



**SPECIAL PROVISIONS  
FOR  
TRAFFIC SIGNALIZATION**

**Woodbury County  
STP-U-7057(701)--70-97  
BHM-7057(692)--8K-97**

**Effective Date  
November 20, 2018**

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

**153011.01 GENERAL**

A. 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.

B. 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 that are either directly or by reference included herewith to result in a complete and finished job.

**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 electronically submit to the Engineer for review 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

Electronic copies of shop drawings shall be furnished for steel mast arm poles to be furnished on the Project. Electronic 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 electronic 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 of 2015, Iowa Department of Transportation, 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, latest edition.

1.05 RIGHT OF WAY

- A. The Contractor shall confine construction operations to the right-of-way, and shall use due care in placing construction tools, equipment, excavated materials, construction materials and supplies, so as to cause the least possible damage to property. The Contractor shall promptly repair at no expense to the Contracting Authority any such damages that may occur.

1.06 PROTECTION OF WORK AND CLEAN UP

- A. The Contractor shall care for all work until final completion and acceptance by the Contracting Authority. Contractor shall repair all damage done to existing improvements caused by its operations. The Contractor shall remove all surplus material and rubbish from the work as it accumulates and before making application for the acceptance of the work.

1.07 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.

1.08 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.

1.09 REJECTED MATERIALS

- A. Rejected materials shall be immediately removed from the work by the Contractor and shall not again be brought upon the work. Work shall be commenced and continued at such points as may be approved by the Engineer and shall be carried out diligently and without unnecessary or unreasonable delay.

1.10 CONTRACTOR'S INVESTIGATION OF WORK

- A. It shall be the responsibility of the Contractor to examine the site of the work to determine what is required and the equipment and labor necessary for the performance of the contract. Contractor represents, by submission of a proposal for the work, that he has investigated the character of the work and conditions which may be encountered, and the quantities and types of related work, and agrees that the contract will be completed in accordance with the Plans and these Special Provisions for the prices specified in his proposal without making claim for any extras.

1.11 COPIES OF CONTRACT DOCUMENTS

- A. The Contractor will be furnished without cost, copies of all contract documents together with any and all addenda thereto. The Contractor shall keep one copy of all constantly accessible on the work site.

1.12 TRAFFIC CONTROL

- A. The Contractor at all times shall conduct the operation in such a manner as to insure the safety of the motorist, the pedestrian, and its own employees. The Contractor shall perform work in such a manner and sequence as to maintain vehicular and pedestrian traffic at all times and to maintain access to adjacent private properties.
- B. Where excavations occur in the sidewalks or other pedestrian-ways, the Contractor shall provide a safe and orderly pedestrian passage around the excavation area. The pedestrian passage shall not subject pedestrians to hazards from traffic or construction operations nor cause pedestrians to walk upon unsuitable or hazardous surfaces.
- C. At the end of each day's work and at all other times when construction operations are suspended, all equipment and other obstructions shall be removed from that portion of the roadway or sidewalk normally open for traffic.
- D. The Contractor shall furnish, install, and maintain all devices for directing, warning and

rerouting traffic flow, including warning lights, barricades, and other devices necessary to adequately inform the motorist of unusual or unsafe conditions and guide them safely through the Project work area.

- E. All required barricades and signs shall be in accordance with Part VI of the Manual On Uniform Traffic Control Devices For Streets and Highways and applicable Iowa DOT Supplemental Specifications and Standard Plans for traffic control. The total required barricades and signs would depend on the approved schedule of operation. A traffic control layout shall be submitted by the Contractor and approved by the Engineer prior to any field operations.

#### 1.13 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 (3) 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.

#### 1.14 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.

#### 1.15 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.

#### 1.16 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.

1.17 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.

1.18 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.

**153011.02 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 (4) 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 five 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 (6) 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 two (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 600lb proper tensile strength. All conduit installed shall include a 1c#10 Tracer Wire with the exception of 1" 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 four (4) foot length in each handhole and a two (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 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 ½ 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.
- C. 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.

## 2.05 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 A.W.G. 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 A.W.G. 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 A.W.G bare copper ground wire shall be installed in all PVC conduit that carries 120-volt signal cables.

## 2.06 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





**153011.03 MATERIALS.**

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 "Highway Lighting" of the "2015 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 Sections 2523.10 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 (7x28) stranded, tinned copper with 25 mil minimum average thickness low-density polyethylene insulation. Insulation shall be color-coded: 1-yellow, 1-blue, 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 (7x28) 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 Hz.

#### 153011.04 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 Centrac's 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 to be 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:

<u>DEPTH</u>	<u>WIDTH</u>	<u>HEIGHT</u>
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 inches. 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
- 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.

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 6 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.

Alternate

- 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 3-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 Owner.

## 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 per second 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 2 slots of the detector rack. The modular cabinet interface unit shall accept up to 16 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.

E. Emergency Vehicle Traffic Signal Priority Control System

1. General

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.

2. 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 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.

3. 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  $\pm 6$  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.

#### 4. 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.

#### F. Battery Back-up System

##### 1. General

- a. This specification is for a system to provide back-up power to fully operate a traffic signal when normal line voltage is interrupted and to maintain a useable output voltage when line voltage is outside normal levels. This specification establishes the minimum requirements for a complete emergency battery backup system for use with Light Emitting Diode Traffic Signal Modules at traffic signals with NEMA, 170 or 2070 cabinets.
- b. The Battery Backup System (BBS) shall include, but not be limited to the following: Inverter/Charger, Batteries, a separate automatic and manually operated Bypass Switch, and all necessary hardware and interconnect wiring. The BBS shall be capable of providing power for both the full normal operation of a traffic signal with all LED displays (all colors: red, yellow, green and pedestrian heads), and flashing mode operation with all LED displays. The BBS shall be designed for outdoor applications.
- c. Furnish, assemble, fabricate, or install new corrosion resistant materials in accordance with specifications. Supply a rack mountable UPS unit, including a front panel with indicators and control switches.



2. Enclosure

- d. The BBS Enclosure shall be capable of being either a Side Mount or Ground Mount installation. The enclosure will house the batteries, UPS and bypass switches. The cabinet must meet the requirements for NEMA 3R enclosures. The housing must have the dimensions so that it may easily be attached to the side of an M, P, or 332 Type traffic signal cabinet. Dimensions of the enclosure shall not exceed 50 inches H by 20 inches W by 17 inches D. The UPS enclosure must not interfere with the opening of the traffic cabinet door. The complete enclosure and door must be made from 0.125 inch thick aluminum. All external seams must be continuously welded. The door opening must have a double flange for weather sealing purposes.
- e. Door: The cabinet must have a door to provide access to the complete cabinet interior. The door must be mounted on a continuous piano hinge. The key lock must be a Corbin cylinder lock with a No. 2 key. A continuous neoprene gasket must be used to weatherproof the enclosure when the door is closed.
- f. Finish: The entire enclosure must be natural aluminum.
- g. Ventilation: Vents and a thermostatically controlled exhaust fan shall be installed in the cabinet.

3. Battery System

Individual batteries shall be easily replaced and commercially available off the shelf. Batteries shall be maintenance free, type AGM/VRLA (Absorbed Glass Mat/Valve Regulated Lead Acid). The batteries must be designed for stand-by applications. Batteries shall be certified by the manufacturer to operate over a temperature range of -25°C to +74°C. Batteries shall have a minimum Manufacturer's Warranty of 2 Years Full Replacement from date of delivery. The warranty shall cover any battery that does not meet 80% of its original reserve capability during the warranty period.

4. BBS Unit

- a. The BBS shall provide a minimum two hours of full run-time operation with an additional four hours minimum of Red Flash operation at an LED only traffic signal with a maximum 800 W active output load. The inverter, when on batteries, shall operate with a minimum efficiency of 84% with a load ranging from 25% to 90% of the BBS total output rating. The BBS shall operate at 97% or higher when operating under normal condition (utility power is available).
- b. The maximum transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be 5 milliseconds. 5 milliseconds maximum allowable transfer time shall also apply when switching from inverter line voltage to utility line voltage.
- c. The BBS shall include a Fail Safe Automatic/Manual Bypass Switch for bypassing the UPS for maintenance. The FS-ATS bypass switch will be 3-stage configurations, UPS Normal mode, bypass UPS on and bypass UPS off.
- d. The BBS shall provide six sets of programmable output contacts. These shall include: One output to indicate the system is "on battery". One output to indicate a programmable low battery condition.

- e. The BBS will provide a visual indication for each output when activated.
  - f. The BBS shall provide inputs to turn the BBS off and to start the self-test.
  - g. Operating temperature for both the inverter/charger, and manual bypass switch shall be  $-37^{\circ}\text{C}$  to  $+74^{\circ}\text{C}$ .
  - h. The Fail Safe ATS Bypass Switch shall be rated at 240VAC/30 amps, minimum. The BBS shall use a temperature compensated charging system. The BBS shall employ a charging system that balances the charge across all the batteries.
  - i. BBS shall bypass the utility line power whenever the utility line voltage is outside of the following voltage range: 85VAC to 175VAC ( $\pm 2\text{VAC}$ ). During a utility input from 85 VAC to 175 VAC the UPS shall maintain a full load output of 108 VAC to 131 VAC at 60Hz. When utilizing battery power, the BBS output voltage shall be between 110 VAC and 128 VAC, pure sine wave output,  $\leq 3\%$  THD, 60Hz  $\pm 3\text{Hz}$ .
  - j. BBS shall be compatible with NEMA, 170 or 2170 Controllers, and cabinet components for full time operation. All loads to the maximum rating of the BBS shall be powered through the BBS system to utilize the UPS internal over/under voltage regulation.
  - k. BBS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service. In the event of inverter/charger failure, battery failure or complete battery discharge, the Fail Safe Transfer Switch shall revert to the NC (and de-energized) state, where utility line power or generator power, if available, is connected to the cabinet.
  - l. Recharge time for the battery, from "protective low-cutoff" to 90% or more of full battery charge capacity, shall not exceed 8 hours, unless limited by the Temperature Regulated charger due to excessive battery heat.
  - m. The battery charger will be compatible with the specified batteries.
  - n. The BBS shall have lightning and surge protection compliant with IEEE/ANSI C.62.41.
  - o. The BBS shall be equipped with an integral system to prevent battery from destructive discharge and overcharge.
5. Maintenance, Displays, Controls and Diagnostics
- a. The BBS shall include a display and /or meter to indicate current battery charge status and conditions.
  - b. The BBS and batteries shall be easily replaced with all needed hardware and shall not require any special tools for installation.
  - c. The BBS shall display via a front panel indicator the number of times the BBS was activated and the total number of hours the unit has operated on battery power. The status display shall show the UPS mode, Alarm status, Input and output voltages, Output current, Battery voltage, battery charger current and last event.

- d. The BBS shall include two separate communication ports, an RJ-45, 10/100 Ethernet port and a DB-9, RS 232 serial port. All programming and monitoring functions shall be available through either port.
- e. The BBS shall include software for programming and monitoring the BBS. The software shall be capable of being used on a PC with all current Microsoft operating systems. Manufacturer shall include a set of operation manuals and wiring diagrams of the BBS with each BBS.

6. Material Warranties

The manufacturer shall provide a 2 year factory-repair warranty for parts and labor on the BBS. Batteries shall be warranted by the manufacturer for full replacement for a minimum 2 years from date of delivery. A battery shall be considered bad when it cannot deliver 80% of its original capability within the stated warranty period. Warranty shall be included in the total price of the BBS.

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 one-sixteenth of an 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 Manual on Uniform Traffic Control Devices. 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.
2. Each 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 Finish

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, if 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 of 8 to 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 mils of galvanizing is removed during brushoff blasting, the galvanized component shall be rejected.

### 3. Exterior Finish

- a. A powder coating or electrostatically applied liquid finish shall be provided to the exterior surface to traffic signal poles, mast arms, luminaire arms, and transformer bases
- b. 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.
- c. To insure quality control, the manufacturer of the poles and mast arms is to perform the process.

### 4. Packaging and Shipment

- a. For protection of the 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

The manufacturer shall provide a minimum of a 10 year warranty for corrosion protection, weathering, and abrasion resistance finish of the steel substrate against defects for a period of 10 years from the date of installation. This warranty shall apply against excessive fading, cracking, or peeling of the finish material.

## 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.