

SP- 092002  
(New)



**SPECIAL PROVISIONS  
FOR  
TRAFFIC SIGNALS**

**City of Mason City in Cerro Gordo County  
STP-U-4822(627)—70-17**

**Effective Date  
May, 18, 2010**

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

## SECTION 10 - OVERVIEW

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

An overview of the work, standards, submittals, substitutions, scheduling and conflicts, testing and maintenance, guarantee, surface restoration, and measurement for payment expected with each traffic signal installation.

#### 1.02 DESCRIPTION OF WORK

Includes the furnishing of all material, equipment, and labor necessary to complete, in place and operational, a traffic control signal(s) as described in the project plans.

#### 1.03 STANDARDS

The Standard Specifications for Highway and Bridge Construction, latest edition, Iowa Department of Transportation, as modified by these specifications or other appropriate special provisions shall apply. The installation of the traffic control signals and appurtenances shall conform to the Manual on Uniform Traffic Control Devices (MUTCD), latest edition.

Electrical equipment shall conform to the standards of the National Electrical Manufacturers Association (NEMA), and all material and work shall conform to the requirements of the National Electrical Code (NEC), International Municipal Signal Association (IMSA), the Standards of the American Society for Testing Materials (ASTM), the American Standards Association (ASA), Institute of Traffic Engineers (ITE) and local ordinances that are in effect at the date of advertising of the project documents. Miscellaneous electrical equipment and materials shall be UL approved.

All workers are to be licensed by the State of Iowa.

#### 1.04 SUBMITTALS

- A. Pre-approved shop drawings: For projects utilizing shop drawings for steel mast arm poles, pre-approved by the Engineer, furnish a copy of the drawings from the manufacturer. The drawings shall be marked to show applicable configurations and quantities for the project. Any minor variations from the pre-approved shop drawings, such as alternate finishes, as described in the plans or specifications, are to be noted.
- B. For projects not utilizing pre-approved shop drawings, six (6) copies of shop drawings shall be furnished for steel mast arm poles to be furnished on the

Project.

- C. Six (6) copies of catalog cuts and manufacturer's specifications shall be furnished for all standard "off-the-shelf" items. The Engineer's review of shop drawings and catalog cuts shall not relieve the Contractor of any responsibility under the Contract documents.
- D. Manufacturers shall certify electrical equipment, signal equipment, and materials to ensure compliance with these project documents.
- E. Forward to the Engineer three (3) copies of a list of unit costs for each item listed on the Schedule of Unit Prices attached to the Specifications by the preconstruction meeting. The sum of the costs for each item shall equal the total Contract Lump Sum price for the traffic signal installation(s).
- F. Upon request, the Contractor will provide material certifications to the Engineer.

#### **1.05 SUBSTITUTIONS**

- A. Use only materials conforming to these specifications unless permitted otherwise by the Engineer.
- B. Obtain approval of Engineer for substitutions prior to use.

#### **1.06 SCHEDULING AND CONFLICTS**

- A. Schedule work to minimize disruption of public streets and facilities. Develop traffic control in accordance with the MUTCD. Submit a schedule of planned work activities.
- B. Immediately notify the Engineer of any conflicts discovered or any changes needed to accommodate unknown or changed conditions as soon as found.

#### **1.07 TESTING AND MAINTENANCE OF SIGNAL EQUIPMENT**

- A. Notify the Engineer the date the signal or signal system will be ready for testing once the project is open to traffic.
- B. A representative from the manufacturer and/or supplier of signal controller shall be at the project site when the signal controllers are ready to be turned on to provide technical assistance including, as a minimum, programming of all necessary input data. Required signal timing data shall be provided by the Engineer.
- C. Upon authorization of the Engineer, 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 and authorization of the Engineer. Any failure or malfunction of the equipment furnished by the Contractor due to workmanship and/or material defects, 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.

- D. Respond, within 24 hours, to perform maintenance or repair of any failure or malfunction reported, after signal turn on and prior to final acceptance of the completed traffic signal system.
- E. Any newly signalized intersection will be put in flash for 48 hours prior to going green. No intersection will be allowed to be unsignalized for more than 8 hours unless approved by the Engineer.

#### **1.08 GUARANTEE**

- A. Fully guarantee the traffic control signal installation against defective equipment and workmanship for 12 months. If defects develop under normal operating conditions within these specified periods after acceptance of the completed installation by the Owner, the defects shall be corrected by, and at the expense of the Contractor. Equipment supplier will provide 12 months of free phone support.
- B. The bond requirements of this scope of work are according to the rules set forth in the Iowa Code and the Iowa Administrative Code.

#### **1.09 SURFACE RESTORATION**

- A. Replace or reconstruct sidewalks, curbs, driveways, roadway pavement and any other surfaces, removed, broken, or damaged with the same kind/quality of materials. Whenever a part of a square or slab of existing concrete sidewalk, driveway, or pavement is broken or damaged, the entire square or slab shall be removed and reconstructed. Restoration is incidental to this bid item unless noted on the plans.
- B. Whenever excavation is made across parkways, driveways or sodden areas, the sod, topsoil, crushed stone or gravel shall be replaced or restored as nearly as possible to its original condition 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.
- C. Any concrete base or demolished concrete shall be totally removed and properly

disposed of. If the total removal of a base will cause harm to an underground utility, the Engineer may opt for the top to be removed 2 feet below grade.

**1.10 MEASUREMENT FOR PAYMENT**

All measurements for payments will be made by the Engineer or authorized representative.

- A. The Traffic Signal Installation(s) will be paid for at the contract lump sum price bid. This price shall be full compensation for furnishing all equipment, materials, and labor necessary or incidental to the construction of the complete signal installation.
- B. Monthly estimates of the work performed will be made based on the Schedule of Unit Prices and will be used to prepare progress payments to the Contractor. The Schedule of Unit Prices will also be used to establish the total cost for any extra work orders related to traffic signal installation work items unless otherwise negotiated.

**1.20 ADMINISTRATIVE RULES**

All workers are bound to any state and local rules pertaining to licensing and permitting of such work.

END OF SECTION

## SECTION – 20- CONDUIT SYSTEM AND CONCRETE BASES

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

Section includes conduit system, hand holes, and structural concrete bases as designated for removal, modification, installation, and construction in the project plans or by the Jurisdiction Engineer.

### PART 2 - PRODUCTS

#### 2.01 HANDHOLES – TYPE I

- A. Furnish pre-cast concrete hand hole with cast iron ring and cover. The body of a hand hole shall meet the requirements for Class 1500D concrete pipe as applicable.
- B. Cast iron ring and cover may be rated light duty for non-traffic areas (145 pounds minimum); but shall be rated heavy duty for traffic areas (320 pounds minimum) where shown on the plans. Deviations in weights shall not exceed plus or minus five percent. The cover shall have the words TRAFFIC SIGNAL cast on the top of the cover.
- C. Hand holes shall be 24 inch diameter and 48 inches long with 4 conduit reliefs 24 inches from the top.

#### TYPE II

- A. Handhole shall be precast-polymer concrete 30 inch x 48 inch x 36 inch with legend "Traffic Signal" on the two-section lid. A minimum of four cable hooks will be installed in each handhole to support cables. Handhole covers shall be Tier 8 or above rated.

#### 2.02 CONDUIT SYSTEM

- A. Rigid steel conduit shall be galvanized steel and meet the requirements of ANSI Standard Specification C80.1, latest revision. Fittings used with rigid steel conduit shall be galvanized steel only.
- B. Polyvinyl chloride conduit (PVC) shall meet the requirements of NEMA TC-2, Type 2, and applicable UL Standards. PVC conduit is to be schedule 80 only.
- C. Sealing compound shall be readily workable soft plastic at temperatures as low as 30 Degree F, and shall not melt or run at temperatures as high as 300

Degree F.

### **PART 3- EXECUTION**

#### **3.01 HAND HOLES**

- A. Hand holes to be installed upon 12 inches of coarse aggregate for drainage.
- B. Hand holes shall be installed in a neat and workman like manner. Top of hand hole shall be flush and level with the abutting surface.
- C. Conduits shall enter the hand hole from the bottom or 24 inches from the top. Conduits shall extend into the hand hole 4 inches from the inside wall.
- D. Extra hand holes may be installed at the Contractor's expense to facilitate his work.

#### **3.02 CONDUIT SYSTEM**

- A. When it is necessary to cut and thread steel conduit, no exposed threads will be allowed. Tighten all couplings until the ends of the conduits are brought together.
- B. Conduits and fittings shall be free of any burrs or oils. Paint any damaged galvanized surfaces with a zinc rich primer.
- C. Use manufactured pipe nipples to eliminate the cutting and threading of short lengths.
- D. Exposed rigid conduit ends shall have a grounding bushing and bonded to the grounding system. PVC conduits shall use a bell type bushing.
- E. Change in direction of conduit shall be accomplished by a means not to damage the outer surface or change the internal dimensions. Bend radius will conform to the National Electric Code (NEC)
- F. Bending of PVC conduit by open flame will not be allowed.
- G. Conduit in open trenches shall be placed a minimum of 24 inches. Conduit placed under traveled portion of roadway shall be a minimum of 48 inches.
- H. Conduit placed under any paving shall be backfilled with approved granular fill. All other will be backfilled with native materials properly tamped. Any excess material will be removed from site and properly disposed of.

- I. Conduits may be directional bored. Bores to be no larger than 20% of the conduits to be installed. Bore pits are to be no closer than 2 feet from edge of roadway.
- J. No water jetting will be allowed.
- K. If the use of a "pot holer" is required, the open hole will be properly covered and marked.
- L. Any excavation over 6 inches deep will be covered or properly fenced off before the Contractor leaves the job site.
- M. Conduits to feed signal bases shall be 3 inches in diameter. No conduit will serve more than 2 signal bases.
- N. All other conduits shall be 3 inches in diameter unless noted on drawings.
- O. Any inter connection or communication cabling shall be in separate conduit system.
- P. **All** conduit systems shall have a #10 orange tracer wire installed.

### 3.03 CONCRETE BASES

- A. Concrete shall be Class C structural concrete.
- B. Concrete bases for poles and cabinets shall be poured to form a monolithic foundation. The bottom of the foundation shall rest on firm undisturbed soil. Remove any standing water before placing any concrete.
- C. Finish center of foundation slightly higher to promote water run off. The top edge of foundation to have a smooth ½ inch radius finish.
- D. No concrete will be allowed to free fall greater than 6 feet.
- E. The top 18 inches of the signal base shall be formed square and set level and a means to hold the forms rigid until the concrete has been deposited.
- F. Anchor bolt are to be secured top and bottom to the dimension as specified by the manufacturer. Threads are to extend enough above the concrete to maintain at least 2 threads above the top nut.
- G. Concrete is to be mechanically vibrated to remove any honeycomb and to totally encompass re-bar.

- H. Top of bases are to be 2 inches above adjoining surface. Expansion material will be placed between base and any other paving.
- I. Cover or grease threads to prevent any concrete sticking to threaded area.
- J. Any conduits, ground rods or anchor bolts shall be in place prior to any concrete being deposited. **NO** concrete will be allowed to be installed until the field inspector gives permission.
- K. Each base shall have an 8 foot ground rod with #6 bare wire. This will be bonded to the pole and grounding system.

END OF SECTION

**SECTION - 30 - WIRING****PART 1 - GENERAL****1.01 SECTION INCLUDES**

Signal cable, power lead-in, street lighting, video detection, loop detector lead-in, tracer wire circuit materials, and grounding, methods, designated for modification or installation in the project plans, or by the Jurisdictional Engineer.

**PART 2 - PRODUCTS****2.01 CABLE**

- A. Cable for signalization shall be rated 600 volts minimum. Cable 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 shall be 600 volt, single conductor, stranded copper, Type THWN or XHHW, with UL approval.
- C. Signal Cable shall be multi-conductor copper wire, and meet the requirements of IMSA Specification 19-1.
- D. Loop Detector Wire (With Plastic Tubing) wire shall meet the requirements of IMSA Specifications 51-5.
- E. Detector Lead-In Cable shall meet the requirements of IMSA Specifications 50-2.
- F. Tracer wire shall be a # 10 A.W.G., single conductor, stranded copper, Type THWN or XHHW, with UL approval and an orange colored jacket.
- G. Ground wire shall be a # 6 A.W.G. bare stranded copper wire and bonding jumpers shall be No. 6 A.W.G. bare stranded copper wire connected by approved clamps.

**2.02 ELECTRICAL SERVICE**

- A. The electrical service shall use a meter pedestal Milbank U4833-0-5T9 or approved equivalent.

**PART 3 - EXECUTION****3.01 CABLE**

- A. Where practical, color codes shall be followed so that the red insulated conductor connects to the red indication terminal, yellow to yellow, green to green, blue for don't walk and orange for walk. Identify circuits at the controller with durable labels attached to the cables.
- B. Signal cable runs shall be continuous from connections made in the signal pole bases to the terminals in the controller cabinet. Splicing will not be allowed in underground hand holes unless specifically called for in the project documents.
- C. Power lead-in cable runs shall be continuous from the meter socket to the controller cabinet.
- D. Loop detector lead in cable, shall be continuous from the terminal in the controller cabinet to a splice made with the detector loop leads, in the first hand hole or pole base provided adjacent to the detector loop. Lead-in cable shall be checked for proper identity and labeled in the cabinet for the loops served
- E. Tracer wire shall be spliced in the hand holes and controller to form a continuous network.
- F. Provide four (4) feet of cable slack in each hand hole and two (2) feet of cable slack in each pole and controller base. Coil cable slack in hand hole and place on the hooks.
- G. Pull cables through conduit by means of a cable grip designed to provide a firm hold upon the exterior covering of the cable(s), with a minimum of dragging on the ground or pavement. This shall be accomplished by means of reels mounted on jacks, frame mounted pulleys, or other suitable devices. Only NEC or UL approved lubricants may be used to facilitate the pulling of cable.

### **3.02 GROUNDING**

- A. Bond poles and cabinets to form a continuous grounded system.
- B. Grounding of the conduit and neutral at the service disconnecting means shall be accomplished as required by the National Electric Code Article 250, except bonding jumpers shall be No. 6 A.W.G. or greater.
- C. Install a ground wire in all conduits that carries 120 volt signal cables.
- D. Each signal and controller base shall have one 5/8 inch diameter 8 foot long copper-clad ground rod with # 6 bare wire.

- E. A supplemental grounding method may be accomplished by attaching a # 6 wire to the re-bar cage by an approved method.
- F. The grounding conductor shall be bonded at the service grounding electrode by exothermic weld.

END OF SECTION

## **SECTION 40 - VEHICLE DETECTION**

### **PART 1 - GENERAL**

#### **1.01 SECTION INCLUDES**

Pavement saw cutting, detector loop wire materials, placement, connection to lead-in, and loop sealant designated for installation of inductive loop detector and video detection in the project plans, or by the Jurisdictional Engineer. In the case of a new pavement installation, vehicle detection will be accomplished by detection loops. All other cases will be done by video.

### **PART 2 - PRODUCTS**

#### **2.01 LOOP DETECTOR SEALANT**

- A. Sealant shall be rapid cure, high viscosity, liquid epoxy, or approved equal, formulated for use in sealing inductive wire loops and leads embedded in asphalt concrete and portland cement concrete. The sealant shall be usable on grades of 15 percent or less without excessive flow of material.
- B. Sealant shall be two component system which consists of a resin constituent identified as pour able, and a hardener identified as quick-setting. Approval of other sealants shall be based on specifications and/or test data regarding physical properties, performance properties and chemical resistance.
- C. Cured sealant shall be unaffected by oils, gasoline, grease, acids and most alkalis. The mixing of components and the filling of the cut shall be in accordance with the directions of the manufacturer.

#### **2.02 SPLICE KIT**

- A. As an acceptable alternate, the Contractor may use a 3M Company 314 mechanical splices, or approved equal, for splices.

### **PART 3 - EXECUTION**

#### **3.01 LOOP DETECTOR INSTALLATION**

- A. Obtain Engineer approval of loop locations prior to saw cutting.
- B. Refer to the plans for the quantity and placement of the loops.
- C. Saw shall be equipped with a depth gauge and horizontal guide to assure proper

depth and alignment of the slot. Provide a clean, straight, well-defined saw cut without damage to adjacent areas. Overlap saw cuts to provide full depth at corners. No saw cuts are to be any closer than 12 inches.

- D. Remove jagged edges or protrusions in the saw cuts before installing loop wire. The saw cuts must be cleaned to remove cutting dust, grit, oil, moisture or other contaminants. Flush saw cuts clean with a stream of water under pressure, and dry the slots using oil-free compressed air.
- E. Install ½ inch backer rod in bottom of trench. Then install detector loop wire on top of backer rod. Pour loop sealant over wire until flush with pavement. If necessary, hold down by means of a material such as tape or doubled-over pieces of the plastic tubing.
- F. The field loop conductors and tubing shall be continuous from the terminating hand hole or base with no splices permitted. At the time of placing the loop wire in the saw cuts, the ends of the tubing shall be sealed to prevent any entrance of moisture into the tubing. Loop wires and tubing that are not embedded in the pavement shall be twisted with at least five (5) turns per foot.
- G. Label each loop with durable tags corresponding to loop numbering as shown on the plans. Loops which are physically adjacent in an individual lane or adjacent lanes shall be wound with opposite rotation (i.e. #1 CW, #2 CCW, #3 CW, etc.). Rotation reversal can be accomplished by reversing leads at the hand hole.
- H. Loops shall be 6 feet by 6 feet square. No corner shall have more than 45 degrees of bend in the wire.
- I. If it is necessary to cross an expansion joint in the paving, means shall be employed to create to allow the wire to flex.
- J. Solder electrical splice between the detector lead-in cable and the loop wire using resin core solder. Provide a watertight protective covering for the spliced wire, the shielding on the detector lead-ins and the end of the tubing containing the loop wires. The use of open flame to heat the wire connection will not be permitted. The Contractor shall use a soldering iron, gun, or torch equipped with a soldering tip. The splice shall be made by the following method:
  - 1. Remove lead-in cable coverings and expose four (4) inches of insulated wire.
  - 2. Remove insulation from each conductor of detector lead-in cable and scrape both copper conductors with knife until bright.
  - 3. Remove the plastic tubing from the loop wires for one and

one-half (1-1/2) inches.

4. Remove the insulation from the loop wires and scrape both copper conductors with knife until bright.
  5. Connect conductors by a soldered "Western Union" type splice, wrapped with waterproof tape and coated with a watertight protective covering.
  6. Cover the exposed shielding, ground wire and end of any unused loop lead-in where the sheathing was cut, with liquid silicone rubber. Apply Butyl Rubber Polymer Tape sealant between the wires and completely cover the silicone rubber.
- K. Contractor shall install pre formed loops in any areas that will have new paving.
- L. The loop lead-in wire shall be protected by a conduit from the hand hole to the edge of the paving. It maybe necessary to drill the curb to facilitate this.
- M. Meter the installed loops by test instruments capable of measuring electrical values of loop wires and lead-ins to measure induced AC voltage, inductance in micro henries, high-low "Q" indication, leakage resistance in megohms, and the resistance of the conductors in ohms. Provide the Jurisdictional Engineer a report on company letterhead indicating the inductance and leakage to ground test values for each loop. An inductance and leakage to ground test shall also be conducted and reported for the total detector lead-in and loop system with the test being conducted at the controller cabinet. Before beginning the required test period, the Jurisdictional Engineer may independently meter any or all loops. Should any loop be found unacceptable, the Contractor may be required to complete additional tests, as required, at his own expense. An acceptable loop installation shall be defined as follows:
1. Inductance: The inductance reading on the loop tester is approximately the calculated value.
  2. Leakage to Ground: Deflection of the pointer to above 100 megohms.
  3. Resistance: The resistance of the circuit is approximately the calculated value.
- N. Any loop not meeting the requirements for an acceptable loop installation shall be repaired or replaced. The Contractor shall bear all costs of replacing loop installations deemed unsatisfactory by the Jurisdictional Engineer.

#### **4.01 VIDEO DETECTION**

- A. Video detection will be accomplished by Econolite Terra color cameras with

interface panel and access card.

- B. Cameras are to be mounted a minimum of 30 feet above the pavement centered above the detected lane as much as possible. Preferred location is on luminaire arm approximately 12 inches to 18 inches from the luminaire.

END OF SECTION

**SECTION 50 - NEMA CONTROLLER AND CABINET****PART 1 - GENERAL****1.01 SECTION INCLUDES**

NEMA Controller, NEMA cabinet, NEMA conflict monitor, flasher, inductive loop vehicle detector, and auxiliary equipment designated for installation in the project plans, or by the Jurisdictional Engineer.

**1.02 STANDARDS**

Controller, cabinet, and auxiliary equipment shall conform to the requirements of NEMA TS-2, latest edition.

**PART 2 - PRODUCTS****2.01 CONTROLLER**

A. The Controller Shall Provide:

1. Two through eight phase operation with four overlaps.
2. Fully prompted, menu driven programmability.
3. The following internal functions:
  - a. Local time base scheduler including automatic accommodation for daylight savings time.
  - b. Local coordination control.
  - c. Local preemption control with at least six programmable internal preemption sequences.
4. Means for receiving actuation on all phases. The actuation of a vehicle detector during the extendible portion of an actuated traffic phase having the right-of-way shall cause the retention of right-of-way by the traffic phase for the set Passage time from the end of the actuation but subject to the Maximum green. The actuation of any detector on a traffic phase not having the right-of-way shall cause the transfer of the right-of-way to that traffic phase at the next opportunity in the normal phase sequence.

B. The controller shall be an Econolite ASC3/2100 Ethernet ready.

C. The controller shall utilize digital timing concepts for interval settings for all phases and shall contain vehicular and pedestrian circuits and timing functions for all phases. The length of timing settings shall not deviate by more than plus

or minus 100 milliseconds from the set value at a power source frequency of 60 Hz.

- D. Controller timing shall be set by means of a front-panel keyboard with momentary contact pushbuttons for entering data. It shall not be necessary to remove or change wires or contacts or to use any tools in making interval adjustments.
- E. The controller shall be of the latest model with the most current software and documentation. It shall have an Ethernet port and a flash memory card to upload/download controller data.
- F. Component parts and terminals shall be readily accessible when the controller modules are removed from the enclosure for adjustments, testing or service. Modules shall be removable and inserted without the use of any tools. Modules of unlike function shall be mechanically keyed or electrically inter-locked to prevent insertion into the wrong opening. All modules of the same function shall be interchangeable.
- G. Mount the control devices, indicators, fuse holders, switches, input/output connectors, and other components required for controller operation on the front panel of the controller. The front panel of the unit shall be permanently marked to identify the fuses, indicators, switches, controls, etc.
- H. Components shall be amply de-rated with regard to heat dissipating capacity and rated voltage so that, with maximum ambient temperatures and maximum applied voltage, a material shortening of life or shift in values shall not occur. Components under 24 hours a day operating conditions in their circuit applications shall have a minimum life of five (5) years.
- I. Each phase shall have identical control parameters which may be independently set.
- J. Provide indications, labeled appropriately, to facilitate the determination of the operation of the controller unit. These indications shall consist of the following, as a minimum:
  - 1. Phase(s) in service.
  - 2. Next phase(s) to be serviced.
  - 3. Presence of vehicle and pedestrian calls, including memory and detector actuations.
  - 4. Ring status indicators, including the following: Minimum Green; Passage;

Yellow Clearance; Red Clearance; Walk; Pedestrian Clearance; Reason for Termination; and Rest State.

- K. The controller shall be capable of programming each phase to operate in the following modes:
  - 1. Nonlocking/locking vehicle detector memory
  - 2. Vehicle recall
  - 3. Pedestrian recall
- L. Data shall be retained in a memory medium which does not require battery backup.
- M. The timing of the Maximum Green shall commence at the beginning of the Green interval. In the absence of detector actuations or assertion of recall switches, the right-of-way indications shall remain on the traffic phase on which the last actuation occurred.
- N. Transfer right-of-way to conflicting phases only after the display of the appropriate change clearance intervals.
- O. Pedestrian actuations received during steady or flashing DON'T WALK indications a phase shall cause the controller to provide pedestrian timing functions for that phase at the next opportunity in the normal phase sequence. Successive pedestrian actuations shall not cause extension of pedestrian intervals.

During coordinated operation if phases are placed in a pedestrian recall mode of operation to operate the controller as a pretimed controller, the WALK intervals shall automatically adjust with changes in the timing plans to provide the maximum amount of WALK interval possible in the phase.

- P. If power is interrupted, the controller shall be capable of automatic reorientation upon power resumption and shall require no manual initiation or switching and revert to main street green.

## **2.02 CONTROLLER CABINET AND AUXILIARY EQUIPMENT**

- A. House the controller and associated equipment in a sturdy, brushed bare aluminum cabinet having no sharp edges, corners or projections. The size of the cabinet shall provide ample space for housing the controller and auxiliary equipment. Provide a hinged door, with an approved doorstop assembly,

permitting complete access to the interior of the cabinet. When closed, the door shall fit closely to neoprene or other suitable gasketing material, making the cabinet weatherproof and dust-tight. Door shall be provided with a strong lock and two sets of keys. Door hinges and pins shall be of a non-corroding material. The cabinet shall contain strong mounting tables, sliding trays or other suitable supports for the controller and associated equipment. There shall be two switches mounted to be activated when the door is opened. One switch is to turn on a lamp and the other is to input the controller to log the door being opened.

- B. 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 keys (two) of different design than that of the main door of the cabinet. The panel behind the auxiliary police door shall contain switches to change from normal function to flashing operation, from manual to auto and a signal on/off. There shall be installed behind the door a weatherproof push button on a coiled cord. The controller shall remain in full operation during flashing operation.
- C. Locate a maintenance panel on the inside of the main door containing the following test switches:
  - 1. Controller Power Switch
  - 2. Detector Test Switches
  - 3. Stop Time Switch
  - 4. Signal Flash Switch
- D. The cabinet shall be provided with the following:
  - 1. A heavy-duty clear plastic envelope, securely attached to the inside wall of the cabinet or cabinet door, for stowing cabinet wiring diagrams. Minimum dimensions shall be 9 inches wide x 12 inches deep.
  - 2. A ventilation fan controlled by a thermostat, and suitable dust filters for the capacity of the ventilating system. The filters shall be dry type, easily removed and replaced, and standard dimensions commercially available. Ventilation fan shall be fused separately and wired after the main AC+ circuit breaker. Provide a thermostat and a device to heat inside of cabinet in the winter.
  - 3. At least an 16-position back panel when the plans call for expansibility to 8 phases. Provide at least 6 sdlc cables.
  - 4. Power protection devices which include the main AC+ power circuit breakers, radio interference suppressors, and lightning 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. The neutral bus and grounding bus will be isolated from each other.

5. 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 22k AIC. It shall be equipped with a solder less 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 the "ON" and "OFF" positions.

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

- a. 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.
  - b. The lightning arrestor/surge suppressor on the AC service shall be an ACP 340 manufactured by EDCO Inc., or approved equal which meets or exceeds the following requirements:
    - 1) Capable of withstanding repeated 20,000 ampere surges (minimum of 25).
    - 2) Have internal follow current limiters (resistive elements).
    - 3) Contain a minimum of three (3) active clamping stages.
    - 4) Self-extinguish within 8.3 milliseconds after trailing edge surge.
    - 5) Parallel impedance of limiters must be less than 15 ohms.
5. An easily accessible AC+ convenience outlet with a 3-wire grounding type receptacle with ground fault protection. This receptacle shall be separately fused from the main AC+ circuit breaker.
  6. An incandescent lamp receptacle mounted on the interior wall of the cabinet which accommodates a standard base light bulb. Fuse and connect lamp with the convenience outlet.
  7. A complete system documentation. Documentation shall consist of:

- a. Three complete operations manuals for each controller and associated equipment including equipment wiring diagrams, schematics, and parts lists sufficient for ordering any parts.
  - b. Three sets of cabinet wiring diagrams. Indicate corresponding phase numbers for each movement from the intersection layout diagram on the cabinet wiring diagram.
- E. Use molded composition barrier type terminal blocks 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 a minimum rating of 600 volts.

Arrange terminal block facilities in function groupings and mount to either panels or brackets fastened to the interior walls of the cabinet. Retain each terminal block using either machine or self-tapping screws which are 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 unfused for the neutral side of the incoming power line.
3. Terminals and bases for each vehicle and pedestrian signal circuit.
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 controller input and output circuits including those circuits not used on the project.
7. Terminals for required auxiliary equipment.

Provide adequate electrical clearance between terminals. Label terminals in accordance with the cabinet wiring diagrams. Terminals shall be accessible without removal of equipment contained in the cabinet.

- F. Furnish hardware necessary for assembly and installation of the cabinet.

- G. 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 pin jack, a spring connected mounting or approved equivalent arrangement.
- H. Neatly train wiring throughout the cabinet and attach to the interior panels using nonconductive clamps or tie-wraps. Bundles of cables shall be laced, 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. Arrange the controller, auxiliary equipment, panel(s), terminals and other accessories within the cabinet to facilitate the entrance and connection of incoming conductors.
- I. Except where terminated by direct soldering, wires shall be provided with terminal lugs for attachment to terminal blocks using screws. Wires shall be identified and labeled in accordance with the cabinet wiring prints.
- J. All wire insulation shall have a minimum rating of 600 volts.
- K. 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.
- L. Load switches shall provide LED indicator lights on the front of the load switch to designate the inputs and outputs. The closing or opening of signal circuits shall be positive without objectionable dark intervals, flickering of lights, or conflicting signal indications. Provide four extra load switches, two extra transfer relays and one extra flasher module.
- M. Cabinet shall be a size P44 or otherwise noted on plans.
- N. Provide a 12 slot detector card rack.

### **2.03 MALFUNCTION MANAGEMENT UNIT (MMU)**

- A. Provide a solid state MMU within the cabinet external to and electrically independent of the controller and enclosed in a finished metal case. The MMU shall detect the occurrence of conflicting Green, Yellow or Walk indications and

shall cause the signals to go into predetermined flashing operation with stop timing applied simultaneously should conflicts be sensed.

- B. The MMU shall utilize liquid crystal displays providing four indicators which display an active Red, Yellow, Green, and Walk input for each channel monitored.
- C. If the actual conflict has been cleared, a reset switch (front mounted) on the MMU shall return the controller to normal operation when depressed.

#### **2.04 FLASHER**

- A. Provide a separate solid state flasher to permit substitution of flashing signal indications for normal vehicle or pedestrian actuated operation. The solid state flasher shall have no contact points or moving parts and shall utilize zero-point switching. The flasher unit shall have a built-in effective radio interference filter. LED indicator lights shall be provided on the front of the flasher to indicate the active circuit. Flashing rate shall not vary when the power source remains within the specified limits.
- B. Obtain flashing of vehicular signal indications from one or more flashers, each of which is a self contained device designed to plug into a panel in the controller cabinet. If the flashing is provided by two flashers, they shall be wired to assure that the flashing of all indications on the same approach is simultaneous.
- C. The cabinet shall contain a power and flash transfer relay assembly to transfer the AC+ power and operation from the controller and load switches to the solid state flasher. This transfer relay assembly shall be controlled by either the flash mode switches located on the Police and maintenance panels or the conflict monitor. The plug-in transfer relays shall be rated at a minimum of 10 amps per pole and shall be enclosed in a transparent case for protection against dust and for visual observance of operation.

#### **2.05 INDUCTIVE LOOP VEHICLE DETECTOR**

- A. Provide a detector rack capable of 16 cards. The rack shall be tagged to indicate the detector number(s) and phase. In case of a failure in the power supply unit for the card rack, fail-safe operation will be provided in that a constant call will be placed on all detector channels.
- B. The detector unit shall be solid state, digital, dual channel, providing detection channel with a minimum inductance range of 50 to 1500 micro-henries. Output circuits of the detector unit shall be provided by relays.
- C. The detector unit shall include the following capabilities:

1. Detection of all motor vehicles.
  2. Indicator light for visual indication of each vehicle detection.
  3. Fail-safe operation (continuous call) in the event of detector loop failure.
  4. Respond to an absolute change (delta L).
- D. The detector unit shall be capable of disabling delay timing by external means during that detector's associated green phase. The delay inhibit on each detector unit shall be in effect during the associated green phase.
- E. The detector unit shall contain a fuse or other reliable protection in the power supply. The fuse shall provide short circuit protection to the power supply and be accessible without removal of the case.
- F. The detector unit shall be capable of normal operation without interference and false calls between sensor units ("crosstalk"). It shall be possible to install the connecting cable in the same conduit as the signal cables, power cables and other detector cables without affecting the normal operation of the detector.

### **PART 3 - EXECUTION**

#### **3.01 CONTROLLER CABINET AND AUXILIARY EQUIPMENT**

- A. Install the controller cabinet on pre-placed caulking material or gasketing material on the concrete base. After the cabinet is installed, place caulking material around the base of the cabinet.
- B. For card rack style detectors, mount detector mounting racks on shelf in the controller cabinet. Wire all detector slots in the cabinet to provide for future use. Label card rack positions with loop numbers.

END OF SECTION

**SECTION 60 - SIGNAL HEADS, PUSHBUTTONS AND SIGNS****PART 1 - GENERAL****1.01 SECTION INCLUDES**

Traffic signal heads, signal lamps, pedestrian pushbuttons, and pushbutton signs designated for installation in the project plans or by the Engineer.

**PART 2 - PRODUCTS****2.01 TRAFFIC SIGNAL HEADS**

- A. The housing for the individual signal sections shall be made of a durable polycarbonate clean, smooth and free from flaws, cracks, blowholes, and other imperfections and containing no sharp fins or projections. The housing shall be 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 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. Provide doors and lenses with water-tight gaskets, hinges and means to secure to the body of the housing by simple locking devices of non-corrosive material.
- B. The visors section shall be durable polycarbonate not less than 0.10 inch in thickness designed to fit tightly against the door and not permit any perceptible filtration of light between the visor housing door. Visors shall be of the tunnel-type at least 8 inches long for 12 inch rectangular signals, at least 9 1/2 inches long for 12 inch diameter signals, and angle slightly downward.
- C. All traffic signal housings shall be designed to hold a 12 inch traffic signal indicator.
- D. All traffic signal heads will be arranged in a vertical manner.
- E. Equip each three section signal head with a six position terminal block and each five section signal head with an eight position terminal block for termination of field wiring.
- F. The signal heads, except door fronts and visors shall be federal yellow. Door fronts and visors shall be black. The color shall be an integral part of the materials composition.
- G. Where shown on the plans, furnish and attach 5 inch back plates to the signal faces capable of withstanding 100 M.P.H. wind gusts.

## **2.02 TRAFFIC SIGNAL INDICATORS**

- A. All traffic and pedestrian signal indicators shall be LED and constructed according to ITE VTSCCH-LED standards.
- B. LED module shall be a sealed self contained unit that is water tight and vibration resistant.
- C. Outside lenses shall have a color tinted incandescent style appearance.
- D. Each module shall be identified on the back to the orientation and color of the module.

## **2.03 PEDESTRIAN INDICATORS**

- A. All pedestrian indicators shall be 16 inch by 18 inch LED with count down timer. The face shall be flat black with an egg crate style cover. Mounting shall be style will be indicated on plans.

## **2.04 PEDESTRIAN PUSH BUTTONS**

- A. Pedestrian push button detectors shall be of the piezio type with and audible tone and LED indication when activated. The entire assembly shall be in a 3 inch weather tight round housing, secure against electrical shock and able to withstand continuous hard usage. The housing shall be made of aluminum alloy and furnished with suitable mounting hardware.
- B. Furnish pushbutton signs conforming to the requirements of the MUTCD and ADA, consistent with the legend as shown on project plans.
- C. Push buttons are to be mounted at a height as required by ADA standards.
- D. Furnish and install 9 inch by 18 inch R10-3 pedestrian sign with arrow to indicate direction of movement.

## **PART 3 - EXECUTION**

### **3.01 TRAFFIC SIGNAL HEADS**

- A. Signal mounting hardware for side of pole mounted signals shall consist of 1-1/2 inch pipe and appropriate fittings, each painted with one coat of primer and two (2) coats of federal yellow enamel. Signals shall be secured to pole by drilling and tapping 3/8 inch-16 bolt using 18-8 or 304 stainless steel hardware. A flat washer is required under any bolt.

- B. Mast arm signal head assemblies shall be rigid mounted utilizing a suitable assembly consisting of both top and bottom brackets which are easily adjustable in both horizontal and vertical planes.
- C. Signal heads and signs to be mounted on horizontal arm shall utilize a Pelco Astro-Brac with the stainless steel band. Make sure the band is long enough to go completely around the tube as the tube dimension varies.

END OF SECTION

## SECTION 70 - POLES

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

Traffic signal mast arm poles, traffic signal pedestals, and overhead mounted street name and traffic control signs designated for installation in the project plans or by the Engineer.

### PART 2 - PRODUCTS

#### 2.01 TRAFFIC SIGNAL POLES

- A. Poles shall be manufactured in accordance with the requirements of the latest Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals as approved by the American Association of State Highway and Transportation Officials.
- B. The pole assembly shall be designed to support any signal heads or any other attachments as shown on plans.
- C. The mast arms and support poles shall be tapered, round, steel poles of the transformer base type. Mast arms shall be continuous to 50feet in length. The poles shall be fabricated from low carbon (maximum carbon 0.30%) steel of U.S. Standard gauge.

After manufacture, they shall have minimum yield strength of 55,000 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 shall not be permissible to fabricate poles and mast arms by welding two sections together.

- D. Welding and fabrication shall conform to the Structural Welding Code AWS D1-180, as modified by AASHTO 1981 Standard Specifications for Welding of Structural Steel Highway Bridges. Longitudinal butt welds, shall have a minimum 60 percent penetration for plates 3/8 inch and less in thickness, and minimum of 80 percent penetration for pates over 3/8 inch in thickness. Personnel performing nondestructive testing shall be qualified in accordance with the American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A and applicable Supplements B (Magnetic Particle) and C (Ultrasonic). Evidence shall be presented for approval of the Jurisdictional Engineer, concerning their qualifications. A report shall be required showing that welds have been inspected and either found satisfactory or found unsatisfactory but repaired and re-inspected and found satisfactory. The cost of all

nondestructive testing shall be paid by the Contractor and will be considered incidental to other items in the contract.

- E. The mast arms and pole assemblies shall be galvanized inside and out in accordance with ASTM A123, latest revision.
- F. The pole shall be equipped with a minimum 8 inch x 12 inch hand hole 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. Hardware shall be corrosion resistant.
- G. Where a combination street lighting/signal pole is specified on the plans, the luminaries arm is to be mounted in the same vertical plane as the signal arm unless otherwise indicated on the plans. The luminaries arm type shall be a single member tapered type arm. The pole shall be equipped with a minimum 4 inch x 6 inch hand hole and cover located opposite the signal mast arm.
- H. The mast arms and poles shall be equipped with all necessary hardware, shims and anchor bolts to provide for a complete installation without additional parts. The anchor bolts shall meet the requirements of ASTM A36 or better and be hot dip galvanized for a minimum of 12 inches on the threaded end.
- I. The anchor bolts shall be threaded a minimum of 6 inches at one end and have a 4-inch long, 90 degree bend at the other end.
- J. The fabricator shall submit drawings, or preapproved shop drawings, for anchor bolts and base design. All hardware shall be steel, hot dipped galvanized meeting the requirements of ASTM A153, Class D or electrodeposited coated of the same coating thickness and so designed for this purpose.

Traffic signal poles shall be detailed on shop drawings, or preapproved 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.

- K. The fabricator shall certify that the mast arms and pole assemblies 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.

## **2.02 TRAFFIC SIGNAL PEDESTALS**

- A. The pedestal shaft shall be fabricated of aluminum tubing with a wall thickness of not less than 0.125 inch. It shall have a satin brush or spun finish. The top of

the shaft shall have an outer diameter of four and one-half (4-1/2) inches and be provided with a pole cap. One end shall have 4 inch pipe threads.

- B. The pedestal base shall be cast aluminum, square in shape, with a hand hole. The size of the hand hole shall be at least four (4) inch by six (6) inch and equipped with a cover which can be securely fastened to the shaft with the use of simple tools. Bases shall have a minimum weight of twenty (20) pounds and shall have a four (4) bolt pattern uniformly spaced on a 12-1/2 inch diameter bolt circle. The exterior of the base shall be smooth and have a neat appearance.
- C. Four (4) three-fourths (3/4) inch by fifteen (15) inch hot rolled steel anchor bolts shall be supplied, complete with all hardware required for installation. The anchor bolts shall have a right angle bend at the bottom end and be hot dip galvanized at the threaded end. Use a 3/4 inch x 2 1/2 inch flat washer on the top and bottom of the base mounting flange.
- D. The fabricator shall certify that the pedestals are capable of withstanding winds up to 80 MPH with a 1.3 gust factor without failure.

## **2.03 SIGNS**

- A. All traffic signs shall conform to the requirements of MUTCD.
- B. Street name signs shall be provided by the city and installed by the contractor. Large signs need to be reinforced according to supplied details on the plans.

## **PART 3 - EXECUTION**

### **3.01 TRAFFIC SIGNAL POLES**

- A. Erect poles so as to be vertical under normal load, with mast arms oriented at 90 degrees to the curb line. Securely bolt bases to the cast-in-place concrete foundations.
- B. After leveling the poles, install stainless steel wire screen around bottom of bases with 1/2 inch stainless banding.
- C. Ground each pole by installing a No. 6 A.W.G. bare stranded copper ground wire between the pole and the ground rod at the foundation.
- D. If the painted or galvanized surface of any equipment is damaged in shipping or installation, such equipment shall be retouched or repaired in a manner satisfactory to the Engineer.
- E. Any hole drilled into the pole/mast arm for a cable shall be at least 7/8 inches in

diameter. Hole shall have a bushing or grommet to protect cable.

**3.02 SIGNS**

- A. Mount signs on the mast arms utilizing a universally adjustable mast arm mounted sign bracket.

END OF SECTION