Mounting Method Support
- IP31 Case Protection
- NEMA TS2 and CE/FCC/UL/RoHS2 Certified
- 5 Year Warranty

4. Electrical

Weatherproof connectors shall be used.

All termination shall offer a secure connection and be secure to the cable conductors. It shall not pull off of the cable when gently tugged. The connection shall not rely on tape to secure it to the cable jacket to prevent it from coming apart.

The correct tools shall be used to crimp the terminal connections. Using the wrong size of crimping die which produces a weak, non-uniform crimp which produces a short-term installation is not acceptable.

Service Installation. (Traffic Signal and Lighting): The Contractor shall supply and install a 2 inch Schedule 80 PVC conduit to the source of power either to the transformer or up the power pole with a weather head connector as required by the power company supplied by the Contractor. The size of the service conductors shall be 3/c No. 3 AWG stranded conductor. The Contractor shall be responsible for coordination of this work with the power company and for payment of connection fees, if any. The address of the source of power will be provided at the time of construction.

Pole: There shall be one conductor for each optical unit or set of optical units operating identically through the same cycle and one conductor for common return. Each overhead red, yellow, green signal head shall be wired with a separate cable from a splice in the pole base according to the conductor combination specified on the plans.

An electrical splice in each wire servicing traffic signal heads on a pole shall be made in the handhole compartment of that pole. All wiring, except loop and magnetic detector wire, shall be one continuous length of cable from the splice in the handhole compartment of the signal pole to the terminal compartment in the controller cabinet. Splices for detectors will be permitted between the detector wire and the detector lead-in cable only at the first handhole provided adjacent to the detector and will be done by City personnel.

All splices in the handhole compartment of a signal pole shall be made using gel filled twist wire connectors. Signal cable splices shall be made using gel-filled wire nuts. Cable connections in signal heads and controller cabinets shall be made at the terminal blocks with a mechanical attachment device attached to each wire end by terminal connectors specified elsewhere in this Special Provision.

Slack for each cable shall be provided by a 4 foot length in each handhole and a 2 foot length in each signal and controller base (measured from the handhole compartment to the end of the cable). In those handholes where detector splices are made, a 4 foot length of cable slack shall be provided in both the loop wire and the shielded lead-in cable.

Cables shall be pulled through conduit by means of a cable grip designed to provide a firm hold upon the exterior covering of the cable or cables, with a minimum of dragging on the ground or pavement. This shall be accomplished by means of reels mounted on jacks or rollers and other suitable devices. A suitable wire lubricant shall be used to reduce friction and strain on wires or cables.

Service cable runs shall be continuous from the power line located on the service pole to the meter located on the controller cabinet or from the meter located on the service pole to the terminal compartment in the controller, whichever is applicable. The service riser shall be topped by standard weather head or otherwise replaced with “U” Guard.

Clearances to the overhead utilities shall be specified by the serving utility. The power company will furnish the electrical meter. The Contractor shall supply the service cabinet. All work shall be in accordance with Section 2525 of the Standard Specifications and the MUTCD.

A uniform systematic color code shall be used.

All wiring shall comply with the National Electrical Code and City Ordinance and shall be subject to the inspection of WTOD.

All wire shall be plainly marked on the outside of the sheath with the manufacturer’s name and identification of the type of the cable.

5. Bonding and Grounding

Metal conduit, service equipment, anchor bolts, metal poles, pedestals, controller cabinets, and all other electrical equipment shall be made mechanically and electrically secure to from a continuous system and shall be effectively grounded. The grounding conductor shall be a No. 6 AWG stranded green copper wire.

Grounding bar shall be accomplished by bonding the grounding circuits to copper clad metal, driven electrodes. All electrodes shall be, as a minimum, 5/8 inches in diameter and 8 foot long copper clad. The electrodes shall be driven vertically until the top of the rod is a minimum of 4 inches below grade. Bonding to the ground rod shall be made by means of suitable screw type positive ground rod clamps. Grounding to waterlines will not be permitted.

Bonding of standards and pedestals shall be by means of a bonding strap attached to an anchor bolt or to 1 3/16 inch, or longer, brass or bronze bolt installed in the pole base.

The service meter and socket shall be bonded to a ground electrode by use of a ground clamp and a No. 6 AWG copper wire and shall be by means of cadmium plated grounding bushing and bonding jumpers. Where there is a change at a pull box or manhole for non- metallic conduit to metallic conduit, the grounding wire in the non-metallic conduit shall be bonded to the metallic conduit.

Existing ungrounded metal poles shall be grounded by means of a driven ground rod.

6. Cables and Wires

The number of conductors and size of all traffic signal cable shall be as specified on the plans. All wire shall be plainly marked on the outside of the sheath with the manufacturer’s name and identification of the type of the cable.

Service Conductors: Power cable shall be a 600-volt, stranded, insulated, single conductor, No. 3 AWG (black and white) unless otherwise stated in the plans. Ground wire shall be No. 6 AWG green stranded copper wire.

Signal Pole Base to Signal Pole Base: This shall be composed of either 5-conductor No. 16 AWG or 12-conductor No. 16 AWG cable IMSA Spec 20-1 Signal Cable – PE insulations, PE Jacket or otherwise specified on project plans. The color code should be NEMA K-1 method 1 with 600 volts rating. The signal cable conductors shall pedestal mounted) and mast arms to signal heads shall be No. 16 AWG cable (the number of conductors shall be specified on plans) and composed of stranded wire.

Luminaire Conductors: Conductors shall consist of type THWN, 600 volt, and single conductor copper stranded wires, which run continuously between poles. Conductors shall meet the requirements of Article 4185.12 of the Standards Specifications and shall be of the size and number shown on the plans.

Detector Lead-In Cable: Detector lead-in cable shall be No. 16 AWG, meeting the requirements of IMSA Specification 50-2 or latest revision thereof.

Tracer Wire: Tracer wire shall be a #10 AWG wire single conductor, stranded copper, Type THWN, with UL approval and orange jacket. Provide in conduit runs that contain fiber optic cable. Tracer wire shall be electrically continuous. Splices are permitted in hand-holes and pull-boxes provided the connection of two or more wires is made using a gel-filled wire connector. An additional 10 foot long "tail" shall be bonded to the tracer to be used for locating purposes.

7. Handholes

Unless otherwise indicated on the plans, handholes shall be constructed as per these Specifications.

Except for fiber optics handholes, the Contractor may furnish a poured-in-place concrete handhole, with cast iron ring and cover, or a pre-cast concrete handhole, with cast iron ring and cover, or a fiberglass handhole. Concrete pipe (referred to as Traffic Handhole), meeting AASHTO Specification designation M86 for non-reinforced or M170 Class III for reinforced, of suitable length and diameter, and provided with cable hooks made with a minimum 1/4 inch diameter steel material. Cast iron ring and cover may be rated light-duty for non-traffic areas (155 pound minimum). Fiber optics handholes shall be as per plans.

Handholes on fill rural cross sections shall have a drain and drain pipe.

A crushed stone sump with a minimum depth of 18 inches shall be provided beneath all handholes.

The cover shall have the name "TRAFFIC" in 2 inch letters cast into the lid. The handhole shall be large enough to house loops in fiber optics cable as per manufacturer's recommendation for minimum diameter of the fiber optics cable loop.

Frames and covers for handholes shall be cast iron and conform to the dimensions shown on the plans. The top of the handhole shall be set flush with the sidewalk or driveway surface. When constructed in an earth shoulder away from the pavement edge, the top surface of the handhole shall be approximately 1 inch above the surface of the ground or as indicated on plans.

The ends of the conduit leading into the handhole shall extend a minimum of 1 inch and not more than 2 inches beyond the inside wall. All conduits in the handhole shall slope inward in a manner so as to provide drainage of water or condensation. Each handhole shall contain a minimum of two cable hooks. The hooks shall be permanently fastened to the inside wall near the top of the handhole.

When precast concrete sections are used for handholes, the conduit entrances shall be neatly grouted between the conduit and the precast concrete. The handhole ring shall fit snugly inside the precast concrete section. Grouting shall be done immediately after conduits are placed into the handhole to prevent washing in of debris.

After installation of handhole and before acceptance by the City, all foreign debris, including but not limited to dirt, leaves, grout, concrete, cans and glass, shall be removed.

All loop detector lead-in conductors shall be placed into a handhole prior to winter shut down.

8. Conduit

All conduits shall be Schedule 80 Poly Vinyl Chloride (PVC) when placed under paved surfaces and Schedule 40 elsewhere.

The number and size of conduit shall be as specified on the plans.

PVC conduits shall be rigid polyvinyl chloride meeting the requirements of NEMA TC-2, Type 2, and applicable UL standards.

Conduit buried in open trenches shall be placed a minimum of 18 inches deep and shall extend a minimum of 3 feet 6 inches from the back of curb unless otherwise directed by the Engineer. Open trench methods of placing conduit will be permitted except where the conduit is to be placed under existing pavement. Conduit in pavement areas shall be placed to a minimum depth of 24 inches below the finished pavement surface or as directed by the Engineer.

The backfill materials from the placement of conduit in open trenches 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. All cinders, broken concrete, or other hard abrasive materials shall be moved and shall not be used in the backfill material. All surplus material shall be removed from the public right-of-way and properly disposed

Whenever excavation is made across parkways, driveways or sodded areas, the sod, topsoil, crushed stone or gravel shall be replaced or restored as nearly as possible to its original grade and the grade involved shall be left in a neat and presentable condition.

Concrete sidewalks, pavements, base courses and bituminous surfaces shall be replaced with new materials.

Underground conduits shall be laid at a distance of at least 6 inches from any water line or other utility line.

When the plans require the conduit be placed without disturbing the existing pavement, the term “pushed” is used. Pushed conduit shall be placed by jacking, pushing, boring or any other means necessary to place the conduit without cutting or removing pavement. The size of a bored hole shall not exceed the outside diameter of the conduit, which is to be placed. Tunneling under the pavement or water jetting will not be permitted. Pits for boring shall not be closer than 2 feet to the back of curb unless otherwise directed by the Engineer. Conduits shall be Schedule 80 PVC unless otherwise shown on the plans.

When it is impractical to push the conduit under pavement due to unanticipated obstructions, the Contractor may, with the Engineer’s permission, cut the existing pavement.

Where conduit is to be placed by trenching methods under existing asphaltic pavement, an 8 inch wide by 18 inch deep trench shall be opened along neat lines. The trench shall be backfilled with crushed stone, acceptable to the Engineer, filled with Class M high-early strength concrete to within 4 inches of the surface level. The concrete shall be allowed to set for a minimum of 48 hours without being exposed to traffic. The final 4 inches of backfill shall be a hot bituminous concrete plant mix acceptable to the Engineer.

A polyethylene pull rope shall be installed in all conduits, which is identified on the plans for future use. At least 2 feet of pull rope shall be doubled back into the conduit at each termination.

Conduit shall be laid to drain and 1 inch drains with crushed stone sumps shall be installed as shown on the plans and at all low points.

The backfill shall be mechanically compacted in 6 inch layers to a density equal to that of the surrounding material. Conduit shall be connected to existing and new light bases and junction boxes.

All required fittings shall be furnished and installed by the Contractor to provide a continuous, enclosed conduit system between poles. Conduit under pavement and driveways shall be rigid steel conduit or PVC Schedule 80, Type 2, in accordance with Article 4185.10 of the Standard Specifications. All trenches shall be backfilled with material containing no broken pieces of concrete or asphalt, stone, brick, wood or other unsuitable material including nested clods.

All conductors and wiring shall be furnished as new material and installed by the Contractor and shall conform to Section 2525 of the Standard Specifications.

Conduit not under pavement or driveways shall be Schedule 40 PVC.

All unused conduits, whether for future use or for later use in the project, shall be capped.

All conduits shall be sloped to drain toward the nearest handhole, and if this should prove to be impractical, then a conduit drain shall be provided with crushed stone drainage sumps at all low points, as detailed in the plans for traffic signal bases. A permeable membrane to keep sand from washing back into the conduit shall be installed at the conduit drain.

Fiber optics conduit shall be high-density polyethylene (HDPE) with minimum wall thickness of 0.07 inch and shall consist of a shell or sleeve tube, over-sheathing at least four inner tubes. Inner tubes shall be rated for direct burial and shall have a minimum OD/ID of 16/13. Inner tubes shall be ridged longitudinally inside and shall have a smooth surface outside. The inside surface of the inner tubes shall have a low friction permanent lining to reduce friction during cable placement. The conduit shall come with preinstalled sleeved copper tracer wire of minimum size No. 20 AWG. The whole outer tube and inner tubes package shall be rated for direct bury and shall be suitable for boring under existing pavement.

9. <u>Fiber Optics Cable</u>

All interconnection and monitoring shall be completed using newly constructed fiber optic cable as shown in the plans. All fiber optic cable shall be placed in HDPE conduit in accordance with Section 17. All other necessary equipment, including patch cords, termination panels and all other equipment, tools and labor necessary to complete the network connections shall be included in the Contractor's bid for Traffic Signalization. At least six strands shall be terminated inside the controller cabinet.

Unless otherwise mentioned on the prior in these specifications or plans, the traffic fiber optics control communications and interconnect cable shall have the following minimum properties.

Fiber optics cable shall be small diameter high fiber-density micro cable suitable to be deployed by blowing into small duct sizes. Micro cable fibers shall be blown through conduits and shall not be pulled to cause stresses higher than manufacturer specified tensile strength for that micro fiber. Where the situation requires pulling fiber optic, such as in an existing conduit, reinforced fiber optic cable may be used.

A 72-Stranded Single-Mode Loose Tube Cable meeting pertinent ANSI, EIA, and TIA specifications for the usage, installation, and location type required by this Project.

Typical Core Diameter: 8.3 um ± 1.0 um

Cladding Diameter: 125.0 um ± 1.0 um

Core Concentricity: ± 1%

Attenuation Uniformity: No point discontinuity greater than 0.1 um at either 1310 nm or 1550 nm

Max Attenuation: 0.40 dB / Mile

The coating shall be a dual layer UV cured acrylate applied by the fiber manufacturer. The coating shall be mechanically or chemically strippable without damage to the fiber. The central member of the cable shall be a glass reinforced plastic rod designed to prevent the buckling of the cable. The cable core interstices shall be filled with water blocking tape to prevent water infiltration. Dielectric fillers may be included in the cable core where needed to lend symmetry to the cable cross-section.

Buffer tubes shall be of dual layer construction with the inner layer made of polycarbonate and the outer layer made of polyester. Each buffer tube shall be water-blocked with a water-swellable yarn or tape. Buffer tubes shall be stranded around the central member using reverse oscillation, or "SZ", stranding process.

The buffer tubes shall meet TIA/EIA-598A, "Color Coding of Fiber Optic Cables". The fiber cable shall include loose tubes with 12 fibers in each tube.

The cable tensile strength shall be provided by a high tensile strength aramid yarn and/or fiber glass.

All dielectric cables, without armoring, shall be sheathed with medium density polyethylene. The minimum nominal jacket thickness shall be 0.055 inch. Jacketing material shall be applied directly over the tensile strength members and flooding compound. The jacket or sheath shall be marked with the manufacturer's name and the words "Optical Cable," the year of manufacture, and sequential feet marks. The markings shall be repeated every 2 feet. The actual length of the cable shall be within the range plus 1% of the length marked. The marking shall be in a contrasting color to the cable jacket. Additionally, the jacket marking shall have a durable weatherproof label which shows the actual attenuation of each fiber expressed in dB/mile.

The cable shall be fabricated to withstand a maximized pulling tension of 600 pounds during installation (short term) and 135 pounds upon installation (long term).

The shipping, storing, installing and operating temperature range of the cable shall be -40°F to +158°F.

The manufacturer shall test at the 100% level all fiber optic cable for the following tests:

a) Each fiber proof tested at a minimum load of 350 Mpa.
b) Each fiber tested for attenuation and the reading shall be part of cable labeling.

The cable shall meet the appropriate standard Fiber Optic Test Procedure for the following measurements:

a) Fluid Penetration
b) Compound Drip
c) Compressive Loading Resistance
d) Cyclic Flexing
e) Cyclic Impact
f) Tensile Loading and Bending

The cable ends shall be available for testing. The cable ends must be sealed to prevent moisture impregnation.

Fiber Optic Jumpers/Patch Cords: All fibers entering the traffic signal controller cabinet shall be terminated in the fiber optic termination unit within the traffic controller cabinet. Length of patch cord will vary according to distribution unit to traffic signal controller, fiber optic modem, or video modem location within controller cabinet and shall provide for 2 feet of total slack.

A sufficient number of patch cords shall be installed to provide a fully-operational communications system.

Controller cabinet patch cords shall consist of factory-assembled patch cords, each containing two fibers. Each such fiber shall have a connector with ceramic ferrule on each end. Each patch cord-shall have a dielectric strength member and a durable outer jacket designed to withstand handling.

Fiber Optic Termination Unit: The unit shall be a rack mount, drawer type enclosure that is dust and moisture repellent. The unit shall provide easy front access with removable rear tray for easy rear access and shall have a maximum dimension of 3.5 inches H by 18.5 inches W by 11.25 inches D. The size of the unit shall be adequate for the number of fibers, proper winding area, and splices. The unit shall provide for cable entry from the side and be capable of accommodating up to 48 connections

Connectors: Only connectors of ceramic ferrule and physical contact end finish shall be used to terminate fibers to equipment. ST connectors shall be used for multi-mode fiber. SC connectors shall be used for single mode fiber. Maximum attenuation per connector shall be 0.75 dB.

Splices: Fusion splices shall be used for all splices. The fiber cable shall be installed in continuous runs as designated on the plans. Splices shall be allowed only in the splice enclosures and controller cabinets as located on the plans. Maximum attenuation per splice shall be 0.3 dB.

Fan Out Kits: Fan out kits shall be provided for separation and protection of individual fibers with buffer tubing and jacketing materials suitable for termination of the fiber and fiber optic connector as specified.

Splice Enclosure: Continuous fiber cable runs and/or traffic signal controller branch circuit points will be spliced in an outside plant splice enclosure located in handholes as shown on plans. Green buffer tube of “trunk-line” fiber cable shall be spliced with “branch-line” fiber cable leading to traffic signal cabinet. The remaining “trunk-line” fiber cable buffer tubes shall remain in-tact and be “expressed” through the splice enclosure. Enclosure shall accept a minimum of six cables and provide enough trays to splice all fibers and provide means of “expressing” in-tact fiber cable buffer tubes. All fiber cables shall enter the enclosure at one end. Enclosure shall be watertight and re-enterable using gel-compressed cable connections and a re-enterable gasket.

Fiber splice loss shall not exceed the limits of TIA/EIA 568.

Tube Color: The green tube shall be extended to the traffic signal cabinet and shall be used exclusively for traffic communications and video monitoring purposes. Orange color tube shall be set aside for other City Entities.

Interconnection: All controllers shall be interconnected and connected to the City’s Traffic Control Center by fiber optic cable.

10. <u>Mounting Hardware</u>

Mounting heights for pedestrian heads should meet the minimum mounting height requirements. Pedestrian heads of the same type and size mounted on the same pole should be approximately the same height measured from the bottom of the pedestrian signal head housing to the closest sidewalk elevation. Different size pedestrian signal heads on the same pole should be mounted with their middle point having approximately the same height.

All pedestrian and vehicular signals heads shall be provided with adjustable cable brackets for mounting, as well as all other hardware necessary to completely mount the signals. All signal heads shall connect to poles and mast arms using adjustable cable tie supported brackets. Brackets shall not be painted unless otherwise shown on the plans. Plumbizers are not acceptable. All openings not used shall be plugged with a metal octagonal signal closure cap. No plastic devices of any type will be allowed. Top and bottom brackets will be required for all pole-mounted signal heads unless otherwise shown in the plans. All mounting brackets shall be stainless steel, not painted.

Control cabinet mounting will be on its own concrete base or pole mounted unless otherwise noted on plans.

Video monitoring cameras should l be mounted as manufacturer recommends.

11. Signal Service Meter Bypass Socket

Service panel cabinets shall be furnished when indicated on the project plans and be installed onto the traffic signal controller cabinet by the Contractor. Meter socket shall be UL and ANSI approved and a stamp showing approvals must be visible on inside of the socket. Meter sockets shall be constructed of steel and finished with light gray coating. The coating shall be electrostatically applied.

The meter socket shall be rated for two 100-amp or 200-amp terminals and have a fifth terminal as a neutral. The meter socket shall also operate with a bypass device so that the traffic signal will not power down during installation or removal of the utility meter. The utility company will supply and install the meter once the Contractor notifies them of the traffic signal startup.

All units shall be any one Anchor Electric U42552-HO, Landis and GYR, HQ-5U-40405-015, Millbank NU9318-XL, Durham T-H5213-U (HCP), or approved equal.

12. Power Disconnect

The cabinet shall come with a properly rated power disconnect. It shall disconnect the power from the utility source to the cabinet so that there are no “hot” circuits or terminals inside the cabinet when servicing it.

13. Traffic Monitoring System

Outdoor monitoring cameras shall be installed with full remote control and monitoring capability activated from the City’s Traffic Operations Center at 625 Glenwood Street, Waterloo, Iowa. Video images shall be flat with no fish-eye effect. Cameras directed towards approaches shall view the approach leg at least 600 feet in length and shall transmit high resolution images such that, when recorded with appropriate resolution, provide clear detail of a car 600 feet away when digitally zoomed. Cameras directed at the intersection (look-down) shall provide a high-resolution image of the entire intersection and part of the intersecting street legs.

14. Salvaged Materials

All existing signal materials and equipment not listed in the Specifications and which are not being incorporated into the final project shall be salvaged by the Contractor and stockpiled on the project site for pick up by WTOD personnel. Such items will remain the property of the City. Contractor may be allowed to deliver the salvaged equipment and materials to the City, but prior authorization and coordination is required. Existing traffic signal equipment and materials to be removed and salvaged, if present, include:

- Galvanized poles and mast arms
- Signal heads and signs mounted on signal poles or mast arms
- Signal controllers and cabinets
- Cameras
- EVP detectors and indicator lights

Existing traffic signal equipment and materials to be removed and properly disposed of by Contractor, if present, shall include:

- Traffic signal pole footings – whole or partial – to be removed.
- Old street name signs to be removed.
- Painted poles and mast arms

C. TRAFFIC CONTROL

It shall be the Contractor's full responsibility to set up and maintain traffic control in compliance with the Contract Documents.

D. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The Traffic Signalization work includes all traffic signal system components, interconnection system, luminaire pole extensions and luminaires which are mounted on the traffic signal poles, as detailed on the plans and described in this Specifications, to provide a fully operational system. Unless listed as a separate bid item, no other payment will be made for work covered by the Specifications, but all work will be considered to be included in the lump sum price for Traffic Signalization. Contractor shall provide a breakdown list price for all items on Lump Sum traffic Signalization bid items immediately after a contract is signed or within a period specified on the plans.

Compensation to the Contractor for all work covered by this Specifications will be made at the Contract Lump Sum price for the signal system installation, complete, in place, and operating. No measurement or payment of individual traffic signal items will be made except for purposes of progress payments. The Contract Lump Sum payment shall be full compensation for all items of work and no separate payment for any individual items will be made.

E. ESTIMATED QUANTITIES FOR LUMP SUM TRAFFIC SIGNALIZATION BID ITEM

The successful bidder shall complete and submit this form as specified in the contract documents.

Item No.	Item Description	Units	Estimated Quantity	Unit Price	Total
1	Traffic Signal Controller, Furnish and Install	EA	25		
2	Traffic Signal Controller, Remove and Salvage	EA	25		
3	Traffic Signal Controller Cabinet, Complete, Furnish and Install (Not Including New, In-Cabinet Fiber Optic Network Equipment: 12-Position Termination Panel, Layer 2 Switch, Etc.)	EA	3		
4	Traffic Signal Controller Cabinet, Complete, Furnish and Install (and Reinstall Existing In-Cabinet Fiber Optic Network Equipment such as Patch Panel, Layer 2 Switch, Etc.)	EA	2		
5	Traffic Signal Controller Cabinet, Remove and Salvage	EA	5		
6	Fiber Termination Panel, 12-Position, Furnish and Install, Complete with Terminations	EA	20		
7	Ethernet Switch, Harsh Environment, Layer 2, Managed, Furnish and Install	EA	21		
8	Exterior Cabinet Enclosure, Furnish and Install	EA	5		
9	Traffic Signal Monitoring System, 1-Camera, Complete, Furnish and Install	EA	1		
10	Traffic Signal Monitoring System, 2-Camera, Complete, Furnish and Install	EA	3		
11	Traffic Signal Monitoring System, 3-Camera, Complete, Furnish and Install	EA	11		
12	Traffic Signal Monitoring System, 4-Camera, Complete, Furnish and Install	EA	9		
13	Traffic Signal Monitoring System, 5-Camera, Complete, Furnish and Install	EA	2		
14	Traffic Signal Monitoring System, 6-Camera, Complete, Furnish and Install	EA	1		
15	Traffic Signal Pedestal Pole Camera-Mount Riser for Use with 1- or 2-Camera Monitoring System, Furnish and Install	EA	2		
16	Traffic Signal Pedestal Pole Camera Mount Riser for Use with 1- or 2-Camera Monitoring System, Painted Black, Furnish and Install	EA	1		
17	Handhole, Type III, Furnish and Install	EA	29		
18	Conduit, 2 Inch Dia., HDPE, Furnish and Install	LF	5,065		
19	Fiber Optic Cable, 72-Ct, Single-Mode, Furnish and Install	LF	7,875		
20	Tracer Wire for Existing Conduit, Furnish and Install	LF	695		
21	Removals, Miscellaneous	LS	1		
22	Surface Restoration	LS	1		
				TOTAL	