SP-120097
(New)

Iowa Department of Transportation

SPECIAL PROVISIONS
FOR
TRAFFIC SIGNALIZATION

Woodbury County
IM-NHS-029-6(242)147--03-97

Effective Date
January 22, 2014

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

PART I - GENERAL REQUIREMENTS

This part of the Special Provisions consists of the general requirements necessary when furnishing a traffic signal installation complete, in place and operative as described in the project plans and these Special Provisions.

1.01 SCOPE OF WORK

A. The work shall consist of furnishing labor, materials and performing all work necessary to install traffic control signals in the City of Sioux City, Iowa, as shown on the plans and as specified in these Special Provisions and contract documents, as directed by the Engineer, and in those sections of the Standard Specifications for Highway and Bridge Construction, Series 2012, that are either directly or by reference included herewith to result in a complete and finished job.

B. Detailed Special Provisions, as included in these “Specifications and Contract Documents” or as may be embodied in the plans in the form of notes or details, modifying these Special Provisions in particular cases shall supersede and control these Special Provisions in those particulars.

1.02 EQUIPMENT AND MATERIALS

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

1. Equipment List

   A list of equipment and materials to be installed will be furnished to each bidder with these Special Provisions. The Contractor shall complete the list by writing in the name of the equipment manufacturer and catalog number of each item listed which he proposes to install. Prior to the purchase and/or fabrication of any component equipment or material for this Project and not more than 60 days after the awarding of the Contract; the Contractor shall submit to the Engineer for review five copies of the Material and Equipment List.

   Review by the Engineer of shop drawings and equipment and material lists shall not relieve the Contractor of any responsibility under the Contract or the successful completion of the work in conformity with the Plans and Special Provisions.

2. Shop Drawings and Catalog Cuts

   Eight copies of shop drawings shall be furnished for steel mast arm poles to be furnished on the Project. Eight copies of catalog cuts and manufacturer’s specifications shall be furnished for all standard off-the-shelf items.

3. Before acceptance of the work, the Contractor shall furnish the Engineer with three copies of the manufacturer’s instructions for maintenance and operation of all signal equipment, wiring diagrams of the installation or system, and a parts list sufficient for the ordering of any parts.

1.03 UTILITIES

A. Utility information of existing underground obstructions known to the Engineer is indicated on the Plans. The locations are from the most recent survey information. The Contractor shall notify owning utilities of the approach to any of their facilities and conform to their requirements. The Contractor shall perform exploratory operations as necessary to verify the location, elevation, and dimensions of all known or suspected underground obstructions ahead of any work affected thereby, and shall use care to avoid damage to them. The Contractor shall also ascertain whether any additional facilities other than those shown on the plans may be present.

1.04 STANDARD SPECIFICATIONS

A. The Standard Specification for Highway and Bridge Construction, Series 2012, Iowa DOT, as modified by these Special Provisions, or other appropriate special provisions shall apply to this

project.

B. The installation of the traffic control signals and appurtenances shall be in conformance with the Manual on Uniform Traffic Control Devices (MUTCD), latest edition.

1.05 REGULATIONS AND CODE

A. All electrical equipment shall conform to the standards of the National Electric Manufacturers Association (NEMA). In addition to the requirement of the plans and these Special Provisions, all material and work shall conform to the requirements of the National Electrical Code, the Standards of the American Society for Testing Materials (ASTM), the American Standards Association (ASA), and local ordinances.

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

1.06 CERTIFICATION OF EQUIPMENT

A. Certification from the manufacturers of all electrical equipment, signal supports, conduit and cable shall be supplied by the Contractor stating said material complies with these Special Provisions.

1.07 SCHEDULE OF UNIT PRICES

A. Prior to any payment by the Contracting Authority for work completed on this project, the Contractor shall complete and forward to the Contracting Authority for approval three copies of a list of unit costs for each item listed on the Schedule of Unit Prices attached to the Special Provisions. The sum of the costs for each item shall equal the total Contract Lump Sum price for the traffic signal installation. Engineer will make monthly estimates of the work performed on the project and the unit costs will be used to prepare progress payments to the Contractor. The unit costs will also be used to establish the total cost for any extra work orders related to traffic signal installation work items.

1.08 TESTING OF SIGNAL EQUIPMENT

A. After the project is open to normal traffic, the Contractor shall notify the Engineer the date the signal or signal system will be ready for testing.

B. Upon concurrence of the Engineer, the Contractor shall place the signal or signal system in operation for a consecutive 30 day test period. The signal(s) shall not be placed into operation without prior notification of the Engineer and concurrence by the Engineer that the signal(s) are ready to be placed into operation. Any failure or malfunction of the equipment, exclusive of minor malfunctions (such as lamp burnouts) occurring during the test period, shall be corrected at the Contractor's expense and the signal or system tested for an additional 30 consecutive day period. This procedure shall be repeated until the signal equipment has operated satisfactorily for 30 consecutive days.

1.09 SIGNAL MAINTENANCE DURING CONSTRUCTION

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

1.10 GUARANTEE

A. In addition to the warranties or guarantees on specific traffic signal equipment listed elsewhere in these Special Provisions, the Contractor shall fully guarantee the traffic control signal installation against defective equipment, materials, and poor work quality. Should any defect develop under normal and proper operating conditions within 12 months after acceptance of the completed installation by the Engineer, this malfunction shall be corrected by, and at the expense of the

Contractor, including all labor, materials, and associated costs.

B. Contractor shall provide this guarantee in writing on Company or Corporation letterhead stationery to the Contracting Authority prior to final acceptance. The Contractor shall transfer all required equipment warranties on the date of final acceptance to the Contracting Authority.

1.11 METHOD OF MEASUREMENT

A. The Traffic Signal Installation(s) as indicated on the plans, complete-in-place and accepted, will be measured as a unit lump sum quantity for all work necessary.

1.12 BASIS OF PAYMENT

A. The Traffic Signal Installation(s) measured as provided above will be paid for at the contract lump sum price bid, which price shall be full compensation for furnishing all equipment, materials, and all other work necessary or incidental to the construction of the complete traffic control signal installation and for all equipment, tools, labor, and incidentals necessary to complete the work.

PART II - INSTALLATION REQUIREMENTS

This part of the Special Provisions consists of the installation details and requirements necessary during the construction of the traffic signal installation(s) complete, in place and operative as described in the project plans and these Special Provisions.

2.01 HANDHOLES

A. Handholes

1. Handholes shall be installed at the locations shown on the plans, and at such additional points as the Contractor, at no own expense to the Contracting Authority, may desire to facilitate the work.

    a. The cover shall have the words, as shown in project plans, integrated into the top of the cover.

    b. Cable hooks – Four cable hooks shall be provided in all handholes. Cable hooks shall be galvanized steel with a minimum diameter of 3/8 inch and a minimum length of 5 inches and anchored in the wall of the handhole utilizing appropriate anchoring devices.

2. Handholes shall be installed in a neat and professional manner. All conduits shall enter the handhole as shown in the details provided in the plans. The Engineer shall approve any deviations from this requirement. The ends of all conduits leading into the handholes shall fit approximately two inches beyond the inside wall. An aggregate drain conforming to the dimensions shown on the plan details shall be provided. Frames and covers for handholes shall be set flush with the sidewalk or pavement surface. In unpaved areas, the top surface of the handhole shall be set with the surface of the ground.

2.02 CONDUIT SYSTEM

A. Conduit shall be placed as shown on the plans. Change in direction of conduit shall be accomplished by bending the conduit. Bends shall be made so that the conduit will not be injured or its internal diameter changed. Bends shall be of uniform curvature and the inside radius of curvature of any bend shall not be less than six times the internal diameter of the conduit.

B. When it is necessary to cut and thread steel conduit, no exposed threads will be permitted. All couplings shall be tightened until the ends of conduits are brought together so that an electrical connection will be made throughout the entire length of the conduit run. All conduit and fittings shall be free from burrs and rough places and all conduit runs shall be cleaned, swabbed and reamed before cables are installed. Nipples shall be used to eliminate cutting and threading where short lengths of conduit are required. Where the galvanized finish on conduit has been injured in handling, such places shall be painted with zinc rich paint. All fittings used with rigid steel conduit shall be galvanized steel only.

C. Approved conduit bushings shall be installed on the exposed ends of rigid steel conduit. Bell end fittings shall be installed on the exposed ends of PVC conduit.

D. Conduit buried in open trenches shall be placed a minimum of 36 inches deep 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.

E. The backfill material 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 or 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.

F. 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 position and the whole area involved shall be left in a neat and presentable condition. Concrete sidewalks, pavements, base courses and bituminous surfaces shall be replaced with new materials.

G. 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 that 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.

H. All conduit openings in the controller cabinet, handholes, and bases shall be sealed with an approved sealing compound. This compound shall be readily workable soft plastic. It shall be workable at temperatures as low as 30°F, and shall not melt or run at temperatures as high as 300°F.

I. All conduit shall include one polypropylene Pull Rope (considered incidental to the cost of the conduit) with a minimum 600 pound proper tensile strength. All conduit installed shall include a 1c#10 Tracer Wire with the exception of 1 inch conduit for pedestrian pushbuttons. The Contractor shall install, splice, and test the tracer wire for continuity. All conduit will be proofed upon completion to verify continuity and integrity of the duct.

2.03 WIRING

A. Where practical, color codes shall be followed so that the red insulated conductor connects to the red indication terminal, yellow to yellow, and green to green. Circuits shall be properly labeled at the controller by durable labels, or other appropriate methods, attached to the cables.

B. All cable runs shall be continuous from connections made in the handhole compartment of signal pole bases to the terminal compartment in the controller cabinet. Splicing will not be allowed in underground handholes unless specifically called for on the plans.

C. Power lead-in cable runs shall be continuous from the Power Company service point to the meter socket and from the meter socket to the controller cabinet. The size and number of conductors shall be as shown on the plans.

D. Slack for each cable shall be provided by a 4 foot length in each handhole and a 2 foot length in each signal pole or pedestal and controller base (measured from the handhole compartment in the pole to the end of the cable).

E. 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 other suitable devices. Frame-mounted pulleys, or other suitable devices, shall be used for pulling the cables out of conduits into handholes. Only vegetable lubricants may be used to facilitate the pulling of cable.

2.04 FIBER OPTIC CABLE

A. Fiber optic cables shall be installed in continuous lengths without intermediate splices throughout the project, except at the location(s) specified in the Plans. Fiber Optic Cable installation work shall be done by contractors with a minimum of two years total and one year continuous work experience with the splicing, termination, and testing of fiber optic cable. All the technical fiber work; splicing, terminating, testing, etc. shall be done by trained personnel. Trained personnel shall oversee other tasks such as pulling the cable into the conduit.

When ordering the fiber optic cable the Contractor shall exercise extreme caution so as to ensure that no additional splicing, beyond that indicated in the Plans, shall be required. Should the Contractor believe additional splices are required; this matter shall be immediately brought to the

attention of the Engineer for resolution.

The Contractor shall install the fiber optic cable in strict adherence to the manufacturer's recommended procedures. Care shall be taken to avoid cable damage during handling and placing. Fiber optic cable is sensitive to excessive pulling, bending and crush forces. The minimum bending and maximum tension requirements for installing the fiber optic cables shall be according to the manufacturer's specifications. The Contractor shall submit the manufacturer's recommended procedures for blowing or pushing central core fiber optic cable and for pulling the loose tube fiber optic cable to the Engineer for review and approval at least 20 working days prior to installing cables.

Cable installation personnel shall be familiar with the cable manufacturer's recommended procedures including, but not limited to the following:

- Proper attachment to the cable for blowing or pushing during installation.
- Proper attachment to the cable strength elements for pulling during installation.
- Cable tensile limitations and tension monitoring procedures.
- Cable bending radius limitations.

To accommodate long continuous installation lengths, bi-directional installation of the optical fiber cable is permissible and shall generally be implemented as follows:

1. From the midpoint of a pull station, blow/push (central core fiber) or pull (loose tube fiber) the optical fiber cables into the conduit from the shipping reel in accordance with the manufacturer's specifications.

2. When this portion of the blow/push (central core fiber) or pull (loose tube fiber) is complete, the remainder of the cable should be removed from the reel to make the inside end available for flowing/pulling in the opposite direction.

3. This is accomplished by hand pulling the cable from the reel and laying it into large "figure eight" loops on the ground. The purpose of the figure eight pattern is to avoid cable tangling and kinking.

4. The figure eight loops shall be laid carefully one upon the other (to prevent subsequent tangling) and shall be in a protected area.

5. The inside reel end of the cable should be available for testing.

6. Should it be necessary to set up a winch at an intermediate pull box, the length of cable shall be pulled to that point and brought out of the pull box and coiled into a figure eight.

7. The figure eight is then turned over to gain access to the free cable end. This can then be reinserted into the conduit system for installation into the next section.

Mechanical aids may be used to assist cable installation. The pulling eye/sheath termination or cable grip hardware on the optical fiber cables shall not be pulled over any sheave blocks. Field installed pulling grips with a rotating type swivel shall be used to pull the fiber optic cable.

No power pulling of fiber optic cable shall be allowed.

The pulling tension and bending radii limitation for optical fiber cables shall not be exceeded under any circumstances. A tension measuring device or break-away swivel shall be placed between the pull line and the end of the cable to ensure that the tension does not exceed 80% of recommended tension or 2225 N, whichever is less. A ball bearing swivel shall be utilized between the pull line and the end cable to prevent the cable from twisting during installation.

Large diameter wheels, pulling sheaves, and cable guides shall be used to maintain the appropriate bending radius. During cable installation, the bend radius shall be maintained at a minimum of twenty times the outside diameter of the cable. The cable shall not be stressed beyond the minimum bend radius at any time during installation. Tension monitoring shall be

provided at all times during the pulling operation and shall be accomplished using commercial dynamometers or load-cell instruments.

Fiber optic cable shall be installed using a cable pulling lubricant recommended by both the fiber optic cable and the conduit manufacturer, and a non-abrasive pull rope/tape conforming to the provisions described under “Conduit” elsewhere in the Special Provisions provided for this project. Cable lubricant shall be compatible with the fiber optic cable outer sheath and existing cable where fiber cable is installed in a conduit with other existing cable. Lubricant shall be applied according to the manufacturer’s recommendations.

Where the fiber optic cable is installed in existing conduct or utility ducts, at locations shown on Plans, the Contractor shall remove all existing cables and install all cables in the same pull to minimize risk of damage to cables. The Contractor shall be responsible for replacing any cables damaged during removal and reinstallation at the cost of the Contractor.

Cable slack shall be provided for each cable at each pull box, splice vault, or fiber optic splice location, as shown on the Plans and as specified in these Special Provisions. Cable slack shall be divided equally on each side of a fiber splice closure. Sufficient slack shall also be provided at all pull boxes to facilitate placing the optical fiber cable against the side of the pull box.

At all pull boxes and cable vaults, cable slack, as shown on the Plans, shall be left by the Contractor for all unspliced cable. Cable slack shall be installed in conduit couplers and shall be coiled and secured with tie wraps, coiled in pull boxes, and secured to the racking hardware in splice vaults. The Contractor shall ensure that the minimum bending radius of the optical fiber cable is not compromised when preparing this stored cable slack.

Following the installation of the conduit sock and cables in conduit, all entrances in cabinets, pull boxes and vaults shall be sealed with mechanical plugs; or at the discretion of the Engineer, using sealing compound, to prevent the ingress of moisture, foreign materials and rodents.

B. Splicing:

All splicing and testing equipment shall have current calibration documentation and copies of certification supplied to the Engineer.

Fiber optic cable shall be installed without splices except where specifically allowed on the Plans or described in these Special Provisions. The single-mode fiber optic cables used for distribution shall be spliced only at pull boxes as shown on the Plans. When splicing into a distribution cable, only those fiber strands associated with specific communication equipment shall be severed. All other fibers shall remain intact. The Engineer may allow additional splices between these specified locations.

Optical fibers shall be spliced using the fusion splice method and the insertion loss shall not exceed 0.05 dB of loss per slice.

Field splicing is permitted for the following:

- Connection of cable reel sections as approved in advance by Engineer.
- Connection of a distribution cable to a drop cable or a breakout cable.
- Connection of drop cable or breakout cable to an optical fiber pigtail termination module at communication equipment locations, or the patch panels in a hub equipment cabinet.

The Contractor shall not exceed the maximum number of field splices permitted as shown on the Plans. Completed splices shall be placed in a splice tray. The splice tray shall then be placed in a watertight fiber splice closure. Field splices shall be conducted only at locations as shown on the Plans as an approved splice location.

All splicing equipment shall be in good working order, properly calibrated, and meeting all industry standards and safety regulations. Cable preparation, closure installation, and splicing shall be accomplished in accordance with accepted and approved industry standards.

Using a mid-span splicing method, a drop cable shall be joined to the fibers in the fiber optic cable span. The termination splices shall be placed in a splice tray and the splice tray (s) shall then be placed in a watertight fiber splice closure.

At equipment cabinets, single-mode optical fiber pigtail termination module shall terminate at the rack-mounted fiber termination unit in each equipment cabinet and be connected to the optical interface to the Ethernet switch/fiber communication equipment with a suitable patch cord. All connected and stored cables shall be routed in each equipment cabinet in a manner that prevents damage during regular operation and maintenance functions. All exposed cable shall be secured every 12 to 18 inches to the equipment frame with nylon ties.

Equipment cabinets shall be equipped with splice trays and suitable means for routing and securing of cables, fiber strands, and fiber jumpers to prevent damage to fibers during all regular operation and maintenance functions.

All splices shall be protected with a thermal shrink sleeve. Upon completion of the splicing operation, all waste material shall be deposited in suitable containers, removed from the job site, and disposed of in an environmentally acceptable manner.

2.05 CONCRETE BASES

A. Concrete bases for poles and controllers shall conform to the dimensions shown on the plans. Excavations for these bases shall be made in a neat and professional manner. The bottom of all foundations shall rest securely on firm undisturbed ground. The material for the forms shall be of sufficient thickness to prevent warping or other deflections from the specified pattern. The forms shall be set level or sloped slightly to blend with the adjacent ground level and means shall be provided for holding them rigidly in place while the concrete is being deposited. All conduits and anchor bolts shall be installed and held rigidly in place before concrete is deposited in the forms. A ground rod shall be placed at each pole and controller base as shown on the plans. Anchor bolts for the signal poles or the controller pads shall be set in place by means of a template constructed to space the anchor bolts in accordance with the manufacturer's requirements. The center of the template and the center of the concrete base shall coincide unless the Engineer shall direct otherwise. Concrete shall be consolidated by vibration during placement.

B. The top of the base shall be finished level. The top edges shall be rounded with an edger having a radius of 1/2 inch. In sidewalk areas, adjacent to sidewalks, or in other paved areas, the top of the base shall be flush with the surrounding paved area and preformed expansion material shall be provided between the base and the other paved area. When installed in an earth shoulder away from the pavement edge, the top of the concrete base shall be approximately 2 inches above the surface of the ground. The exposed surface of the base shall have a rubbed surface finish.

C. 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 as determined by the Engineer, the entire foundation or base shall be removed and a new foundation or base installed at the Contractor's expense.

D. 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 foundations must be given seven days to cure before poles are erected.

2.06 BONDING AND GROUNDING

A. All conduit, steel poles and pedestals shall be bonded to form a continuous system, and be effectively grounded. Bonding jumpers shall be No. 6 AWG bare copper wire or equal connected by approved clamps.

B. Grounding of the conduit and neutral at the service point shall be accomplished as required by the National Electric Safety Code, except bonding jumpers shall be No. 6 AWG or equal.

C. Ground electrodes shall be provided at each signal pole and pedestal and at the controller as detailed on the plans.

D. A No. 6 AWGbare copper ground wire shall be installed in all PVC conduit that carries 120 volt signal cables.

2.07 SIGNAL APPURTENANCES

A. Signal Faces

1. All traffic signal displays shall be installed as indicated on the plans. All overhead displays located on each mast arm shall have each red indication set at approximately the same elevation, unless otherwise directed by the Engineer.

2. During the course of construction and until the 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 towards approaching traffic.

B. Controller Cabinet

1. The controller cabinet shall be installed at the location indicated on the plans with the back of the cabinet toward the intersection such that the signal heads can be viewed while facing the controller, unless otherwise directed by the Engineer.

2. All conduit openings in the controller cabinet shall be sealed with an approved sealing compound. This compound shall be a readily workable soft plastic. It shall be workable at temperatures as low as 30°F, and shall not melt or run at temperatures as high as 300°F. The controller cabinet shall be installed on pre-placed caulking material on the concrete base. After the cabinet is installed in place, the Contractor shall also place caulking material around the base of the cabinet. All conduit openings in the controller cabinet shall be sealed with an approved sealing compound. This compound shall be a readily workable soft plastic. It shall be workable at temperatures as low as 30°F, and shall not melt or run at temperatures as high as 300°F. The controller cabinet shall be installed on pre-placed caulking material on the concrete base. After the cabinet is installed in place, the Contractor shall also place caulking material around the base of the cabinet.

C. Pole Erection

1. All poles shall be erected vertically, with mast arms oriented at 90 degrees to the curb line, unless otherwise specified. The bases shall be securely bolted to the cast-in-place concrete foundations. Leveling shall be accomplished by the use of metal shims and/or one nut or two nuts on each anchor bolt. One nut shall be turned on each anchor bolt and the pole placed in position on these nuts. The top nuts shall then be turned into place loosely and the pole adjusted to the vertical position by adjusting both the upper and lower nuts. After leveling the poles, mortar shall be troweled between the pole base and the foundation. Where metal shims are used for leveling, caulking material shall be placed between the pole base and foundation. If grout or caulk is placed around the pole base, a weep hole shall be left in the material to allow water to drain from inside the base.

2. Exposed edges of mortar shall be neatly finished to present a pleasing appearance. Mortar shall be of the expansive type. Each pole shall be grounded by installing a No. 6 A.W.G. bare copper ground wire between the pole and the ground rod at the foundation.

D. Painting

1. If the painted surface of any equipment is damaged in shipping or installation, such equipment shall be retouched or repaired in a manner satisfactory to the Engineer.

2.08 REPLACING DAMAGED IMPROVEMENTS

A. Improvements such as sidewalks, curbs, driveways, roadway pavement and any other

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

B. Surface restoration shall be considered incidental to the bid items of the project and will not be paid for separately.

2.09 CONTROLLER CABINET AND AUXILIARY EQUIPMENT

A. Install the controller cabinet on pre-placed caulking material on the concrete base. After the cabinet is installed, place caulking material around the base of the cabinet.

B. For card rack style detectors, mount detector mounting racks on shelf in the controller cabinet. Wire all detector slots in the cabinet to provide for future loop inputs. Label card rack positions with loop numbers.

2.10 STREET NAME SIGNS

A. All signs shall be handled and installed carefully to prevent any damage to the sign faces. Any sign faces which are damaged prior to or as a result of improper installation will be rejected

Sign mounting hardware shall include stainless steel bolts, washers, strapping, mounting brackets, etc.

Overhead mount:

- 18 inches by 48 inches - minimum of two places
- 18 inches by 60 inches - minimum of three places
- 18 inches by 72 inches - minimum of three places

Pole mount:

- 12 inches by 36 inches - mount on bracket which is banded directly to pole.
- Greater than 36 inches - add stiffener

PART III - MATERIAL REQUIREMENTS

This part of the Special Provisions consists of the material requirements necessary for the construction of a traffic signal installation complete, in place, and operative as described in the project plans and these Special Provisions.

3.01 GENERAL MATERIAL REQUIREMENTS

A. All materials used in the fabrication or assembly of the items listed below shall comply with the applicable parts of Section 2523 of the Standard Specifications with the additions as stated herein.

B. Unless otherwise noted on the plans or in these Special Provisions all materials furnished shall be of new stock. New materials shall be the products of reputable suppliers and manufacturers approved by the Engineer. Miscellaneous electrical equipment and materials shall be UL approved.

C. Materials delivered to the project shall be stored at a secure site and shall be protected from damage due to inclement weather prior to installation.

D. Upon request by the Engineer, appropriate quantities of materials shall be made available by the Contractor for material testing purposes.

3.02 CONCRETE

A. Concrete for concrete bases shall be Class C structural concrete meeting the requirements of Section 2403 of the Standard Specifications.

3.03 CONDUIT

A. General

1. The number, type, and size of conduit shall be shown on the plans.

2. Conduit shall meet the requirements of Articles 2523.03, N and 4185.10 of the Standard Specifications.

B. Rigid Metal Conduit

1. Conduit shown on the plans as rigid metal conduit (RMC) shall be galvanized steel meeting the requirements of ANSI Standard Specification C80.1, latest revision.

C. Polyvinyl Chloride Conduit

1. Conduit shown on the plans as polyvinyl chloride (PVC) shall be schedule 40 rigid polyvinyl chloride conduit (or HDPE SOR 13.5) meeting the requirements of NEMA TC-2, Type 2, and applicable UL Standards.

3.04 REINFORCING STEEL

A. Reinforcing steel shall be of the type and size as shown on the plans and shall conform to the requirements of Section 2404 of the Standard Specifications.

3.05 TRAFFIC SIGNS

A. Traffic signs shall conform to the requirements of Section 4186 of the Standard Specifications and shall use urban rated prismatic reflective sheeting.

B. Street name signs shall be manufactured utilizing “VIP Diamond grade” reflectorized sheeting material. The letters shall be Series B or C Caps, with a height of 10 inches. The legend and border shall be white and the background shall be green. The border shall be 0.75 inches in width. The signs shall be single faced. The corners of the sign blank shall have a 1.5 inch radius.

C. Traffic signs and street name signs shall be mounted on the mast arms utilizing a universally adjustable mast arm mounted street name sign bracket.

3.06 ELECTRICAL CABLE

A. General

1. Electrical cable for intersection signalization shall be rated 600 volts minimum.

2. The number of conductors and size of all electrical cable shall be as shown on the plans.

3. 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.

B. Power Lead-In Cable

1. Power lead-in cable shall be of the sizes as shown on the plans.

2. Power lead-in cable shall be 600 volt, single conductor, stranded copper, Type USE, with UL approval.

C. Signal Cable

1. Signal cable shall be 600 volt, multi-conductor, with copper conductors of the number and size shown on the plans.

2. Signal cable shall meet the requirements of the International Municipal Signal Association (IMSA) Specification 19-1, latest revision thereof for polyethylene insulated, polyvinyl chloride jacketed signal cable. All conductors shall be No. 14 AWG unless otherwise specified on the plans.

D. Video Detection Cable

1. The video detection cable required to power and transmit the signal from the Machine Vision Processor (MVP) to the controller cabinet shall be as recommended by the video detection equipment manufacturer and supplied by the video detection equipment supplier as part of a complete video detection system.

E. Luminaire Wire

1. Cable for streetlights shall be THWN (90°C) stranded No. 8 AWG. Use for lighting circuits.

F. Tracer Wire

1. A tracer wire shall be installed in all conduits with signal cables, detector cables, or communications cables.

2. The tracer wire shall be a No. 10 AWG wire.

3. The tracer wire shall be a single conductor, stranded copper, Type THHN, with UL approval and an orange colored jacket.

4. The tracer wire shall be spliced in the handholes to form a continuous network.

G. Opticom Cable

1. Model 738 Detector Cable or equivalent for Global Traffic Technologies Opticom Priority Control Systems shall be used for Priority Detectors. Detector cable shall meet the requirements of IPCEA-S.61-402 / NEMA WC 5, Section 7.4, 600-volt control cable, 75°C, Type B. The cable shall contain three conductors, each of which shall be No. 20 stranded, tinned copper with 25 mil minimum average thickness low-density polyethylene insulation. Insulation shall be color-coded: 1-yellow, 1blue, and 1-orange. The shield shall be either tinned copper braid or aluminized polyester film with a nominal 20% overlap. Where the film

is used, a No. 20 stranded, tinned, bare drain wire shall be placed between the insulated conductors and the shield and in contact with the conductive surface of the shield. The jacket shall be black polyvinyl chloride with minimum ratings of 600 volts and 80°C and a minimum thickness of 45 mils. The jacket shall be marked as required by IPCEA / NEMA.

2. The finished outside diameter of the cable shall not exceed 0.35 inches.

3. The capacitance as measured between any conductor and the other conductors and the shield shall not exceed 48 picofarads per foot at 1000 hertz.

3.07 LOCATE STICK

A. A locate stick shall be installed as part of the communication tracer system. This system is used by the locate technician to locate City communication cables.

Fiber hand holes between intersections, where notes on the plans, shall have a locate stick oriented parallel to the tracer wire, placed 4 feet from the center of the fiber pull box, 2 feet deep, over the fiber conduit. The tracer wire system shall include a ground wire, No 14 THHN, green in color, attached to the center grounding lug of the locate stick and attached to the 10 foot ground rod in the fiber hand hole, with a 1/2 inch conduit between the locate stick and the fiber hand hole. The tracer wires shall be attached to the appropriate locate stick lug based on the direction of the tracer wire. For example, tracer wire coming in from the left shall be attached to the left locate stick lug. A jumper shall be attached to appropriate locate stick lugs to complete a continuous tracer wire run.

B. The contractor shall supply the locate stick, which is considered incidental to the cost of providing the fiber handhole. It shall be a 5 foot by 3 inch triangular flexible orange plastic marker with five separate access terminals and set screw to hold terminal concealment cap on. Decals shall be placed on all three sides with “Warning, Fiber Optic Cable, City of Sioux City. Before digging in this area call Iowa One Call 1-800-292-8989”, as shown in the detail.

C. The Contractor shall also provide the ground wire, No 14 THHN, green in color in 1/2 inch conduit from the locate stick to the fiber pull box ground rod and the 1/2 inch by 10 foot ground rod. Bend out all three barbs towards the bottom of the stick until the tips touch the post to ensure proper alignment. Place the locate stick in the hole and backfill making sure the barbs stay out and dirt falls on top of them. Properly tamp the soil as the hole is backfilled. The tracer wires shall be attached to the appropriate locate stick lug based on the direction of the tracer wire. For example, tracer wire coming in from the left shall be attached to the left locate stick lug.

D. A jumper shall be attached to appropriate locate stick lugs to complete a continuous tracer wire run.

3.08 CONDUIT SOCK

A. Conduit Sock is flexible, multi-celled, textile innerduct system designed specifically for pulling additional cables into conduit. Conduit Sock shall be 2 inch, 3 cell category allowing for maximum of three cables at 0.70 inch diameter and should be installed as per manufacturer’s requirements. Conduit Sock shall be MaxCell MXC 2003 YL (length) for the Distribution Fiber Optic Cable and MaxCell MXC 2003 GR (length) for the Backbone Fiber Optic Cable or approved equivalent.

3.09 FIBER OPTIC INTERCONNECT COMMUNICATIONS SYSTEM

A. General Requirements

1. Contractor to furnish all components of the Fiber Optic Interconnect Upgrade communications system, as shown on the plans, including conduit, pull boxes, 48 strand fiber optic backbone cables, 48 strand fiber optic distribution cables, six strand fiber optic drop cables, fiber patch panels, patch cords, splice enclosures, fiber jumpers, device connecting cables, fiber distribution unit, hardened Ethernet switches, SC connectors, mounting kits, ground and tracer wire, pull rope, and synthetic conduit socks to ensure a fully-operational

system.

2. Contractor shall furnish and install all necessary miscellaneous equipment and cabling to make the Fiber Optic cabled communication system operational.

3. All installed equipment shall be operational within NEMA TS2 Standards for temperature, humidity voltage, vibration and shock.

B. Fiber Optic Cable:

Fiber optic cables shall be supplied in the configurations shown on the Plans and specified in these Special Provisions.

There shall be three principal cable types procured under this specification. They are identified using a naming convention of “backbone cable” which shall contain 48 single-mode optical fibers; “distribution cable” which shall contain 48 single-mode optical fibers; and a “drop cable” which shall contain six single-mode optical fibers. Backbone, distribution and drop cable shall be loose tube fiber optic cable for installation in conduit.

All materials furnished, assembled, fabricated or installed as part of the fiber optic communications system shall be new, corrosion resistant and in strict accordance with the details shown on the Plans and in these Special Provisions. All fibers in the cables shall be usable fibers and free of surface imperfections and occlusions, in order to meet or exceed all of the optical, mechanical, and environmental requirements contained in these Special Provisions. Each fiber optic, outside plant cable for this project shall be all-dielectric, dry water-blocking material, duct type, with loose buffer tubes, and shall conform to these Special Provisions.

All cables shall be free of material or manufacturing defects and dimensional non-uniformity that would:

- Interfere with the cable installation employing accepted cable installation practices.
- Degrade the transmission performance and environmental resistance after installation.
- Inhibit proper connection to interfacing elements.
- Otherwise yield an inferior product.

The Contractor shall furnish, install, splice and test all the required fiber optic cable. All splicing kits, fiber optic cable caps, moisture/water sealants, terminators, splice trays, patch cords, connectors, and accessories to complete the fiber optic network shall be provided as incidental items subsidiary to the cost of other major items. All equipment for installation, splicing and testing shall be provided by the Contractor.

All fiber optic glass/cable on this project shall be from the same manufacturer who is regularly engaged in the production of optical fiber material.

The cable shall be qualified as compliant with Chapter XVII, of Title 7, Part 1755.900 of the Code of Federal Regulations, “REA Specification for Filled Fiber Optic Cables.”

Packaging

1. The completed cable shall be packaged for shipment on non-returnable wooden reels. Required cable lengths shall be stated in the purchase order.

2. Top and bottom ends of the cable shall be available for testing.

3. Both ends of the cable shall be sealed to prevent the ingress of moisture.

4. Each reel shall have a weather resistant reel tag attached identifying the reel and cable.

Cable Marking

1. The optical fiber cable outer jacket shall be marked with the manufacturer’s name, the month and year of manufacture, the words “Optical Cable,” telecommunications handset symbol as

required by Section 350G of the National Electrical Safety Code (NSEC®), fiber count, fiber type and sequential measurement marks.

2. The markings shall be a numerical sequence, at intervals no greater than 10 feet, to determine the length of cable and amount of cable remaining on the reel.
3. The actual length of the cable shall be within 0+1% of the length marking.
4. The marking shall be in a contrasting color to the cable jacket.
5. Height of the markings is 1/8 inch nominal.

Quality Control

1. The manufacturer(s) of supplied optical cable, optical cable assemblies, and hardware shall be TL 9000 and/or ISO 9001 registered. All cabled optical fibers shall be 100% attenuation tested. The attenuation of each fiber shall be provided with each cable reel.

Color Coding

1. Optical fibers shall be distinguishable from others in the same buffer tube by means of color-coding. The color coding shall be the following:
   a. Blue (BL) 5. Slate (SL) 9. Yellow (YL)
   b. Orange (OR) 6. White (WT) 10. Violet (VL)
   c. Green (GR) 7. Red (RD) 11. Rose (RS)
   d. Brown (BR) 8. Black (BK) 12. Aqua (AQ)
2. The colors shall be targeted in accordance with the Munsell color shades and shall meet TIA/EIA598B “Color Coding of Optic Fiber Cables” and RUS 7 CFR 1755.900.
3. The color formulation shall be compatible with the fiber coating and the buffer tube filling compound, and be heat stable. It shall not fade or smear or be susceptible to migration. It shall not affect the transmission characteristics of the optical fibers and shall not cause fibers to stick together.

Physical Characteristic of Fiber

1. All fibers within the finished cable shall be composed primarily of silica and shall have a matched clad index of refraction profile. All Fiber optic glass used in fiber optic cable, fiber optic jumpers, and fiber optic pigtail connections shall be from the same manufacturer and be of the same type and quality. This glass shall have low or zero water peaks allowing the use of 1310nm, 1383nm, and 1550nm wavelengths. In addition to the above requirements, all fiber cable shall be suitable for installation in underground conduit or lashed to messenger cable, and meets or exceeds the following specifications:
   - Operational Wavelength: 1310nm and 1550 nm.
   - Optical Attenuation: at 1310 nm: 0.4 dB/km at 68°F; at 1550 nm: 0.25 dB/km at 68°F
   - Optical Dispersion: at 1310 nm: 4.5 psec/nm-km; at 1550 nm: .20 psec/nm-km.
   - Zero Dispersion Wavelength: 1300 to 1320 nm, nominal.
   - Zero Dispersion Slope: 0.092 ps/nm2-km.
   - Fiber Core Diameter: 8.2 mm, typical.
   - Fiber Coating Diameter: 250 +/-10mm.
   - Fiber Cladding Diameter: 125 +/-1mm.
   - Core to Cladding Offset: 0.8 mm.
   - Cladding NonCircularity: 1.0%.
   - Spot Size: 9.3 +/-0.5 mm at 1310nm. 10.5 +/-1mm at 1550 nm.
   - Cutoff Wavelength: .1250 nm.

- Crush Resistance: 300 lb/ft length of cable.
- Cable Outside Diameter: 1/2 inch, maximum.
- Minimum Bending Radius: Installation: 20 times cable outside diameter. Static: 10 times cable outside diameter
- Operating Temperature: Installation: -22°F to 158°F Humidity: 0 to 100%.
- Tensile Strength: Installation: 600 pounds Static: 135 pounds

PART IV - EQUIPMENT REQUIREMENTS

This part of the Special Provisions consists of the equipment requirements necessary for the construction of a traffic signal installation complete, in place, and operative as described in the project plans and these Special Provisions.

4.01 GENERAL REQUIREMENTS

A. All materials used in the fabrication or assembly of the items listed below shall comply with the applicable parts of Section 2523 of the Standard Specifications with the additions as stated herein.

B. Unless otherwise noted on the plans or in this specification, all materials furnished shall be new and in so far as practicable, major items of signal control equipment should be of the same type and consist of products of the same supplier in order to secure uniformity, single responsibility and most satisfactory service. Unless specifically noted otherwise, all signalization equipment shall be similar to the best grade of this type of equipment.

C. The Contractor shall install all of the equipment and wiring necessary for intersection signalization as indicated on the plans and in accordance with this specification.

D. The traffic signal system shall be complete, and the Contractor shall furnish and install all equipment necessary for the satisfactory operation of electrical apparatus and for the complete operation of the traffic signal system whether specifically mentioned or not.

E. Controller, cabinet, and auxiliary equipment shall conform to the requirements of NEMA TS2, latest edition.

4.02 ACTUATED CONTROLLER, CABINET AND AUXILIARY EQUIPMENT

A. Traffic Signal Controller

Contractor shall supply either ECONOLITE ASC/3-2100 or SIEMENS EPAC 300 traffic signal controllers configured for shelf mounting and satisfying NEMA TS-2 requirements.

The traffic signal controllers shall be compatible with Centracs Central System Software by using controller firmware developed by Econolite for long-term support of the system. The signal controllers shall allow for a time-based control with fiber optic and/or radio communications. Controllers shall allow for Ethernet support for a 10/100 Base T full duplex network. IP Address coordination with WCICC is required.

B. Warranty

The manufacturer shall certify that the equipment meets the required specification and shall supply a complete catalog description. The following documents shall be provided:

- A warranty statement which stipulates that equipment supplied shall be warranted for 2 years from the date of purchase
- Operations manual

If a malfunction in the controller unit, or its auxiliary equipment occurs during the warranty period, the manufacturer shall, within 48 hours after notification (excluding Saturday and Sunday), furnish a like controller unit, module, or auxiliary equipment, for use while the warranted unit is being repaired. The isolation of any malfunction during the warranty period shall be the responsibility of the manufacturer. After the manufacturer has repaired the returned equipment, the department shall then return the spare component to the manufacturer.

C. Controller Cabinet and Terminal Facilities

The controller cabinet and fiber communications hardware shall meet the following functional requirements:

1. Cabinet Shell

   Contractor shall supply Size M cabinets, clean cut in design and appearance, to house the control equipment required for a Traffic Signal/ITS system and having the following maximum dimensions:

   DEPTH WIDTH HEIGHT 17 inches 31 inches 49 inches

   Cabinets shall be new, corrosion resistant, UL-50 approved, NEMA TS2 compliant, constructed of welded sheet aluminum type 5052-H32 with a minimum thickness of 0.125 inch. The aluminum shall be smooth and the exterior shall be left in its unpainted natural color. The cabinet structure shall be effectively sealed to prevent the entry of rain, dust, and dirt. All exterior seams for cabinet and doors shall be continuously welded.

   As a minimum, the following components and hardware should be included as part of the item “Complete” Signal Cabinet:
   - Minimum of eight Reno LS200, or equivalent, load switches
   - Two Flash Transfer Relays
   - One MMU (Reno 1600 GE, or approved equal, is preferred but Reno MMU1600, or approved equal, is acceptable)
   - Two Bus Interface Units
   - Two Mounting Shelves
   - TS2, 16 position Backpanel
   - One Heater on Thermostat
   - Two Fans on Thermostat
   - Two Lamps – one high, one low
   - Six SDLC Cables (accessible without requiring access to the back panel)
   - One Cabinet Power Supply
   - One Quad 120 V Outlet assembly
   - Lightning Suppression
   - 100 Amp Breaker System (A 100 Amp Main Circuit breaker with two breakers for traffic signal and roadway lighting shall be installed in the cabinets. The size of the roadway lighting breaker shall be coordinated with MidAmerican Energy Co. Sufficient space shall be provided to allow for a minimum of two future breaker installations)
   - EVP Input panel
   - 10/100 Ethernet Switch (See specification below)
   - Fiber Enclosure (See Specification below)
   - Anchor Bolts

2. Cabinet Doors

   The cabinet door shall be sturdy, torsionally rigid, and attached by a heavy gauge aluminum butt hinge utilizing a stainless steel hinge and carriage bolted in place for ease of door removal. The door shall substantially cover the full area of the front of the cabinet. The cabinet door shall be provided with a three position automatic door stop positioning mechanism.

   A closed-cell neoprene door gasket shall be provided to act as a permanent and weather resistant seal at the cabinet door facing. A dust filter suitable for the capacity of ventilation system shall be provided. Filters shall be dry type, easily removed and replaced, and of standard dimensions commercially available.

   A heavy-duty clear plastic envelope shall be provided, securely attached to the inside wall of the cabinet or cabinet door, for stowing cabinet wiring diagrams and equipment manuals. Minimum dimensions shall be 9 inches wide by 12 inches deep.

   Each cabinet door shall be provided with a high quality, heavy duty tumbler-type lock. Two keys for each tumbler lock shall be provided for each cabinet. All locks for the project shall be

keyed identically in the key pattern identified by the City of Sioux City. Keys shall be given to the City of Sioux City. Do not attach keys to the exterior of the cabinet at any time during storage or installation.

In addition to the main door of the controller cabinet, there shall be an auxiliary police door provided in the main door provided with a strong lock and two keys of different design than that of the main door of the cabinet. The panel behind the auxiliary police door shall contain a switch to change from normal function to flashing operation. The controller shall remain in full operation during flash operation. Provide a signal on-off switch to interrupt power to the signal heads only and continue controller operation.

3. Grounding

   The cabinet internal ground shall consist of one or more ground bus-bars permanently affixed to the cabinet and connected to the grounding electrode. Use bare stranded No. 6 AWG copper wire between bus-bars and between the bus-bar and grounding electrode. Each copper ground bus-bar shall have a minimum of 20 connector points. Each connector point shall be capable of securing at least one No. 10 AWG conductor. AC neutral and equipment ground wiring shall return to the bus-bars.

4. Fiber Enclosure

   Surface mount enclosure shall be intended for termination of outside plant (OSP) cables, cross-connect and/or interconnect installation. The enclosure shall be constructed with a hinged front door, be capable of terminating up to 24 ST and SC connectors, include cable entry protectors for incoming fiber, include fiber jumper bend limiters and include labels for identifying fiber splices and terminations. Surface mount enclosure shall be SYSTIMAX 200LS LIU, or approved equal, with Adapter Panel that Accepts 3 Duplex SC Adapters.

5. 10/100 Ethernet Switch

   Contractor shall supply 10/100 based Ethernet switches required for the communications of the Traffic Signal/ITS System. Field hardened NEMA TS-2 (traffic control equipment), fully managed network switches shall be installed within traffic signal cabinets. Field programming and certification of a working traffic signal control and communications system is not part of this specification. Ethernet switch specifications are as follows:
   - Din-rail mounting.
   - 120 VAC power supply.
   - Minimum of six copper based 10/100 Fast Ethernet ports.
   - Minimum of two singlemode, 10/100 fiber optic ports equipped with SC connectorized 10/100 singlemode fiber modules capable of transmission over a minimum distance of 2 km.
   - VLAN (802.1Q) capable.
   - Multicast routing capable.
   - Support IGMP Snooping.
   - Port Rate Limiting and Broadcast Storm Limiting support.
   - SNMP capable.
   - Browser based management interface.
   - Support Rapid Spanning Tree Protocol (802.1w)
   - Quality of Service (802.1p) capable.

   <u>Alternate</u>
   - Din-rail mounting.
   - 120 VAC power supply.
   - Minimum of eight copper based 10/100 Fast Ethernet ports.
   - Minimum of two pluggable singlemode, Gigabit fiber optic ports equipped with SC connectorized Gigabit singlemode fiber modules capable of transmission over a minimum

distance of 2 km.
- VLAN (802.1Q) capable.
- Multicast routing capable.
- Support IGMP Snooping.
- Port Rate Limiting and Broadcast Storm Limiting support.
- SNMP capable.
- Browser based management interface.
- Support Rapid Spanning Tree Protocol (802.1w).
- Quality of Service (802.1p) capable.

6. Electrical design

   a. The distribution of the 117 VAC throughout the cabinet shall not occur until the AC+ has first passed through the power protection devices.

   b. The cabinet shall be provided with power protection devices which include the main AC+ power circuit breakers, radio interference suppressors, and lighting and surge protectors. These devices shall be in addition to any protection devices furnished with the controller and auxiliary equipment. The protection devices shall be mounted on a panel that is securely fastened to an interior wall of the cabinet.

   c. The AC+ field service shall be connected directly to a circuit breaker. This circuit breaker shall be a single pole, nonadjustable, magnetic breaker rated for 117 VAC operation with a minimum rating as shown on the plans. It shall be equipped with a solderless connector suitable for terminating the power lead-in wire. The circuit breaker shall be capable of manual operation and shall be clearly marked to indicate "ON and "OFF" position

   d. Radio interference suppressors (RIS), adequate in number to handle the power requirements for the cabinet, shall be wired in series with and after the main AC+ circuit breaker. The RIS shall be designed to minimize interference in all broadcast, transmission and aircraft frequency bands.

   e. The controller cabinet shall be furnished with a lighting arrestor on the AC service. The surge suppressor shall be an SHP 300-10 manufactured by EDCO Inc., or approved equal which meets the following requirements:

      1) The unit must be capable of withstanding repeated 20,000 ampere surges (minimum of 25).

      2) The unit must have internal follow current limiters (resistive elements).

      3) The unit shall contain a minimum of three active clamping stages.

      4) The unit must self-extinguish within 8.3 milliseconds after trailing edge surge.

      5) Parallel impedance of limiters must be less than 15 ohms.

   f. External surge protection to the communications cables is required. The communications cable surge protector shall be an SRA-64C manufactured by EDCO, Inc. or approved equal which meets the following requirements:

      1) The unit must be a two-stage protector intended for use on data or communications pairs.

      2) The peak surge current for the unit shall be 10K amperes.

      3) The unit must be able to withstand at least one hundred 2000 ampere surges.

      4) The response time for the unit shall be less than 5 nanoseconds.

      5) The unit shall be epoxy encapsulated.

g. The controller shall contain a connector enabling outgoing and incoming electrical circuits to be connected or disconnected easily without the necessity of installing or removing individual wires. The connector may be a multiple pin jack, a spring connected mounting, or approved equivalent mounting. In the event of a power interruption, the controller shall be capable of automatic reorientation upon power resumption and shall require no manual initiation or switching.

h. Electrical connections from the controller and auxiliary devices to outgoing and incoming circuits shall be made in such a manner that the controller or auxiliary device can be replaced with a similar unit, without the necessity of disconnecting and reconnecting the individual wires. This may be accomplished by means of a multiple plug, a spring connected mounting, or approved equivalent arrangement.

i. All cabinet wiring shall be neatly trained throughout the cabinet and attached to the interior panels using nonconductive clamps and tie-wraps. Bundles of cables shall be laced or tied or enclosed in a sheathing material. The cabinet wiring shall not interfere with the entrance, training, or connection of the incoming or outgoing field conductors. Except where terminated by direct soldering, all wires shall be provided with terminal lugs for attachment to terminal blocks using screws. All wires shall be identified and labeled in accordance with the wiring prints. All wiring insulation shall have a minimum rating of 600 volts.

j. An AC+ convenience outlet with a three wire grounding type receptacle shall be provided and easily accessible. This receptacle and the incandescent lamp shall be separately fused from the main AC+ circuit breaker. The outlet shall be provided with ground fault protection.

k. The cabinet shall be furnished with two incandescent lamps. One lamp shall have a goose neck assembly. The lamp shall be equipped with a 25 Watt, R14 bulb. The second lamp receptacle shall be mounted on the interior wall of the cabinet and shall accommodate a standard base light bulb. These lamps shall be controlled by manual switches mounted on the maintenance panel. The lamps shall be fused and connected with the convenience outlet as referenced above.

l. The cabinet duct fan unit shall be fused separately and after the main AC+ circuit breaker.

m. Molded composition barrier type terminal blocks shall be used for termination of the incoming and outgoing signals within the cabinet assembly. Each terminal block shall be of one-piece construction with a minimum of twelve terminals. Each terminal shall have a threaded contact plate with a binder head screw. The terminal blocks shall have minimum rating of 600 volts. All terminals shall be identified and labeled in accordance with the cabinet wiring diagram. The terminal block facilities shall be arranged in function groupings and mounted to either panels or brackets fastened to the interior wall of the cabinet. Each terminal block shall be retained using either machine or self tapping screws and shall be easily removed and replaced. The minimum terminals are as follows:

    1) Terminal with circuit breaker with integral power line switch for the incoming power line.

    2) Terminal un-fused for the neutral side of the incoming power line.

    3) Terminals and bases for each vehicle and pedestrian signal circuit. The terminals for the vehicle and pedestrian signal circuits shall be provided with lug type connectors.

    4) Terminals for vehicle phase detector and pedestrian pushbutton cables. Terminals for vehicle detectors include AC+, AC neutral, relay common, relay closure, and the loops or probes from the field.

5) Terminals and bases for signal flasher and outgoing signal field circuits.

6) Terminals for all controller input and output circuits including those circuits not used on the project.

7) Terminals for all required auxiliary equipment.

n. Adequate electrical clearance shall be provided between terminals. The controller, auxiliary equipment, panel(s), terminals and other accessories shall be so arranged within the cabinet that they will facilitate the entrance and connection of incoming conductors.

o. The outgoing signal circuits shall be of the same polarity as the line (+) side of the power service. The incoming signal indication conductors shall be common and of the same polarity as the grounded (-) side of the power service. The neutral (-) side of the power service shall be connected to the cabinet in an approved manner to a copper ground bus located on the panel with the main AC+ circuit breaker. The cabinet shall, in turn, be connected to an earth ground through a ground rod.

7. Documentation

a. Complete system documentation shall be provided. Such documentation shall as a minimum consist of:

1) Three complete operations manuals for each controller and associated signal equipment including equipment wiring diagrams, schematics, and parts list sufficient for ordering any parts.

2) Three sets of cabinet wiring diagrams. The corresponding phase numbers for each movement shall be indicated on the intersection layout diagram on the cabinet wiring diagram.

b. The controllers shall be provided with the most current software and documentation.

8. Warranty

The cabinets, Ethernet switches, cabinet accessory equipment, and all other material supplied under this bid shall be warranted by the manufacturer against mechanical and electrical defects for a period of 18 months from date of shipment or 12 months from date of installation. The manufacturer's warranty shall be supplied in writing with each cabinet and controller. Any defects shall be corrected by the manufacturer or supplier at no cost to the Contracting Authority.

D. Video Detection System

1. General

This specification sets forth the minimum requirements for a system that monitors vehicles on a roadway via processing of video images. The detection of vehicles passing through the field-of-view of an image sensor shall be made available to a large variety of end user applications as simple contact closure outputs that reflect the current real-time detector or alarm states (on/off) or as summary traffic statistics that are reported locally or remotely. The contact closure outputs shall be provided to a traffic signal controller and comply with the National Electrical Manufacturers Association (NEMA) type C or D detector rack or 170 input file rack standards.

The system architecture shall fully support Ethernet networking of system components through a variety of industry standard and commercially available infrastructures that are used in the traffic industry. The data communications shall support direct connect, [modem,] and multi-drop interconnects. Simple, standard Ethernet wiring shall be supported to minimize overall system cost and improve reliability, utilizing existing infrastructure and ease

of system installation and maintenance. Both streaming video and data communications shall optionally be interconnected over long distances through fiber optic, microwave, or other commonly used digital communications transport configurations.

On the software application side of the network, the system shall be integrated through a client-server relationship. A communications server application shall provide the data communications interface between as few as one to as many as hundreds of Machine Vision Processor (MVP) sensors and a number of client applications. The client applications shall either be hosted on the same PC as the communications server or may be distributed over a local area network of PC's using the industry standard TCP/IP network protocol. Multiple client applications shall execute simultaneously on the same host or multiple hosts, depending on the network configuration. Additionally, a web-browser interface shall allow use of industry standard Internet web browsers to connect to MVP sensors for setup, maintenance, and playing digital streaming video.

2. System Hardware

The machine vision system hardware shall consist of three components: 1) a color, 22x zoom, MVP sensor 2) a modular cabinet interface unit 3) a communication interface panel. Additionally, a laptop computer shall host the server and client applications that are used to program and monitor the system components. The real-time performance shall be observed by viewing the video output from the sensor with overlaid flashing detectors to indicate the current detection state (on/off). The MVP sensor shall optionally store cumulative traffic statistics internally in non-volatile memory for later retrieval and analysis.

The MVP shall communicate to the modular cabinet interface unit via the communications interface panel and the software applications using the industry standard TCP/IP network protocol. The MVP shall have a built-in, Ethernet-ready, Internet Protocol (IP) address and shall be addressable with no plug in devices or converters required. The MVP shall provide standard MPEG-4 streaming digital video. Achievable frame rates shall vary from 5 to 30 frames/sec as a function of video quality and available bandwidth.

The modular cabinet interface unit shall communicate directly with up to eight MVP sensors and shall comply with the form factor and electrical characteristics to plug directly into a NEMA type C or D detector rack providing up to 32 inputs and 64 outputs or a 170 input file rack providing up to 16 contact closure inputs and 24 contact closure outputs to a traffic signal controller.

The communication interface panel shall provide four sets of three electrical terminations for three-wire power cables for up to eight MVP sensors that may be mounted on a pole or mast arm with a traffic signal cabinet or junction box. The communication interface panel shall provide high-energy transient protection to electrically protect the modular cabinet interface unit and connected MVP sensors. The communications interface panel shall provide single-point Ethernet connectivity via RJ45 connector for communication to and between the modular cabinet interface module and the MVP sensors.

A laptop is to be provided to program the detection zones based on the following specifications: Intel Core 2 Duo Processor 2.4GHz, 4GB DDR2, 320GB SATA HDD, three USB ports, built-in Ethernet, wireless and graphics accelerator, 15 inch LED display, DC-RW/DVD (8x min.) DC-ROM, Windows 7 Professional operating system and a 2 year parts and labor warranty.

3. System Software

The MVP sensor embedded software shall incorporate multiple applications that perform a variety of diagnostic, installation, fault tolerant operations, data communications, digital video streaming, and vehicle detection processing. The detection shall be reliable, consistent, and perform under all weather, lighting, and traffic congestion levels. An embedded web server shall permit standard internet browsers to connect and perform basic configuration,

maintenance, and video streaming services.

There shall be a suite of client applications that reside on the host client / server PC. The applications shall execute under Microsoft Windows XP or Vista. Available client applications shall include:

- Master network browser: Learn a network of connected modular cabinet interface units and MVP sensors, display basic information, and launch applications software to perform operations within that system of sensors.
- Configuration setup: Create and modify detector configurations to be executed on the MVP sensor and the modular cabinet interface unit.
- Operation log: Retrieve, display, and save field hardware run-time operation logs of special events that have occurred.
- Software install: Reconfigure one or more MVP sensors with a newer release of embedded system software.
- Streaming video player: Play and record streaming video with flashing detector overlay.
- Data retrieval: Fetch once or poll for traffic data and alarms and store on PC storage media.
- Communications server: Provide fault-tolerant, real-time TCP/IP communications to / from all devices and client applications with full logging capability for systems integration.

4. Functional Capabilities

   a. MVP Sensor

      The MVP sensor shall be an integrated imaging color CCD array with zoom lens optics, high-speed, dual-core image processing hardware bundled into a sealed enclosure. The CCD array shall be directly controlled by the dual-core processor, thus providing high-quality video for detection that has virtually no noise to degrade detection performance. It shall be possible to zoom the lens as required for setup and operation. It shall provide JPEG video compression as well as standard MPEG-4 digital streaming video with flashing detector overlay. The MVP shall provide direct real-time iris and shutter speed control. The MVP image sensor shall be equipped with an integrated 22x zoom lens that can be changed using either configuration computer software. The digital streaming video output and all data communications shall be transmitted over the three-wire power cable.

      1) Power

         The MVP sensor shall operate on 110/220 VAC, 50/60Hz at a maximum of 25 watts. The camera and processor electronics shall consume a maximum of 10 watts and the remaining 15 watts shall support an enclosure heater.

      2) Detection Zone Programming

         Placement of detection zones shall be by means of a PC with a Windows XP or Vista operating system, a keyboard, and a mouse. The PC monitor shall be able to show the detection zones superimposed on images of traffic scenes.

         The detection zones shall be created by using a mouse to draw detection zones on the PC monitor. Using the mouse and keyboard it shall be possible to place, size, and orient detection zones to provide optimal road coverage for vehicle detection. It shall be possible to download detector configurations from the PC to the MVP sensor and cabinet interface module, to retrieve the detector configuration that is currently running in the MVP sensor, and to back up detector configurations by saving them to the PC fixed disks or other removable storage media.

         The supervisor computer's mouse and keyboard shall be used to edit previously defined detector configurations to permit adjustment of the detection zone size and placement, to add detectors for additional traffic applications, or to reprogram the MVP sensor for different traffic applications or changes in installation site geometry or

traffic rerouting.

3) Optimal Detection

The video detection system shall optimally detect vehicle passage and presence when the MVP sensor is mounted 30 feet or higher above the roadway, when the image sensor is adjacent to the desired coverage area, and when the distance to the farthest detection zone locations are not greater than ten times the mounting height of the MVP.

The recommended deployment geometry for optimal detection also requires that there be an unobstructed view of each traveled lane where detection is required. Although optimal detection may be obtained when the MVP is mounted directly above the traveled lanes, the MVP shall not be required to be directly over the roadway. The MVP shall be able to view either approaching or receding traffic or both in the same field of view. The preferred MVP sensor orientation shall be to view approaching traffic since there are more high contrast features on vehicles as viewed from the front rather than the rear. The MVP sensor placed at a mounting height that minimizes vehicle image occlusion shall be able to simultaneously monitor a maximum of six traffic lanes when mounted at the road-side or up to eight traffic lanes when mounted in the center with four lanes on each side.

b. Modular Cabinet Interface Unit

The modular cabinet interface unit shall provide the hardware and software means for up to eight MVP sensors to communicate real-time detection states and alarms to a local traffic signal controller. It shall comply with the electrical and protocol specifications of the detector rack standards. The card shall have 1500 Vrms isolation between rack logic ground and street wiring. The modular cabinet interface unit shall be a simple interface card that plugs directly into a

170 input file rack or a NEMA type C or D detector rack. The modular cabinet interface unit shall occupy only two slots of the detector rack. The modular cabinet interface unit shall accept up to16 phase inputs and shall provide up to 24 detector outputs.

c. Communications Interface Panel

The communications interface panel shall support up to eight MVPs. The communications interface panel shall accept 110/220 VAC, 50/60 Hz power and provide predefined wire termination blocks for MVP power connections, a Broadband-over-Power-Line (BPL) transceiver to support up to 10MB/s interdevice communications, electrical surge protectors to isolate the modular cabinet interface unit and MVP sensors, and an interface connector to cable directly to the modular cabinet interface unit.

The interface panel shall provide power for up to eight MVP sensors, taking local line voltage 110/220 VAC, 50/60 Hz and producing 110/220 VAC, 50/60 Hz, at about 30 watts to each MVP sensor. Two 1/2 amp SLO-BLO fuses shall protect the communications interface panel.

5. System Installation and Training

The supplier of the video detection system may supervise the installation and testing of the video detection system and computer equipment as required by the contracting agency.

Training is available to personnel of the contracting agency in the operation, set up, and maintenance of the video detection system. The MVP sensor and its support hardware / software is a sophisticated leading-edge technology system. Proper instruction from certified instructors is recommended to ensure that the end user has complete competency in system operation. The User's Guide is not an adequate substitute for practical classroom training and formal certification by an approved agency.

6. Warranty, Service, and Support

   For a minimum of 2 years, the supplier shall warrant the video detection system. An option for additional year(s) warranty for up to 5 years shall be available. Ongoing software support by the supplier shall include software updates of the MVP sensor, modular cabinet interface unit, and supervisor computer applications. These updates shall be provided free of charge during the warranty period. The supplier shall maintain a program for technical support and software updates following expiration of the warranty period. This program shall be available to the contracting agency in the form of a separate agreement for continuing support.

7. Guarantee

   a. The equipment furnished under this specification shall be new, of the latest model, fabricated in a first-class quality manner from good quality material.

   b. The entire controller unit shall be warranted to be free from defects in work quality and materials for a minimum of one year from date of acceptance. Any parts found to be defective shall, upon concurrence of the defect by the manufacturer, be replaced free of charge.

   c. The Contracting Authority shall be furnished with a certification from the equipment manufacturer stating that the equipment furnished under this specification complies with all provisions of this specification. If there are any items that do not comply with this specification, then a list of those exceptions must be detailed on the certification.

8. Emergency Vehicle Traffic Signal Priority Control System

   The Contractor shall install the emergency vehicle traffic signal priority control system units to identify the presence of designated priority or probe vehicles. In priority vehicle mode, the data-encoded communication will request the traffic signal controller to advance to and/or hold a desired traffic signal display selected from phases normally available. In probe vehicle mode, no traffic signal priority is requested – only a record of the probe vehicle's presence is generated.

   The required priority control, data-encoded, infrared communications system will be comprised of five basic matched components: data-encoded emitter, infrared detector, detector cable, phase selector and system software .To ensure system integrity, operation and compatibility, all components will be from the same manufacturer. Contractor shall install the Global Traffic Technologies Opticom brand emergency vehicle traffic signal priority control system, (Preempt System) in all traffic signal systems.

   Emergency vehicle traffic signal detector systems shall consist of a receiver and associated wire components. The receivers shall be mounted at or near the intersections to be controlled.

   a. Opticom Detection

      Each optical detection / discriminator assembly shall consist of one or more detectors, connecting cable and a discriminator module. Each such assembly when used with standard emitters shall have a range of at least 1800 feet. Standard emitters for both classes of signals shall be available from the manufacturer of the system.

      The emergency vehicle preemption (EVPE) detector shall be mounted on the mast arm using an astro bracket with threaded nipples and lock washers.

      The emergency vehicle preemption (EVPE) detector cable shall be a Global Traffic Technologies Opticom detector cable, Model 738 (or approved equal).

      Field terminal T-9 in the cabinet shall be fully configured for proper preemption operation.

      All internal circuitry shall be solid-state and electric power shall be provided by the

respective discriminator module.

b. Optical Detector

Each optical detector, Model 722, shall be a weatherproof unit capable of being easily mounted on a mast arm. The housing shall have at least one opening threaded for 3/4 inch conduit, through which all wiring shall enter. Each detector shall weigh not more than 2 pounds and shall present a maximum wind load area of 36 square inches. Each detector shall be capable of receiving optical energy from either one of both of two axially opposed directions. The reception angle shall be a maximum of ± 6 degrees (12 degrees total included angle) measured in the horizontal plane about the center axis of the light-sensing element. The reception angle in the vertical plane measured about the center axis of the light-sensing element shall be a maximum of 4 degrees above and 8 degrees below that center axis. Measurements are to be taken with emitter assembly at near maximum range.

c. Phase Selector

The phase selector, Model 764, designed to be installed in the traffic controller cabinet, will accommodate data-encoded signals and is intended for use directly with numerous controllers. These include California/New York Type 170 controllers with compatible software, NEMA controllers, or other controllers along with the system card rack and suitable system interface equipment and controller software.

The phase selector will be a plug-in, two or four channel, multiple-priority device intended to be installed directly into a card rack located within the controller cabinet.

The phase selector will be powered from 115 volt (89 volts AC to 135 volts AC), 60Hz mains and will contain an internal, regulated power supply that supports up to twelve infrared detectors. The phase selector may also operate on 24 VDC.

The phase selector will have the capability of storing up to 10,000 of the most recent priority control calls, probe frequency passages, or unauthorized vehicle occurrences. When the log is full, the phase selector will drop the oldest entry to accommodate the new entry. The phase selector will store the record in non-volatile memory and will retain the record if power terminates.

All equipment and cabling necessary for the operation of the Preempt System shall be supplied and installed by the contractor to Global Traffic Technologies specifications.

Software configuration and system testing of the Preempt System shall be completed by the City Traffic Division personnel.

4.03 VEHICULAR SIGNAL HEADS

A. General

1. This section of the specifications describes the minimum acceptable design and operating requirements for vehicular signal heads with 12 inch diameter lens openings, including all fittings and brackets as shown on the plans.

2. All components of the vehicular signal heads furnished under this specification shall comply with the latest version of the Institute of Transportation Engineers (ITE) Standard(s) for Adjustable Face Vehicle Traffic Control Signal Heads.

B. Signal Head Assembly

1. The housing for the individual signal sections shall be made of a durable polycarbonate. It shall be clean, smooth and free from flaws, cracks, blowholes, and other imperfections. It shall be designed as a self-contained unit capable of separate mounting or inclusion in a signal face containing two or more signal sections rigidly and securely fastened together. It

shall be equipped with openings and positive locking devices in the top and bottom so that it may be rotated between waterproof supporting brackets capable of being directed and secured at any angle in the horizontal plane. Doors and lenses shall be provided with suitable watertight gaskets and doors shall be suitably hinged and held securely to the body of the housing by simple locking devices of non-corrosive material.

2. The optical system shall be so designed as to prevent any objectionable reflection of sunrays even at times of the day when the sun may shine directly into the lens.

3. Lenses shall be 12 inches in diameter as specified on the plans. Lenses shall be glass. Red, yellow, and green LED lenses shall be used in all signal heads. LED lenses shall meet the following ITE specification: Vehicle Traffic Control Signal Heads – Part 2: Light Emitting Diode (LED) Vehicle Traffic Control Signal Modules, An Interim Purchase Specification of the Institute of Transportation Engineers.

4. The visors for each signal section shall be durable polycarbonate not less than 0.10 inches in thickness. It shall be designed to fit tightly against the door, and shall not permit any perceptible filtration of light between it and the housing door. Visors shall be of the tunnel-type at least 8 inches long for all 12 inch rectangular pedestrian signals, at least 9 1/2 inches long for 12 inch diameter signals, shall angle slightly downward, and shall be of the type specified on the plans.

5. The reflector holder shall be designed to separately support the reflector and socket in proper relation to the lens. The reflector holder shall either be hinged to the left-hand side of the signal body when viewed from the front with the right-hand side held in place by a spring catch or other quickly releasable means, or the reflector shall be mounted in a manner that does not require it to be removed from its normal position during bulb replacement. Both the hinge device and the spring catch, or equivalent, shall be of a flexible nature which will permit the reflector holder to be pushed inwardly for at least 1/16 inch and to align itself correctly with the lens when the door of the optical unit is closed and pressed against the rim of the reflector holder. By such means, the joint between the reflector holder and the lens shall be rendered dust-tight. It shall not be necessary to remove any screws or nuts in order to swing the reflector holder out of the body section to obtain access to the light socket. The reflector shall be alzak treated aluminum or polycarbonate. Glass is not acceptable. The reflector assembly shall be interchangeable and shall be designed so that it can be easily removed without the use of tools. When polycarbonate reflectors are furnished, gaskets shall be fabricated of silicone material.

6. The lamp receptacle shall be of the fixed focus type, positioning the lamp filament at the correct focal point in respect to the reflector. The assembly shall be designed so that the lamp socket can be rotated through 360 degrees and eight positions of adjustment for proper positioning of the lamp filament after relamping the signal. The lamp socket shall be equipped with color-coded wire, either 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 designed to withstand 105°C. The wiring leads shall be terminated with spade lugs for ease of connection to the terminal block. The socket shall be equipped with a gasket to insure a dust-tight fit between the socket and reflector.

C. Optically Programmable Signal Heads

The intent of this specification is to describe a 12 inch adjustable programmable limiting traffic signal head which shall permit the visibility zone of the indication to be determined optically. The head shall employ no louvers or hoods to obtain this programmable limitation, however, if required, hoods shall be provided to eliminate extraneous light falling on the lens. The project indication may be selectively visible or veiled anywhere within 15 degrees of the optical axis.

D. Specialized Options

1. One section of each 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.

2. The color of all polycarbonate signal heads shall be black in their entirety. The color shall be an integral part of the materials composition.

3. Signal mounting hardware for side of pole mounted signals shall consist of galvanized steel or aluminum 1 1/2 inch pipe and appropriate fittings. Banding brackets shall be aluminum.

4. Mast arm signal head assemblies shall be rigid mounted utilizing a suitable assembly consisting of both top and bottom brackets and easily adjustable in both horizontal and vertical planes. Mast arm brackets shall be aluminum.

5. 5 inch backplates shall be furnished and attached to the signal faces to provide a dark background for signal indications mounted to the mast arms of the signal poles. Backplates shall be construction of one-piece durable black plastic capable of withstanding a 100 mph wind.

E. Miscellaneous Requirements

1. The signal heads shall be constructed of the highest quality materials. High-grade quality of work 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.

F. Certification

1. The Contracting Authority shall be furnished with a certification from the manufacturer of the signal head that the equipment furnished under this specification complies with all provisions of this specification. If there are any items that do not comply with this specification, a list of those exceptions must be detailed on the certification.

4.04 PEDESTRIAN SIGNAL HEADS

The pedestrian signal head shall comply with the latest version of the Institute of Transportation Engineers Standards on Pedestrian Traffic Control Signal Indications and the MUTCD. The pedestrian signal head shall be one 18 inch section with side-by-side indications as shown on the plans. Combination hand/person pedestrian signal modules shall incorporate separate power supplies for the hand and the person icons. The pedestrian signal head shall be the Dialight Countdown Pedestrian Signal or an equivalent signal approved by the City Traffic Engineer

A. The signal heads shall use the international symbols (walking person and raised hand).

B. Lenses shall be polycarbonate; glass lenses are not acceptable.

C. All pedestrian signal indications shall be LED. The “walking person” symbol and “raised hand” symbol shall be Dialight LED display or approved equal. All LED signal indications shall meet ITE specifications for signal color and intensity.

D. The “walking person” symbol shall be Portland orange and the “walking person” symbol shall be lunar white.

E. The color of all polycarbonate signal heads, except door fronts and inside and outside of visors, shall be federal yellow. Door fronts and inside and outside of visors shall be black in their entirety. The color shall be an integral part of the materials composition.

F. Pedestrian signal mounting hardware shall consist of 1 1/2 inch diameter polycarbonate with appropriate fittings and shall be federal yellow. Pedestrian signals shall be secured to pole by using a minimum 5/8 inch wide stainless steel band.

G. The pedestrian signal head shall include polycarbonate visors for each section. Visors shall be a minimum of 9 inches long.

H. The one-section pedestrian head shall include a 1 1/2 inch deep egg crate or Z-crate screen of polycarbonate.

4.05 PEDESTRIAN PUSH BUTTONS

A. The pedestrian push button shall be pressure activated, with no moving parts. The pedestrian push button shall provide audible and visual feedback of actuation. The feedback indications shall be powered by the existing switch wires.

B. Construction

The push button body shall be constructed of aluminum with a yellow powder coated finish. The button material shall be stainless steel.

C. Solid State Switch The push button shall be equipped with a solid state switch with these characteristics:

- Operating force no greater than 3 pounds
- Operating temperature shall be -30°F to 165°F
- Operating voltage shall be 15-36V DC or 12-28V AC
- On resistance shall be 10Ω typical
- Operating life shall be greater than 100 million operations
- Switch hold time shall be 6 seconds minimum
- Operating Standby Current shall be 10μA typical (equivalent to 2MΩat
- 20V)

D. LED.

The LED indicator shall display an approx. 0.025 second red flash each time the button is pressed, with a luminous intensity of greater than 1200 mcd, and a viewing angle of 160 degrees or greater.

E. Beeper.

The beeper shall sound simultaneously with the LED flash. The beeper shall emit separate tones for press and release.

F. Sign.

An MUTCD R10-4A sign shall be provided and installed by the contractor.

4.05 STREET LIGHT LUMINAIRES

A. General

1. For luminaire information (type and quantity) see P sheets in the project plans.

4.07 TRAFFIC SIGNAL POLES

A. General

1. This section of the Special Provisions describes minimum acceptable design, material, and fabrication requirements for traffic signal poles.

2. The traffic signal mast arm and pole assemblies shall be designed to support the number of signal heads (use weight and projected areas of polycarbonate signal heads) and aluminum signs as shown on the plans. The mast arm and pole assemblies shall be designed to support a minimum of two signal heads.

3. The mast arm and support poles shall be continuous tapered, round, steel poles of the anchor base type as shown on the plans. The poles shall be fabricated from low carbon (maximum carbon 0.30%) steel of U.S. Standard gauge.

After manufactured, they shall have a minimum yield strength of 48,000 PSI. The base and flange plates shall be of structural steel conforming to AASHTO M183 (ASTM A36) and cast steel conforming to ASTM A27, Grade 65-35 or better.

It may be permissible to fabricate poles and mast arms by welding two sections together. The method used for connecting the sections shall result in a smooth joint and shall be factory welded as follows:

a. All longitudinal butt welds, except within one foot of a transverse butt-welded joint, shall have a minimum 60% penetration for plates 3/8 inch and less in thickness, and a minimum of 80% penetration for plates over 3/8 inch in thickness.

b. All longitudinal butt welds on poles and arms within one foot of a transverse butt-welded joint shall have 100% penetration.

c. All transverse butt welds for connecting sections shall have 100% penetration achieved by back-up ring or bar.

4. Pole manufacturers shall certify that only certified welding operators in accordance with AWS D1.1-80 were used and only electrodes as modified by AASHTO 1981 Standard Specifications for Welding of Structural Steel for Highway Bridges were used.

B. Mast Arm

1. The mast arm shall be designed to support traffic signals and/or signs as shown on the plans and indicated in these Special Provisions. They shall be certified by the fabricator that the mast arms are capable of withstanding winds up to 80 mph with a 1.3 gust factor without failure. The mast arms shall be galvanized inside and out in accordance with ASTM 123, latest revision.

C. Poles

1. The pole shall be designed to support the traffic signals and/or signs as shown on the plans. The pole shall be galvanized inside and out in accordance with the requirements of ASTM A123, latest revision. The pole shall be equipped with a minimum 8 inch by 12 inch handhole and cover located in the transformer base of the pole. Securing of the cover to the base shall be done with the use of simple tools. All hardware shall be corrosion resistant.

   Each mast arm pole shall be manufactured with a handhole opposite of the mast arm mounting plate for access to the mast arm.

D. Traffic Signal Pedestrian Poles

1. Materials

   a. Pedestal

      The height from the bottom of the base to the top of the shaft as specified in the contract documents.

   b. Pedestal Shaft

      Schedule 80 with satin brush or spun finish aluminum tubing. Top of the shaft outer diameter to be 4 1/2 inches and provided with a pole cap. Supply base collar for poles with shaft lengths greater than 10 feet.

   c. Pedestal Base

      Cast aluminum, square in shape, with a handhole.

      1) Handhole

Minimum of 6 inches and equipped with a cast aluminum cover that can be securely fastened to the base with the use of simple tools.

2) Base

Minimum weight of 20 pounds with a four bolt pattern uniformly spaced on a 12 1/2 inch diameter bolt circle. Meet or exceed AASHTO breakaway requirements.

2. Anchor Bolts

Four 3/4 inch by 15 inch steel, hot dip galvanized anchor bolts with right angle bend at the bottom end, complete with all hardware required for installation.

E. Combination Pole

1. Where a combination street lighting/signal pole is specified on the plans, the above applies with the luminaire arm to be mounted in the same vertical plane as the signal arm unless otherwise indicated on the plans or by the Engineer.

2. The luminaire arm shall be of the single member tapered type.

3. The luminaire arm shall provide the spread as shown on the plans and a rise sufficient to provide for a nominal mounting height of 35 feet when attached to the pole.

F. Galvanizing/Powder Coating

1. The poles, mast arms, luminaire arms, and transformer bases be galvanized inside and out in accordance with ASTM A123, latest revision, with the following additional requirements.

a. All hot-dipped galvanized components to be powder-coated shall not receive a water quench or chromate quench.

b. All drainage spikes and surface defects shall be removed.

c. Galvanized components shall not be left outside or allowed to get wet.

d. Galvanized components shall not be transported uncovered.

2. Surface Preparation

a. If contamination of the galvanizing has occurred or is suspected, the galvanizing shall be cleaned with a proprietary solvent/detergent designed for pre-cleaning and completely rinsed off prior to powder-coating. Solvents should only be applied with lint-free rags or soft-bristled nylon brushes. Once rinsed, the components shall be allowed to completely air-dry.

b. If ash residue from galvanizing is present, it should be removed using a solution of one to two percent ammonia. Apply the ammonia solution with a nylon brush, rinse thoroughly with hot water and allow to dry completely.

c. After the poles and arms are galvanized and all contamination, ash residue, etc. is cleaned off, their exterior surfaces shall receive a brushoff blast. The abrasive shall be Aluminum/Magnesium silicate with a particle size between 8-20 mils. Other natural media with a Mohs hardness of no more than five can also be used (corncobs, walnut shells, corundum, limestone, and mineral sands).

d. Brush-Off blasting should occur only when ambient temperature is 70°F or greater, with no more than 50% relative humidity.

e. If more than 1.5 mil of galvanizing is removed during brushoff blasting, the galvanized component shall be rejected.

3. Powder Coating

   To insure quality control, the manufacturer of the poles and mast arms is to perform the powder coating process.

   Exterior surface to traffic signal poles, mast arms, luminaire arms, and transformer bases are to be coated with a urethane or triglycidyl isocyanurate (TGIC) polyester powder of a DEGASSING GRADE ONLY to a minimum dry film thickness of 2 mils. Interior surfaces of the base end of traffic signal and pedestrian poles are to be mechanically cleaned and coated with a zinc rich epoxy power to a minimum depth of 2 feet.

   All galvanized components to be powder coated shall be preheated in an oven to the temperature recommended by the manufacturer of the powder coat to assist in avoidance of pinholing during powder cure.

   The coatings are to be electrostatically applied and cured in a gas fired convection oven by heating the coated components to a specified temperature and holding that temperature for a duration of time as recommended by the manufacturer of the powder coat (see Product Data sheet for powder coat) to ensure sufficient stoving time to meet during specifications of the powder.

   The inspector shall check for correct cure by solvent testing.

   The finish coating for exterior surfaces is to be colored black in accordance with RAL 9005, unless another finish color has been specified in the plans.

4. Packaging and Shipment For protection of the powder coated finish during shipping, poles, mast arms, luminaire arms and transformer bases are to be wrapped with a 3/16 inch ultra-violet inhibited plastic backed foam envelope with a built-in mechanism for easy removal of the wrap. In addition, traffic signal poles are to be cradled in a 1 inch thick rubberized foam base.

5. Warranty

   Powder coating is to provide corrosion protection and abrasion resistance of the steel substrate for a minimum of 10 years.

G. Hardware

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

2. The anchor bolts shall meet the requirements of ASTM A36 or better.

3. The anchor bolts shall be hot dipped galvanized in their entirety.

4. The anchor bolts shall be threaded a minimum of six inches at one end and have a minimum four inch long, 90 degree bend at the other end.

H. Shop Drawings

1. All traffic signal poles shall be detailed on shop drawings by the manufacturer indicating pole and arm dimensions and attachment method along with signal weight, projected areas, and type of mounting that it is designed to accommodate.

I. Certifications

1. The fabricator shall certify that the mast arms are capable of withstanding winds up to 80 mph with a 1.3 gust factor without failure; that only certified welding operators in accordance with AWS D1.1-80 or latest revisions were used; and that only electrodes as modified by AASHTO 1981 Standard Specifications for Welding of Structural Steel for Highway Bridges

were used.

4.08 TRAFFIC SIGNS

A. Traffic signs shall conform to the requirements of Section 4186 of the Standard Specifications.

B. Traffic signs shall be mounted on the mast arms utilizing a universally adjustable mast arm mounted sign bracket.

C. The Contractor shall furnish and install all regulatory and street name signs as per project plans. The signs shall meet current MUTCD specifications.

	TRAFFIC SIGNALIZATION				
No.	Description	QUANT.	UNIT	Unit Price	Unit Extension
1	Solid State Controller with Cabinet, Accessories	5	Each	$	$
2	Video Detection System	5	Each	$	$
3	Emergency Vehicle Preemption System	5	Each	$	$
4	Pedestrian Pushbutton with R10-4A sign	22	Each	$	$
5	Pedestrian Signal Head-18 in Hand-Walking Person Symbol; Countdown	22	Each	$	$
6	Traffic Signal Head-12 in R,Y,G,<Y,<G; w/ Backplate	2	Each	$	$
7	Traffic Signal Head-12 in <R,<Y,<G; w/ Backplate	5	Each	$	$
8	Traffic Signal Head-12 in R,Y,G; w/ Backplate	31	Each	$	$
9	Traffic Signal Head-12 in R,Y,G; No Backplate	10	Each	$	$
10	Traffic Signal Head-12 in R,Y,G,Y>,G>; No Backplate	2	Each	$	$
11	Traffic Signal Head-12 in R,Y,G,Y>,G>; w/ Backplate	2	Each	$	$
12	Handhole - Type III	24	Each	$	$
13	Cable-1c, #6 AWG, Power Lead-In	420	Feet	$	$
14	Cable-20c, #14 AWG, Signal Circuits	4,333	Feet	$	$
15	Cable-5c, #14 AWG, Signal Circuits	1,759	Feet	$	$
16	Cable-2c (PB)	3,743	Feet	$	$
17	Cable-Preempt Wire (per manufacturer)	889	Feet	$	$
18	Cable-Video Detection, (Coax - per manufacturer)	1,894	Feet	$	$
19	Cable-Video Power, (CAM - per manufacturer)	1,894	Feet	$	$
20	Cable, Fiber Optic - 12 Singlemode	204	Feet	$	$
21	Cable, Fiber Optic - 96 Singlemode	737	Feet	$	$
22	Cable, Fiber Optic - 144 Singlemode	4,043	Feet	$	$
23	Cable-1c, #6 AWG, Bare Copper Wire for Ground Circuits	6,078	Feet	$	$
24	Cable-1c, #8, for Street Lighting	2,950	Feet	$	$
25	Cable-1c, #10 AWG, Tracer Wire	6,078	Feet	$	$
26	Pull Rope	2,066	Feet	$	$
27	Conduit-2 in PVC (HDPE)	706	Feet	$	$
28	Conduit-2 in Rigid Metal	1,431	Feet	$	$
29	Conduit-3 in PVC (HDPE)	601	Feet	$	$
30	Conduit-3 in Rigid Metal	2,010	Feet	$	$
31	Conduit-4 in PVC (HDPE)	110	Feet	$	$
32	Concrete Base-Controller	5	Each	$	$
33	Concrete Base-Pedestal Pole 2 ft Dia. X 3 ft	6	Each	$	$
34	Concrete Base-3 ft Dia. X 10 ft	11	Each	$	$
35	Concrete Base-3 ft Dia. X 16 ft	1	Each	$	$
36	Concrete Base-3.5 ft Dia. X 21 ft	3	Each	$	$
37	Concrete Base-3.5 ft Dia. X 23 ft	1	Each	$	$
38	Pedestal Pole-10 ft	6	Each	$	$
39	Mastarm Pole-25 ft Mastarm Length	2	Each	$	$
40	Mastarm Pole-35 ft Mastarm Length	1	Each	$	$
41	Mastarm Pole-40 ft Mastarm Length	1	Each	$	$
42	Combo Pole-0 ft Mastarm Length	2	Each	$	$
43	Combo Pole-30 ft Mastarm Length	3	Each	$	$
44	Combo Pole-35 ft Mastarm Length	2	Each	$	$
45	Combo Pole-60 ft Mastarm Length	1	Each	$	$
46	Combo Pole-65 ft Mastarm Length	2	Each	$	$
47	Combo Pole-70 ft Mastarm Length	1	Each	$	$
48	Combo Pole-75 ft Mastarm Length	1	Each	$	$
49	Type A Sign; Mastarm Mounted	22	Each	$	$
50	Street Name Sign; Mastarm Mounted	15	Each	$	$
				Sub-Total	$
			TOTAL LUMP SUM TRAFFIC SIGNALIZATION =		$