

**SP-092006
(New)**



**SPECIAL PROVISIONS
FOR
TRAFFIC SIGNALIZATION**

**Black Hawk County
STP-U-8155(715)--70-07**

**Effective Date
July 20, 2010**

THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

PART 1 DESCRIPTION

1. DEFINITIONS

Terms used in these Special Provisions shall have the meanings defined in paragraph a below.

- a City means City of Waterloo, Iowa or its representatives.
- b DOT means Iowa Department of Transportation

2. RELATED SPECIFICATIONS AND STANDARDS

The Contractor shall comply with all of the standards listed in paragraphs below unless otherwise modified by the Contract Documents. The Contractor shall notify the City of Waterloo Traffic Operations Department (WTOD) in writing of any discrepancy or ambiguity as to the intent or meaning of the Contract Documents 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.

Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction, Series 2009

ITE (Institute of Transportation Engineers) Standards.

Specifications of the Underwriters Laboratories, Inc.

National Electrical Code.

National Electrical Safety Code.

MUTCD - Iowa Manual on Uniform Traffic Control Devices.

NEMA (National Electrical Manufacturers Association) standards.

ASTM (American Society for Testing Materials) standards.

ANSI (American National Standards Institute) standards.

IMSA (International Municipal Signal Association) standards.

Local Ordinances.

All pertinent state and federal laws and regulations covering material, design, construction, and operation.

PART 2 MATERIALS AND CONSTRUCTION

1. SOLID STATE ACTUATED TRAFFIC SIGNAL CONTROLLERS

Controller shall be NEMA TS-2 Type 1.

Controller shall conform to Section 2525 of the Standard Specifications.

Controllers shall be two- to eight-phase and have two-phase pedestrian movements. Pedestrian timing functions shall be provided on all controllers.

Controller shall be capable of being integrated into and shall be compatible with one of the City's existing closed loop traffic signal systems manufactured by Siemens or Econolite. Controller shall have all the latest upgrade revisions made to it.

A minimum of four independent preemption functions shall be provided on each controller.

Controllers shall be capable of free operation and shall revert to such operation in the event of an appropriate signal from the master controller or an interruption in the communications for three consecutive cycles.

Coordination of controllers shall include, interconnect and stand-alone time-based coordination features and traffic responsive program select of the master.

Controllers shall be provided with volume-density operational features, and shall be capable of generating database reports and status reports.

The controller shall contain all necessary communications equipment and shall be capable of full upload and download to and from the master without the use of an external communications interface unit.

Each local controller shall have an RS-232 port, which can be used to communicate (upload and download controller data) with a portable PC AT computer via an RS-232 null modem cable. All RS-232 and system modems shall be installed as part of each local controller and system master controller.

2. VEHICULAR SIGNAL HEADS-LED

Signal indications shall be 12 inches in diameter.

The signal heads shall be sectional in construction requiring one section for each light indication.

All traffic signal light sources shall be light-emitting diode (LED). LED and LED assemblies shall meet and exceed all pertinent NEMA, IEEE, and ITE standards.

Signal heads lenses can be made of glass or ultraviolet (UV) stabilized synthetic materials.

Non-polycarbonate synthetic lenses shall meet the ITE color standards and 3 1/2 foot drop test.

Lenses should have a smooth outer surface and shall be free of bubbles, flaws and imperfections. Lenses shall be capable of withstanding ultraviolet exposure from direct sunlight for a minimum period of 36 months without exhibiting evidence of deterioration.

Lenses may be tinted or may use transparent film or materials with similar characteristics to enhance "ON/OFF" contrasts. The use of tinting or other materials to enhance "ON/OFF" contrast shall not affect chromaticity and shall be uniform across the face of the lens.

If a polymeric lens is used, a surface coating or chemical surface treatment shall be used to provide front surface abrasion resistance.

The housing for the individual sections shall be made of a die-cast aluminum. The top and bottom of each section shall have an integral locking ring with separations to permit rotation of the signal head in five-degree increments. Openings in the top and bottom of the signal shall accommodate standard 1 1/2 inch diameter bracket arms. All joints between sections shall be waterproof. Locknuts or other means approved by the Engineer shall hold the section firmly together.

Each section shall be complete with a one-piece, hinged door with watertight gaskets and two (2) stainless steel locking devices. The hinged pins shall be designed so that the doors may be easily removed and reinstalled without use of special tools.

One section of a three or more section assembly shall be equipped with terminal block for termination of field wiring.

Each lens shall have a visor as per plans or Special Provisions not less than 8 inches in length and designed to shield each lens. Aluminum tunnel visors shall have a minimum thickness of 0.05 inches and be painted flat black.

The lamp socket shall be equipped with color-coded wire, red, yellow, or green, depending upon the lens color of the section.

The socket wires shall be a minimum of 26 inches long, composed of wire with insulation designated to withstand 105 degrees C (Celsius). The wiring leads shall be terminated with spade lugs for ease of connection to terminal block. The socket shall be equipped with a gasket to insure a dust-tight fit.

A coupling washer assembly comprised of two (2) washers, three (3) cadmium-plated bolts, nuts and lock washers shall lock the individual sections together. The hole in the coupling washer assembly shall be large enough to accommodate three (3), 3/4 inch cables.

When traffic signal heads are attached to mast arms, the bracketing shall be astro-bracket type or City approved equivalent. No plumbizers are acceptable.

The signal heads shall be constructed of the highest quality materials. High-grade quality shall be used throughout. Each head shall have a smooth surface both inside and outside and shall contain no sharp fins or sharp projections of any kind.

All components of the vehicular traffic signal heads furnished shall comply with the latest ITE Standards on adjustable face vehicle traffic control signal heads.

Certification. The City shall be furnished with a certification from the manufacturer of the signal head that the equipment furnished complies with all provisions of this Special Provision. If there are any items, which do not comply with this Special Provision, a list of those exceptions must be detailed on the certification.

All screws, latching bolts and hinge pins shall be according to manufacturers' recommendations. One section of the three-section signal shall be equipped with a six-position terminal block for termination of field wiring. Each five-indication signal shall be equipped with an eight-position terminal block.

All surfaces of metal signal housing doors and visor shall be treated with either a prime coat of zinc chromate or a chromate aluminum oxide coating process. The finish shall be of best quality oven-baked, federal yellow, enamel, except the doors and visors shall be flat black.

3. OPTICALLY PROGRAMMABLE TRAFFIC SIGNAL HEADS-LED

Visibility programming signal heads shall utilize LED for light source and shall be programmable remotely without the need to climb up to the signal head. Programmable-visibility traffic signal heads shall have 12 inch diameter lens openings and shall include all necessary fittings and brackets. These signal heads shall permit the visibility zone of the indication to be determined optically. The field of light coverage vertically, laterally, and longitudinally shall be controlled within one (1) degree of any axis. The projected signal indication shall be visible or selectively veiled anywhere within 15 degrees of the optical axis. The appurtenances and components of the optically limiting signal head shall be in conformance with the applicable requirements of traffic signal heads, except as hereinafter provided.

4. PEDESTRIAN SIGNAL HEADS

All pedestrian signal heads shall include all the necessary fittings and brackets and shall use LED.

The signal shall be with a universal Don't Walk "HAND" symbol indication and a universal Walk "MAN" symbol indication in one-section head.

All main bodies and door assemblies for pedestrian signals shall be constructed of die-cast aluminum.

Lenses shall be 12 inches.

Other properties shall be the same as defined for vehicular traffic signal heads defined earlier.

5. BACKPLATES

Backplates shall be aluminum and louvered. Backplates shall be 5 inch border in size and shall be at least 0.05 inches thick. A 1 inch radius shall be provided on all corners. Each backplate shall be furnished with all the necessary mounting hardware for attachment according to manufacturers' instructions.

The size of each backplate shall be suitable for mounting on three-section and five-section, 12 inch signal heads including space for plumbizers, when called for. All mounting hardware shall be rustproof and corrosion resistant.

6. GALVANIZED STEEL TRAFFIC SIGNAL PEDESTALS

Construction. The length of the pedestal, from the bottom of the base to the top of the shaft shall be 10 feet or as otherwise specified on the plans.

The pedestal shaft shall be fabricated of tubing with a wall thickness of at least 1/8 inches. It shall have a satin brush or spun finish. The top of the shaft shall have an outer diameter to receive a pole-top mounting bracket of a traffic signal or a pedestal-mounted traffic signal controller.

Galvanization of the pole shall be in accordance with the latest revision of ASTM A123. All hardware shall be of hot dipped galvanized steel in accordance with the latest revision of ASTM A123. All pedestal poles shall be galvanized steel and shall be in conformance with Section 2525 of the Standard Specifications.

The pedestal base shall be cast-aluminum, square in shape, with a handhole. The size of the handhole shall be at least 4 inches by 6 inches and equipped with a cover, which can be securely fastened to the shaft with the use of simple tools.

Bases shall have a minimum weight of 20 pounds, and shall have a four-bolt pattern uniformly spaced on a 13 3/4 inch diameter bolt circle. The exterior of the base shall be smooth and have a neat appearance.

Anchor Bolts. Galvanized, hot rolled steel anchor bolts, sizes as determined by the pole manufacturer, shall be supplied, complete with all the hardware required for installation. The anchor bolts shall have a right angle bend at the bottom end and threaded at the top end.

7. GALVANIZED STEEL TRAFFIC SIGNAL SUPPORTS

The signal tubular mast arms and support poles shall be continuous steel poles of the anchor base type as shown on the plans. The pole shall be fabricated from low carbon (maximum carbon 0.30%) steel of U.S. Standard Gauge and shall be manufactured from steel sheet with one continuous welded vertical seam.

After manufactured, they shall have a minimum yield strength of 48,000 psi. The base shall be of heavy cast or rolled steel attached to the lower end of the shaft by a continuous weld on both the inside and outside of the shaft. The diameter of the bolt circle shall be as specified by the manufacturer.

It is permissible to fabricate poles and mast arms by welding two sections together by vendor only. Welding and fabrication shall conform to the Structural Welding Code AWS, as modified by AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges and the current Supplemental Specifications for Structural Steel.

The pole shall be designed to support the traffic signals and/or signs with the clearance as shown on the plans. Where called for on the plans, the poles shall be designed to assume high-rise design luminaire arms for streetlights. If needed, the shaft may be drilled in the field for mast arm clamps. The pole shall be equipped with a minimum 2 foot by 1 foot 10 inch transformer base. Securing of the cover of the shaft shall be possible with the use of simple tools.

The mast arms and poles shall be equipped with all necessary hardware, shims, and anchor bolts to provide a complete installation without additional parts.

In addition to what is shown on the plans, all signal poles and mast arms shall be designed to carry a five-section traffic signal head and a 24 inch by 36 inch sign at the end of each mast arm.

Galvanization of the pole and mast arms shall be in accordance with the latest revision of ASTM A123. All hardware shall be of hot dipped galvanized steel in accordance with the latest revision of ASTM A123. All mast arms and support poles shall be galvanized steel and shall be in conformance with Section 2525 of the Standard Specifications.

All luminaire extensions shall provide for 35 foot mounting height and 15 foot overhang unless otherwise specified on the plans.

All signal supports shall contain the anchor bolts. The anchor bolts shall be constructed from A36 steel with a minimum yield strength of 50,000 psi. The anchor bolts shall be hot dipped galvanized for a minimum of 12 inches on the threaded end and shall be threaded a minimum of 6 inches at one end and have a 4 inch long, 90 degree bend at the other end.

Certification. The fabricator shall certify that the mast arms are capable of withstanding winds of at least 100 mph without failure; that only certified welding operators in accordance with AWS D1.1-75 or latest revisions were used; and that only electrodes as modified by the current version of AASHTO Standard Specifications for Welding of Structural Steel for Highway Bridges were used.

8. MOUNTING HARDWARE

Signals heads shall be provided with adjustable cable brackets for mounting, as well as all other hardware necessary to completely mount the signals. 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.

Control cabinet mounting will be on separate concrete bases unless otherwise noted on plans.

9. PEDESTRIAN PUSHBUTTON DETECTORS

Pedestrian pushbutton detectors shall have a pressure or piezo-electric activated solid state with no handles or toggle switches. The body shall be powdered coated aluminum. The body color shall be yellow in color and the push button shall be stainless steel. The contacts shall be entirely insulated from the case and operating button with terminals for making connections. The case shall have one outlet using 1/2 inch diameter pipe.

The entire assembly shall be weatherproof, water tight, and freeze proof and shall be secure against electrical shock and be of such construction as to withstand continuous hard usage. The contact shall be normally open and no current flowing except at the moment of actuation.

The push button shall have an LED light and shall flash each time the button is pushed. The push button shall emit an audible sound when the button is pushed and emit an audible sound of different frequency when the button is released.

10. SIGNAL SERVICE METER BYPASS SOCKET

Service panel cabinets shall be furnished when indicated in the Contract Documents 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 Anchor Electric U42552-HO, Landis and GYR, HQ-5U-40405-015, Millbank NU9318-XL, or Durham T-H5213-U (HCP) or equivalent.

11. 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.

12. EMERGENCY VEHICLE PRE-EMPTION (EVP) SYSTEM

EVP system shall be fully compatible with City's existing OptiCom system and shall conform to the plans.

13. VIDEO DETECTION SYSTEM (VDS)

The Video Detection System and its components, referred to as the VDS, shall comply with the requirements listed in this Special Provisions as stated in the following paragraphs, and shall be mounted according to the manufacturers recommendations. The VDS shall be fully operable. The VDS shall be compatible with one of the City's existing video detection systems and be of latest model. City currently uses Autoscope, PEEK, and ITERIS cameras.

VDS shall have capability of full integration into the NEMA TS2 Type 1 control cabinet operation and shall support it. Compatible signal output for detection as NEMA loop detectors, VDS cameras shall be IP based and shall not require separate cables bundles for power.

14. TRAFFIC MONITORING CAMERA

- a Monitoring camera shall be fully compatible with the City's existing remote control and monitoring system and in conformance with the requirements under this Special Provision. The minimum system capabilities and features shall be Pan - Tilt - Zoom , Auto Focus, High-Resolution Integrated Camera/Optics with self cleaning lens, built-in back box memory to store camera and location-specific dome settings, including labels, presets, patterns, and zones. These settings shall be automatically downloaded if a new dome drive is installed. It shall meet or exceed Pelco IV camera specifications for precision, zooming, rotation, alarms, surge protection, etc.

15. WIRELESS COMMUNICATIONS

- a Wireless unit shall be 4.9 GHz, integrated, fully-functional, radio-configurable as an access point, a point-to-point bridge, or a client adapter. It shall include support for tunneling protocols such as VPN, PPTP, RSA, etc. The unit shall require low power not exceeding 5.5 watts. Access points shall have the capability to be wirelessly connected to each other while also serving the client along with Wi-Fi protected access. Client and point-to-point installation shall have the capability of being aligned without having to log into the radio by means such as LED indications. Radios shall have at least +13 dBm of output that can be scaled back when necessary. Radio communication device shall be IP addressable and internet ready for web-based management. Remote configuration shall be based IP address supporting TCP/IP protocol. Operating temperature shall be between -58 degrees F to 122 degrees F or better. City's existing radio equipment is listed below.

Existing Main Tower - 250 Ft City Hall Tower (Main Access Point)

TR-49 F Access Point, Outdoor Ruggedized
WISP495901 Antenna, Sectorized. With Coax Jumper, Radio to Antenna

Existing Remote Access Point

8670M Client (Link to Main Access Point)
WISP495966 Directional Antenna
AP-4900M-R Access Point, Outdoor Ruggedized
WISP495901 Antenna, Sectorized. With Coax Jumper, Radio to Antenna

Existing Other Equipment

T24130 Altronix24vAC 100VA Power Supply
NET 300T Pelco Net Transmitter (Network Receiver)
Net 300R Pelco Net Receiver (Network Transmitter)
500-24TT Cisco Catalyst Express 24 Port Switch
KBD-300A Dome Controller
CM6800 Matrix Switcher
DX8016 Digital Video Recorder

16. NETWORK VIDEO TRANSMISSION RECEIVER AND TRANSMITTER

- a Network video transmission receiver and transmitter shall have the features and capabilities listed in paragraphs b to t below.
- b Send and Receive Live Video and Control Data Over Ethernet Networks
- c Dual MPEG-4 Video Streams
- d Adjustable Bandwidth, Image Rate, and Quality
- e View Video on PC, Analog Monitor, or Both
- f Internet Configuration RTP, RTCP, UDP, TCP, IP, HTTP, SNMP, IGMP, ICMP, ARP
- g Video Coding MPEG-4 (M-JPEG in Server Push mode)
- h Video Frame Rate Up to 30 images/second
- i FCC Class B certified
- j Video Input or Output 1, BNC, NTSC, 75 ohms, 1 Vp-p
- k LAN Interface Ethernet 10/100BaseT auto-sensing, RJ-45
- l LAN Data Rate 9.6 Kbps to 1.5 Mbps
- m Data Interface 1 RS-232/RS-422/RS-485, bidirectional (9-pin, D-sub)
- n Alarm Input 2 terminal, 30 VDC maximum
- o Alarm Output 1 terminal, 30 VDC, 1 A
- p FCC Class B certified
- q Installed with provisions to work in temperature range of -27.5 degrees F to 140 degrees F when installed outdoors
- r Video Image Size NTSC 704 by 480 pixels, 704 by 240 pixels, 352 by 240 pixels
- s Operating Voltage 12-24 VDC, power supply shall be included,
- t Power Consumption Approximately 10 W

17. MONITORING CAMERA AND WIRELESS SYSTEM MISCELLANEOUS

Mean time between failures and warranty: 100,000 hours, one year on parts and labor, and manufacturer's warranty, whichever provides for longest combination coverage.

Design: The Contractor shall be responsible for designing a fully functional system that meets the minimum requirements of the Special Provisions.

Installation: The system is purchased installed in place and connected to Traffic Operations Center. The City will provide a bucket truck and operator. It shall be the Contractor's responsibility to assure the delivery of a working system including the use of proper equipment, appropriate installation, acceptable communication, and central location's remote digital video recording, monitoring, and control capabilities.

System shall include antennas, cables, jumpers, pole mounts, protectors, and all items necessary to make a complete working system, which shall be in accordance with the wireless and camera manufacturer's recommendations to provide a complete working system suitable for traffic monitoring.

18. INDUCTIVE DETECTOR LOOPS

The WTOD will perform all splicing of loop wires and the detector lead-in cable inside the handholes. The detector cable shall start and terminate at the closest handhole adjacent to the detector loops.

All loops are individually placed in pavement and terminated in handholes.

Loop Wire. The loop wire shall be 600 volt stranded copper, #14 AWG, type THWN, with UL approval. The loop wire shall be protected by a flexible vinyl plastic tubing of 3/16 inch inner diameter, a minimum of 1/32 inch wall thickness, 1/4 inch outer diameter. The tubing shall also be highly abrasion resistant and have a smooth bore.

A 6 foot slack for each loop wire shall be provided in each handhole.

The Contractor shall obtain Engineer's field verification of all loop locations prior to beginning of construction.

Inductive loops consisting of three turns (four turns for back loops) of wire shall be saw-cut in the pavement, with the width of cut being 3/8 inches and with a depth of 2 1/2 inches to 2 3/4 inches deep. Sharp (120 degrees or less) corners shall be provided with an additional diagonal saw cut as shown in the plans. All saw cuts shall be overlapped sufficiently so that a full 2 1/2 inches to 2 3/4 inches depth of cut results around the entire perimeter of the loop. For each additional turn of wire, 1/4 inches of depth shall be added to the saw cut. Generally, for all front loops have three (3) turns and all back loops have four (4) turns of #14 AWG wire unless otherwise shown on plans or determined by Engineer during construction of the loop.

For curbed streets, the saw cut shall be extended to the gutter line and a hole shall be drilled through the gutter line toward the handhole. No saw cut will be allowed into the curb face. For non-curbed streets, the saw cut shall extend to a hole drilled near the edge of the pavement as shown on the plans. A length of 3/4 inch diameter PVC conduit shall be inserted and sealed into the drilled hole from the outside edge of the pavement.

Prior to placement of wire, the saw cut shall be clean and free of water and all foreign materials that may cause premature failure. Loop wire, encased in plastic vinyl tubing, shall be placed in the finished cut.

Short pieces of backer rope of 3 inches to 4 inches shall be used where necessary to assure that the loop wire will remain at the bottom of the saw cut and not float up into the sealant. Lead-in wires outside of the loop shall be twisted approximately one turn per foot. All wire installation must be made without damage to the wire or its insulation. All damaged wire shall be replaced.

Loop testing completed in accordance with Section 2525 of the Standard Specifications. During saw cut and prefabrication loop testing, the City, the Contractor, and/or consultant shall be present during all testing procedures. Any loop that tests below the 100 mega ohms value shall be considered to be a faulty loop and shall be replaced.

After obtaining satisfactory test results, the loop shall be sealed with an approved sealant. The sealer shall be used strictly in accordance with the manufacturer's instructions. If sealant is placed below recommended manufacturer's temperature requirements, i.e., placement during late fall and winter, the loop shall not be accepted until the outside air temperature is at or above the manufacturer's temperature. The sealer shall be poured into the slot to half depth. When both the loop and lead-in slots are half filled, check for air bubbles or material pileup and then proceed to fill the slots to roadway level. Excess sealant shall be removed by means of a "Squeegee".

In all cases, there shall be neither a trough nor a mound formed. The sealer, when poured into a saw cut, should completely surround the wire, displace all air therein and completely fill the area of the slot, except for that portion filled with the wire hold down material. Allow sufficient time for the sealer to harden in accordance with manufacturer's instructions before allowing traffic to move over the area.

The saw slot filler shall be a two component system, high viscosity liquid or approved equal formulated for use in sealing inductive wire loops and leads embedded in asphalt concrete and Portland cement concrete. The saw slot filler shall be useable on grades of 15% or less without excessive flow of material, unless otherwise approved by the Engineer.

The Engineer shall approve the sealer. Approval of other sealants shall be based on specifications and/or test data about their physical properties, performance properties and chemical resistance. The cured sealer shall be unaffected by oils, gasoline, grease, acids and most alkalis. The mixing of components and the filling of the cut shall be in accordance with the directions of the manufacturer.

After completion of the sealing, the loop shall be final tested, as described in paragraph above. Completed sealed loop must pass continuity and resistance test prior to being accepted.

19. BLANK OUT SIGNS

The blankout signs shall be LED and shall be completely black (blankout) unless during activation. All mounting hardware shall be included to either mount the blankout signs on the traffic signal mast arm or the traffic signal vertical member. The entire sign shall be weatherproof and withstand temperatures from minus -35 degrees F to +165 degrees F.

20. LUMINAIRES

The luminaires shall be as shown in the plans and as modified in these Special Provisions. Luminaires shall be 250 watt high pressure sodium vapor with integral constant wattage ballast wired and installed for operation on 120 volt AC, single phase, 60 Hz. Luminaires shall provide ANSI/IES light distribution pattern Type II. Luminaire and lamp size required for a particular system shall be as shown in the plans.

Lighting conductors installed for luminaires shall be 1/C No. 10 stranded type THWN, unless otherwise indicated on the plans.

The Contractor shall verify that the luminaire photocell is operational prior to installation.

Each luminaire shall be complete with EEI-NEMA Standard through terminal polarized, twist-lock type photoelectric control receptacle.

Individual luminaires shall be provided with molded in-line fuse connector within the mast arm pole base. Molded fused connector shall provide waterproof connections with breakaway feature, and be sized to fit the conductors. Fuses shall be 10-ampere cartridge type. The neutral conductor shall not be fused.

The photoelectric control turning "ON" and "OFF" roadway luminaires shall be in accordance with the following:

The photoelectric controls shall be of a solid-state crystal sensing type with an inverted turn-on and turn-off design and shall meet the design and quality requirements specified in the current acceptable standards to ANSI C136.10. The device shall have surge protection conforming to the requirements in the current acceptable surge protection ANSI standards.

The voltage rating of the control device shall be multi-voltage operating properly over the input voltage range of 105 to 285 volts, 50-60 Hertz, alternating current with no change in the turn-on and turn-off foot-candle values, and a maximum total drift of not more than 1% over ten (10) years. The control device shall be fully rated at 1800 VA, fifteen (15) amps for all HID lamps.

The control device shall have a minimum 30-second time delay to eliminate false operation due to lighting or stray passing lights, shall provide fail-safe operation (the light supply shall remain "ON" if the control circuit fails), and shall be equipped with an arrester for built-in transient surge protection.

The "TURN ON" level of the control device shall be 3.0 foot-candles at the appropriate voltage; the "TURN OFF" level of the control device 60% of the turn on value.

21. MATERIAL AND INSTALLATION REQUIREMENTS

The contract work shall comply with the applicable requirements of the Standard Specifications for Highway and Bridge Construction and current supplements in particular the following parts:

Section 2402: Excavation for Structures

Section 2403: Structural Concrete

Section 2404: Reinforcement

Section 2405: Foundations and Substructures

Section 2408: Steel Structures

Section 2423: Support Structures for Highway Signs, Luminaires, and Traffic Signals

Section 2525: Traffic Signalization

Section 4187: Materials for Support Structures

Division 26: Roadside Development (2601.01 to 2612)

MATERIAL REQUIREMENTS

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.

CONCRETE

Concrete for foundations and handholes shall be Class C-4 structural concrete meeting the requirements of Section 2403 of the Standard Specifications, and current supplements.

CONDUITS

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

Polyvinyl Chloride. Conduit specified on the plans, as polyvinyl chloride (PVC) shall be rigid polyvinyl chloride meeting the requirements of NEMA TC-2, type 2, and applicable UL standards.

TRAFFIC SIGNAL LAMP

All traffic signal heads shall utilize LED for light source.

REINFORCEMENT BARS

All reinforcement bars for concrete foundations shall be of the type and size specified on the plans and shall meet the requirements of Section 2404 of the Standard Specifications, and current supplements.

CABLES AND WIRES

The number of conductors and size of all traffic signal cables 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, #8 AWG (black and white) unless otherwise stated in the plans. Ground wire shall be #6 AWG green stranded copper wire.

Signal Pole Base to Signal Pole Base. This shall be composed of either 5 conductor #16 AWG or 12 conductor #16 AWG cable or otherwise specified on project plans. The insulation shall be THHN/THWN conductor insulated 90 degrees C; PVC with nylon sheath meeting the VWI flame test as specified in UL standard 83. The color code shall be NEMA K-1 method 1 with 600 volts rating. The signal cable conductors shall be composed of stranded wire.

Signal Pole Base to Signal Heads. The wire running inside all signal poles (either mast arm or pedestal mounted) and mast arms to signal heads shall be #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/THHN, 600 volt, and single conductor copper stranded wires, which run continuously between poles. Conductors shall meet the requirements of Section 4185.12 of the Standard Specifications and shall be of the size and number shown on the plans.

Detector Lead-In Cable. Detector lead-in cable shall be #14 AWG, meeting the requirements of IMSA Specification 50-2 or latest revision thereof.

Loop Detector Wire. See Supplemental Information.

Communications Cable. The traffic control communications cable shall be either 6-pair, 12-pair, or 25-pair cable as per plans (see interconnect wiring detail plans), with #19 AWG, solid copper conductors. The cable shall be high density polyethylene with telephone industry color coding, conforming to REA Specification PE-39, type BJFC with .005 inch copper shield. The cable filling shall be a petroleum-polyethylene gel compound, which shall completely fill the entire cable within the outer jacket. The polyethylene compound shall be cleaned from all conductors when Contractor strips back while hooking up the interconnect to the Engineer's satisfaction. The dielectric strength, conductor to conductor, shall be a minimum of 7,000 volts and a minimum of 15,000 volts from conductor to shield. Pair assignments shall be in conformance with City requirements as determined prior to construction. (Consult REA-39, type BJFC spec.)

HANDHOLES

The Contractor may furnish a pour-in-place concrete handhole, with cast iron ring and cover, or a pre-cast concrete handhole, with cast iron ring and cover. Concrete pipe, 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). The cover shall have the name "TRAFFIC" in 2 inch letters cast into the lid.

REFLECTORIZED STREET NAME SIGNS

Length and Width. Sign length and width are determined based on the street name, letter size and type. Normally mounted intersection identification signs have a standard width of 18 inches. The substrate shall be aluminum, 6061-T6, 0.10 inches minimum thickness or of material specified by the Engineer. The number of letters in the street name, including the prefixes and suffixes, shall determine the length. The nameplate shall have a minimum length of 48 inches. Where extra length is required, it shall be provided in 6 inch increments.

Unmounted faces shall be shipped 18 1/4 inches wide and the length with 1/4 inch added (Example: 48 1/4 inches, 54 1/4 inches, etc.). The face shall be registered in the lower right corner with right and bottom border correct (3/4 inch) and the extra 1/4 inch at the top and left edge. This coverage shall help take care of any problems in application.

General. When an abbreviation of the street name is required to place it within the maximum sign length, approval shall be obtained from the traffic Engineer. The sign copy shall be in accordance with this Special Provision. Corners of the mounted nameplate shall be rounded (radius of corner must correspond to border radius) or square, as specified by the Engineer or as required by the legend.

Reflective Sheeting. The sign face shall be made from engraved grade type retro-reflective sheeting.

Processing. Colors are to be specified by the traffic Engineer. When screen processing, transparent screen process color shall be coated with a clear finish. Screen processed opaque black color need not be clear coated. All screen processing and clear coating shall be in accordance with the recommendations of the sheeting manufacturer. Sign faces may be produced by direct application of cutout copy onto mechanically applied background in accordance with sheeting manufacturers' recommendations.

Application. For mounted signs, reflective sheeting shall be applied to sign blades that have been properly prepared. The sign faces shall be applied using the heat-vacuum process or squeeze roller application in accordance with the recommendations of the sheeting manufacturer.

Legend Size and Series. Unless otherwise specified on the plans, street name signs (18 inch width) shall be designed using 8 inch U.C. and 6 inch L.C., D series letters for all copy. When sign length is restricted to certain sizes, the readability of "C" series at 100% spacing is greater than "D" series at 75%.

Letter Design. Standard abbreviations for street, avenue, boulevard, etc. shall be used following the street name or number. The traffic Engineer will list abbreviations. Periods, hyphens, commas and other punctuation shall not be used. Legend shall optically be spaced and centered, both horizontally and vertically. The charts for standard alphabets (capital or upper case) for highway signs for letter design and spacing shall be used.

The manual states "initial capital letters shall be one-third higher than the nominal lower case loop height", i.e., height of the lower case letter 'c' or 'o' is the loop height.

Letter Spacing. The control for the spacing values in traffic layout is the distance recognized as aesthetic spacing between two straight letters (HN). A spacing control of two times the width of the stroke of the letter shall be the aesthetic control (100%). The spacing control (100% value) is used as a basis for all aesthetic letter spacing and two times this control plus 1/2 the aesthetic spacing from letter to letter is used as the space between words in the complete legend.

When a legend is too long for a given blade length, the next 6 inch longer length shall be used; inter-letter, inter-word and end spacing shall then be expanded up to 25%, in 5% increments, to better use the longer length required.

The end margins are set at the space between two works. Where necessary the end margins may have a fixed minimum (Example: 3 inches or more as needed).

Spacing shall be uniform from one (1) procurement to another for consistency of appearance of similar legends.

Border. The border shall be 3/4 inches wide with 2 1/4 inch radius corners set on a square corner. The dimension between the inside edges of the border vertically and horizontally shall be 16.5 inches wide by 1.5 inches shorter than the chosen length of the sign blade. (See Length and Width section.)

General Characteristics and Packaging. The finished signs shall be free from defects such as ragged edges, cracks, scales, or blisters, and the legend shall be clean-cut. Signs shall be packed in accordance with commercially acceptable standards with recommended slip-sheet paper on the sign face and padding against the sign face for mounted signs. Signs shall be protected from moisture when in shipment or storage.

FOUNDATIONS

The concrete bases shall conform to the dimensions shown on the plans. The bottom of all foundations shall rest securely on firm undisturbed ground. Forms shall be used for the above ground portion of all foundations. Whenever the excavation for a foundation is irregular in shape, forms shall be used to provide the proper dimensions of the foundations below grade. The material for the forms shall be of sufficient thickness to prevent warping or other deflections from the specified pattern. The forms shall be leveled and a means shall be provided for holding them rigidly in place while the concrete is being deposited.

Where the foundation cannot be constructed as shown on the plans because of an obstruction, the Contractor shall relocate the foundation or use other effective methods of supporting the pole after securing the Engineer's approval.

The Contractor shall be responsible for the proper elevation, offset and level of each foundation.

Conduits, drains and ground rods shall be installed as shown on the plans. Conduit inlets shall be installed as shown on the plans. Two conduit inlets shall be installed as a minimum per foundation. Inlets not used shall be capped below grade. A ground rod shall be placed external to each foundation. All ground rods shall be a minimum of 5/8 inch in diameter, 8 foot long, copper clad and shall be external to the concrete foundation, driven 4 inches below ground surface. Anchor bolts, conduits and reinforcement shall be held rigidly in place before the concrete is poured. Anchor bolts shall be held in place by means of a template constructed to space the anchor bolts uniformly in accordance with the pattern shown on the plans, and not to protrude excessively after installation of equipment.

The center of the template and the center of the concrete base shall coincide unless otherwise directed by the Engineer. High-frequency vibrator shall consolidate concrete after it is placed in the form. The top of the base shall be finished level or flush with the sidewalk where indicated on plans and the top edges shall be rounded with an edger having a radius of 1/2 inch. The exposed surface of the base shall have a rubbed surface finish.

Should the Contractor or the Contractor's representative find that it is necessary to alter or reconfigure any portion of the installation or there would be a conflict with the design versus the site grade ditches, utilities, etc., the City or its representative shall be notified in writing of the portions that are in conflict. Immediate response shall be given by the City or its representative to avoid delays.

After the foundation or base has been poured, absolutely no modification of any sort may be made. If the anchor bolts, conduit, or any part of the foundation or base is installed in an incorrect manner such as below grade, as determined by the Engineer, the entire foundation or base shall be removed and a new

foundation or base installed. The Contractor shall bear all costs of replacing work deemed unsatisfactory by the Engineer.

Prior to setting poles, the anchor bolts shall be covered in such a manner as to protect them against damage and to protect the public from possible injury.

The foundation must be given seven days to cure before the poles are erected.

New bases shall be constructed and finished to the dimensions shown on the plans. Concrete shall be as specified in Section 2403.02 of the Standard Specifications for Class C, mix no. C-4, air-entrained P.C. concrete, and shall be placed in accordance with Section 2403 of the Standard Specifications.

Reinforcement shall be in accordance with Section 2404 of the Standard Specifications. The top of the signal base shall be at a minimum of 2 inches and a maximum of 3 inches above the finished grade.

HANDHOLES (CONCRETE)

Unless otherwise indicated on the plans, handholes shall be constructed as per these Special Provisions. Handholes on fill section shall have a drain and drain pipe.

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 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.

CONDUIT

All conduit ends shall be threaded and shall be capped with standard pipe caps until wiring is started. When caps are removed, the threaded ends shall be provided with approved conduit bushings.

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 removed 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" or "bored" 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.

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 forty-eight (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 Section 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.

ELECTRICAL

The required number of conductors to each signal head shall be one (1) conductor for each optical unit or set of optical units operating identically through the same cycle and one (1) 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 twist wire connectors. 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.

For traffic signal wiring, the required number of conductors to each signal head shall be one (1) conductor for each optical unit and one (1) conductor for common return per signal head, plus additional spare conductors as shown in the plans. 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 the WTOD.

POLE ERECTION

All poles are to be erected vertically with the mast arm at a right angle to the centerline of the street, unless otherwise specified, and securely bolted to the cast-in-place concrete foundations at the locations indicated on the plans.

Leveling shall be accomplished by the use of nuts on each anchor bolt. One nut shall be placed on each anchor bolt and the pole placed in position on these nuts. The top nuts shall then be placed loosely and the pole adjusted to the vertical position by adjusting both the upper and lower nuts and final tightening of top nut to expose a maximum of three full threads.

All threaded pedestal poles shall be drilled and tapped and a 1/4 inch diameter by 3/4 inch long galvanized or stainless steel bolt shall be installed through the base and the pole to prevent turning of the pole.

BONDING AND GROUNDING

Metal conduit, service equipment, anchor bolts, metal poles, pedestals, controller cabinets, interconnect cable shields, 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 #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 inches, 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 #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 handhole 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.

Interconnect cable shield shall be bonded at all cable splice points. The interconnect cable shield shall also be bonded to the ground buss at the cabinet of the system master.

SPLICING

Communications Cable Splicing. Cable splices shall be performed on either a terminal strip in a controller cabinet or in a pull box only at the direction of the Engineer. In the latter case, a splice enclosure shall be used to provide a watertight and weatherproof housing for the splice. All cable pairs are to be spliced color to color.

Splicing of cable pairs shall be twisted together, soldered and capped with a crimp-type insulated electrical sleeve. All splices shall be encapsulated and shall be waterproof.

The watertight and weatherproof splice required inside all pull boxes and holes shall consist of the cable pairs spliced together as indicated in the Electrical section.

The cable shield shall be connected across each splice by means of a bonded connection. Mechanical bonding of all shields in cable splices shall be electrically continuous throughout the entire system.

Where cable termination cannot be completed, slack cable shall be coiled and placed in a safe place. Ends of each cable shall be taped to prevent water from entering the cable. The protective cover shall remain until pair splicing is completed and the splice is properly enclosed.

The City shall be provided with locations of cable splices made in any handholes.

All tests shall be performed in the presence of City representatives. The Contractor shall perform the test and document the test results. When the tests are completed, whether successful or not, the test results and the test data shall be furnished to the City.

Tests, as described below, shall be conducted for all cable conductors and the cable shield, including spares, and shall include all field termination.

Loop Splicing. The electrical splice between the loop lead-in cable to the controller and the loop wire shall be soldered using dipped or resin core solder and provided with a watertight protective covering for the spliced wire, the shielding on the loop lead-ins and the end of the tubing containing the loop wires. No torch soldering will be allowed. Remove the insulation from each conductor of a pair of lead-in cable conductors for 1 inch and scrape both copper conductors with knife until bright. Remove the plastic tubing from the loop wires for 1 1/2 inches. Remove the insulation from the loop wires for 1 inch and scrape both copper conductors with knife until bright. Solder the loop wires together where needed for series connection and to the lead-in wires and cover with a wire nut twisted on tightly. Cover the exposed shielding, drain wire and wire nut splices with an electrical coating product. Any unused loop lead-in wire shall have the end of it also covered with the electrical coating product.

TRAFFIC SIGNAL DISPLAYS

During the course of construction and until the new signals are placed in operation, signal faces shall be covered or turned away from approaching traffic. When ready for operation, they shall be securely fastened in position facing toward approaching traffic. All traffic signal displays shall be installed as indicated on the plans and aligned and leveled per MUTCD on all axes. All optically limited signal heads shall be properly masked to limit their field of view as directed by the Engineer. Three section overhead displays located on mast arms shall have the red indication above the mast arm and five section displays shall have two sections above the mast arm, unless otherwise directed by the Engineer.

Where signal heads are being replaced, it shall be done in a manner to minimize disruption of traffic.

CONTROLLER CABINETS

The controller cabinet shall be a fully operational and functional NEMA TS2 Type 1 cabinet and shall meet or exceed all the requirements of the Special Provisions. The controller cabinet shall include everything for TS2 operations such as bus interface units (BIU) and 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 (4) outlets and mounted 100/10 Ethernet switch with at least four (4) outlets.

All conduit openings in the controller cabinet shall be sealed with an approved sealing compound. The sealing compound shall be approved by the WTOD before sealing operations. This compound shall be a readily workable soft plastic except those provided for drains. It shall be workable at temperatures as low as 30 degrees F, and shall not melt or run at temperatures as high as 300 degrees 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 are to be included. A gasket 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 to be fused ahead of the cabinet circuit breaker. The detector rack(s) shall be fully equipped 8 position rack(s). The load switch shall be fully loaded on 12 bay load switch locations.

Maintenance Switches. Inside the cabinet shall include properly rated and of good quality Stop Time Control, Timer Power, Flash, and Detector Test Switches.

The stop time control switch will be a 3-position switch labeled MANUAL-OFF-NORMAL. The center off position will allow the controller to cycle normally during flash.

The flash switch shall let the controller continue to operate within the cabinet for field evaluation of the controller.

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 connect to the controller cabinet with standard screws and no lug terminals will be accepted.

Terminals shall be provided which will allow the easy addition in the field of manufacturer's standard features available but not purchased initially.

No hardware or terminal facilities shall be attached to the cabinet door excluding an intersection call/display panels as required.

Two cabinet electrical prints shall be provided at a minimum for each cabinet.

Where the cabinet seats on the concrete base, the bottom edge of the cabinet shall be waterproofed as described here. Approved 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 the same key as other electrical control cabinets owned by the City.

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.

Traffic signal loads will be metered while the streetlights are non-metered. There must be a streetlight disconnect in the controller cabinet.

Any load switch circuit supplying power to a single indication with the exception of a red light shall have a ballast resistor attached inside the cabinet. A 10 watt or greater, 3000 ohm resistor shall be adequate.

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

Cabinet AC power/lightning and overload protection devices. Protection devices shall consist of a solid state non-gas tube surge protector connected to the cabinet ground. An EDCO 5 HP 300-10, of a City approved equivalent surrestor shall be used.

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.

The supplier shall install one 30 AMP breaker, 2-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 project plans. The supplier

of controller cabinet shall install a disconnect breaker panel and be connect as per the traffic signal schematic on the project plans.

LOOP DETECTORS/AMPLIFIERS

All loop detector amplifiers shall be two (2) channel card rack mounted. The card rack will include an appropriate power supply. Acceptable amplifiers shall be IDC, Sarasota, EDI, Reno or City approved equivalent. The two (2) channel card rack detectors shall have a separate output to be used for system detection from each channel. The detector card rack shall also accommodate video detection cards when necessary.

Detectors shall have the capability of operating in "pulse" or "presence" mode, "delay" timing on each channel, adjustable in one (1) second increments or less, and "extension" timing on each channel, adjustable in 0.5-second increments or less.

Internal lightning protection.

Loop isolation transformer to allow operation with a single point short between loop and ground.

The detector card rack shall include a slot for a four-circuit 754 Opticom phase selector. The preemption outputs from the controller shall be wired to the Yellow input of the four pedestrian load switch positions to power the preemption confirmation lights.

Lightning and Over voltage Protection. The Contractor or his representative shall furnish and install lightning protection devices within each control cabinet to protect all communications cable and equipment from over voltage and over current. Protection devices shall consist of a solid-state non-gas tube surge protector connected to each of the interconnect conductors.

The design of the protection device shall be compatible with the communication equipment to ensure that no damage will be done to any component prior to spark over.

Provisions shall be made such that in the event of a field cabinet knockdown wherein accidental over voltage conditions could be produced in the communications system, the location experiencing the problem will be isolated. An EDCO-SRA-64C data line surge protector or City approved equivalent shall be used.

SERVICE INSTALLATION

(Traffic Signal and Lighting): The Contractor shall supply and install a 2 inch RSC or PVC (which ever is applicable) 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, and shall be supplied by the Contractor. The size of the service conductors shall be 3c-#3 AWG stranded conductor, or as indicated on the plans. The Contractor will be responsible for coordination this work with the power company. The address of the source of power shall be shown on the project plans or provided by the WTOD.

EVP DETECTOR AND LIGHT INSTALLATION

The detectors, indicator lights, wiring and connections shall be installed in accordance with the manufacturer's instructions.

In the event at installation, a noticeable obstruction is present in line with the detector, the Contractor shall advise the Engineer before installation.

The detector and indicator light shall be attached to the traffic signal mast arm to the satisfaction of the Engineer.

All hardware shall be tightened securely.

The detector and indicator light shall be installed and mounted in such a way so as to insure the watertight integrity of the complete assembly. The detector shall be installed with the drain hole at the bottom.

There shall be no detector cable splices from the EVP detector on the traffic signal mast arm to the traffic signal cabinet. The detector cable shall be marked in the traffic signal cabinet as to which street and direction it is associated.

All EVP detectors and EVP indicator lights shall be operational when each traffic control signal system is initially turned on.

The Contractor shall furnish and install 3/c #20 AWG EVP detector cables and 3/c #14 cables for the confirmation lights where indicated in the plans. Emergency vehicle pre-emption cables (3/c #20) shall be installed continuous without splices or terminals from the EVP detector to the traffic signal cabinet.

THE LOCATION OF ALL SIGNAL STANDARDS

The locations of all signal standards shown on the plans are subject to adjustment depending on the actual locations of existing underground utilities and overhead utilities. Actual locations of standards will be selected at the time of construction upon location of existing utilities.

PAINTING

If the painted surface of any equipment is damaged in shipping or installation, such equipment shall be retouched or repainted in a manner satisfactory to the Engineer. All signal heads, which are salvaged and reused in the new installation, shall be sanded, spot-primed and painted with two finish coats by the Contractor. Signal heads shall be federal yellow. Colored prints shall be submitted to the Engineer for approval. No paint shall be applied under any condition of weather, temperature and humidity that, in the opinion of the Engineer, or against the manufacturers' recommended application procedures, is unsatisfactory for painting.

SALVAGED MATERIALS

All existing signal materials and equipment not listed in the Special Provisions and which are not being incorporated into the final project shall be salvaged by the Contractor and stockpiled on the project site. Such items will remain the property of the City.

SUPPLEMENTAL INFORMATION

The following sections of the Special Provisions are modified for this Project as indicated:

22. MATERIAL AND INSTALLATION REQUIREMENTS

Controller Cabinets. Contractor shall provide 16-channel back panel. For additional information regarding intersection phasing requirements for emergency vehicle pre-emption, contact the WTOD.

VEHICULAR SIGNAL HEADS-LED. The signal housing shall be flat black in color, similar to the color for the doors and visors.

BACKPLATES. The backplates shall be flat black in color.

GALVANIZED STEEL TRAFFIC SIGNAL PEDESTALS. Pedestal poles shall have a frangible aluminum transformer base. Breakaway support system shall conform to the requirements of AASHTO's Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

REFLECTORIZED STREET NAME SIGNS.

Length and Width. Intersection identification signs shall have a standard width of 24 inches.

Legend Size and Series. Street name signs (24 inch width) shall be designed using 12 inch U.C. and 9 inch L.C., D series letters for all copy. When sign length is restricted to certain sizes, the readability of "C" series at 100% spacing is greater than "D" series at 75%.

TRAFFIC SIGNAL UNINTERRUPTED POWER SUPPLY:

Service Enclosure:

- Service enclosure shall be 20 inches wide by 50 inches high by 10 ¼ inches deep.
- Service enclosure shall meet EUSERC requirements.
- Service enclosure shall be fabricated from 1/8 inch aluminum.
- Interior of service enclosure shall be fabricated from 14 gauge cold rolled steel and painted white.
- Service enclosure shall be anodized.
- Service enclosure shall have continuous welded seams.
- Service enclosure shall have full length deadfront with stainless steel hinge.
- Service enclosure shall be a UL 508 industrial control panel label for service entrance equipment.

- Service enclosure shall have pull section with removable step.
- Service enclosure shall have fully framed side hinged outer door with swaged close tolerance sides for flush fit with top drip lip and closed cell neoprene flange compressed gaskets.
- Service enclosure shall have hinged deadfront with 1/4 turn latch and knurled knobs.
- Deadfront door shall be hinged on the same side as exterior door and open a minimum of 100 degrees.
- Removable backpanel shall be mounted on four welded 1/4 inch studs.
- All circuit breakers shall be mounted in a vertical position, handle up for "On" handle down for "Off".
- Circuit breakers shall be of cable-in cable-out type.
- Service enclosure shall consist of absolutely no "Bolt-On" or "Plug-In" circuit breakers.
- Service enclosure shall be completely prewired in the factory.
- Wiring will be to NEMA IIB standards showing external connections and external equipment.
- All bussing shall be UL approved copper THHN cable bussing, fully rated.
- The function of all circuit breakers, switches and other components as required shall be identified by laminated engraved plastic nameplates with minimum 1/4 inch letters fastened with minimum of two #4-40 stainless steel machine screws.
- Wiring schematics will be Computer Aided Drafting and include all external equipment and connections per NEMA IIB.
- As Built factory drawings shall be enclosed in clear plastic and held inside the outer door by welded hooks.
- Manufacturers will be required to furnish independent laboratory certification of metal preparation and finish and to confirm that the overall product meets these Special Provisions. If this agency wishes to witness this testing, all costs to be paid by Contractor.

TRAFFIC SIGNAL BATTERY BACKUP SYSTEM (BBS):

Enclosure Specifications:

Anodized aluminum weatherproof enclosure shall house BBS and batteries. Enclosure shall be TIG welded construction with welding materials specifically designed for the material to be welded. Enclosure shall have fully framed side hinged outer doors with swaged close tolerance sides for flush fit with drip lip and closed cell neoprene flange compressed gaskets. Front door shall incorporate a full-length piano hinge, pad-lockable draw latch (center area on door-latch side), and a pad lockable welded-in place vandal-proof tab rated at 2000 lbs. There shall be no exposed nut, bolts, screws, rivets or other fasteners on the exterior of the enclosure. Maximum cabinet dimensions are 46 inches H by 20 inches W by 10.25 inches D. BBS shall be mounted in an interior tilt out housing with 800 lb rated stops. Battery connectors shall be Anderson Connectors with silver plated contacts. Batteries shall be installed in fixed position framed trays for seismic safety and be readily accessible for maintenance. Batteries shall be mounted allowing airflow front and back. Enclosure can include two transfer bypass switches, one for BBS bypass the second for auxiliary generator (optional). All switches must be panel mounted on interior dead front panel board. UV resistant plastic laminated nameplates shall identify all controls and major components.

A plastic covered wiring diagram will be attached to the inside of the front door. All components shall be factory wired and conform to required NEMA, NEC, and UL standards. A chassis ground point shall be provided. Panel shall be UL 508 Industrial Control Panel rated.

BBS Panel Minimum Features:

- System shall provide 700 watts of full control run time for two (2) hours. In addition the system shall provide six (6) to eight (8) hours of flash.
- BBS bypass and BBS isolation switch.
- Deadfront safety panel board with all switches, indicating fuses, plugs, and isolation fuses for each battery pre-wired with phenolic nameplates.
- All nameplates shall be screwed on phenolic engraved type.
- All wire terminating lugs shall be full wrap around type.
- All batteries shall be captive spaced from external captive sides in earthquake proof buckets.
- Cabinet ventilation shall be by (qty. 2) 4 inch by 1/4 inch louvers top and bottom with encapsulated bug screens, cleanable filters and a 100cfm fan to completely exchange air a minimum of 25 times per minute.
- All DC terminals and connections shall incorporate safety covers such that the safety covers are in place for every normal maintenance mode.
- Event Counters and Total Run Time Counter.

BBS Unit Minimum Specifications:

BBS unit shall provide a true sine-wave output with minimum 1400 Volt-Amp continuous capacity. BBS must provide for utility service isolation when in operation. The minimum rating for wattage output will be 950 watts. The BBS shall be capable of running an intersection with LED lights (for Run Time consult manufacturer). The unit shall operate off-line, with transfer time of 2 ms or less, with battery condition indicator, with automatic test provisions, and with hot-swappable batteries (all batteries in system). BBS will automatically recharge batteries from full discharge to 95% capacity within 6 hours. BBS will provide on-line operation for a minimum input of 92 to 145 VAC, provide full load output of 120VAC – 10% / +4% at 60 Hz +/- 0.05% over a temperature range of -37 degrees C (optional adder) to +74 degrees C and be a UL Approved Design.

For safety and maintenance, the BBS shall not exceed 28 pounds. The BBS unit will be delivered with maintenance manuals and schematic diagrams.

BBS Unit Minimum Features:

- 1400VA 950 Watts, with quick make/break connectors and plugs. (Systems requiring hard wiring termination to/from the inverter are unacceptable).
- Surge energy withstand 480 Joules, 6.5kA
- Common mode clamping 0 ns < 5ns typical UL 1449
- Conditioned power – Computer quality
- Transient lighting protection – 160 Joules
- Transfer to battery time – 2 ms
- Retransfer to utility – 2 ms
- Each battery shall be 24 volts @ 18 AH with heavy duty Anderson plugs and isolated fused (deadfront panel mounted 30 amp) connections to the BBS for greater system reliability and ease of maintenance. Series wiring is unacceptable.
- Fan cooling shall be fused for locked rotor current.
- Cooling air shall be ducted to cool the front and back of each battery with air space on all four sides and top of battery.
- BBS covers shall be 60% open on both sides to diminish the environmental effects of extreme temperatures.
- Includes USB and RS232, DB9 Computer Interface Ports.
- Low voltage safety design at 24v DC. (Higher voltage DC systems are unacceptable).

BBS Communications Module:

All inverter connections shall be made without the use of tools. This includes: A/C-Input, A/C-Output, Normally-Open, and Normally-Closed programmable contacts.

Smart Slot Relay I/O Module;

Input #1	Turn the BBS on.
Input #2	Turn the BBS off.
Input #3	Start the BBS self-test.
Input #4	Shut down the BBS (when on battery).
Output #1	The BBS is on-battery (during a power failure, self-test or run time calibration).
Output #2	BBS has a low battery – Programmable.
Output #3	The protected load is not receiving power from the BBS.
Output #4	Replace the BBS batteries.
Output #5	The BBS is overloaded.
Output #6	Any BBS fault or self-test failure.

Batteries:

Batteries shall be maintenance-free, type AGM/VRLA (Absorbed Glass Mat / Valve Regulated Lead Acid), such as APC Smart-UPS RMXL or approved equal. Batteries shall be independently pre-wired and individually fused. Batteries shall be furnished with heavy-duty 50 amp rated silver-plated Anderson Connectors. 100 Amp internal fuse by Battery supplier. Batteries shall be lightweight for personnel safety and protection plus ease of installation and maintenance. Batteries with a weight of over 26 lbs are not acceptable.

Enclosure Temperature Compensation:

Operating temperature shall be a minimum -37 degrees C to +74 degrees C.

Power System Analyzer and Conflict Resolution Module:

The BBS will incorporate an integrated Power System Analyzer and a Conflict Resolution Module. The Analyzer will evaluate and make limited adjustments to the incoming utility power and shall automatically transfer load to the battery back-up power if utility power is lost. When utility power becomes available, the BBS will analyze the power to verify stability and return to normal operation. The system will provide automatic BBS failure detection and automatically isolate the failed BBS and lock the unit on to utility power. Once the failure has been corrected, the system will return to the normal operation.

Triple Bypass System for Offline BBS:

1. SPACT – Smart Power Analyzer with Conflict Monitor Isolation and Transfer Module.
2. PCM – Power Conflict Monitor
3. The PCM is a totally redundant failsafe system. The PCM monitors load bus power available continuously. If load bus power fails for 5ms the PCM will transfer and isolate the BBS and guarantee that commercial power will be locked on.
4. Watchdog Timer – Redundant 5 ms delay and hard transfer to utility power.
5. The outboard Smart Transfer Switch shall not interrupt the normal controller function. Transfer time shall be 2ms.
6. Onboard Smart I/O module will execute lockout of battery back up system upon Smart detection of any inverter BBS fault. If BBS resets itself, it will automatically be available for backup.
7. ON Inverter to timed relay for Full Time control of Output, 0 to 10 hours.

Smart Battery Charger:

The BBS shall charge from shutoff discharge to 95% fully charged in less than 6 hours. Batteries shall be ambient enclosure compensated to less than 120 degrees F. The battery charger shall utilize Smart Cell Technology to extend battery life.

Intelligent Battery Management:

The BBS shall utilize Intelligent Battery Management that provides a precision battery charging system and automatic true-load battery tests. The Intelligent Battery Management system shall provide redundant overcharge protection and regulate under and over voltages without switching to battery.

The BBS shall have a Battery Replacement Warning system that automatically performs a self-test every two weeks to alert the user to degrading batteries before they wear out. Through software, or the push of a button, these self-tests may be performed at any time. The BBS battery charging systems shall be microprocessor controlled to precisely charge batteries in less time than legacy BBS systems.

Hot-Swappable Battery Replacement:

The BBS shall have a 60 second, user friendly, hot-swappable battery replacement system that allows safe and easy replacement of batteries while the system is up and running.

Warranty:

Manufacturers shall provide a two (2) year factory-replacement parts warranty on the BBS. Batteries shall be warranted for full replacement for two (2) years. The warranty shall be included in the total bid price of the BBS.

PART 3 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

See Iowa Department of Transportation Standard Specification Section 2525.04 and 2525.05.