



# Technical Specifications **TRAFFIC CONTROL SIGNALIZATION**



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## REFERENCE MATERIALS

References should be made to the following Pennsylvania Department of Transportation (PennDOT) publications:

- PennDOT Publication 46, Traffic Engineering Manual, dated March 3, 2014, or latest revision, and its addenda
- PennDOT Publication 111M, Traffic Control – Pavement Markings and Signing Standards (TC-8600 and TC-8700 series), dated June 17, 2013, or latest revision, and its addenda
- PennDOT Publication 148, Traffic Standards – Signals (TC-8800 series), dated December 12, 2011, or latest revision, and its addenda
- PennDOT Publication 149, Traffic Signal Design Handbook, dated May 2013, and its addenda
- PennDOT Publication 191, Guidelines for the Maintenance of Traffic Signal Systems, dated October 28, 2010, or latest revision, and its addenda
- PennDOT Publication 212, Official Traffic Control Devices, dated March 2006, or latest revision, and its addenda
- PennDOT Publication 213, Temporary Traffic Control Guidelines, dated June 6, 2014, or latest revision, and its addenda
- PennDOT Publication 408, Specifications, dated April 2016, or latest revision, and its addenda

References should also be made to the following national publications:

- National Electrical Manufacturer’s Association (NEMA), Standards Publication No. TS2, 2003
- National Transportation Communications for ITS Protocol (NTCIP) Standards, current edition, as noted.
- 2003 American Association of State Highway and Transportation Officials (AASHTO) criteria specified.
- ANSI/TIA/EIA-568-B, Commercial Building Telecommunications Cabling Standard, dated May 2001 or latest revision.



## SUMMARY

This specification implements traffic signal control standards throughout City of Allentown in order to provide a standardization of traffic signal equipment, facilitate an Adaptive Traffic Signal system, and to reduce long-term maintenance costs. These standards pertain to materials, construction methods, traffic signal controller assembly, and traffic signal supports and shall be strictly followed for all traffic signal construction projects.

The purpose of this specification is to provide design engineers and qualified traffic signal contractors with the general requirements and administrative details governing the furnishing and installation of traffic signals, signs, and pavement markings within the City of Allentown.

## REQUIREMENTS AT ALL LOCATIONS WITHIN THE CITY

### GENERAL REQUIREMENTS

Special provisions for vendor specific equipment and non-standard PennDOT items have been included as part of this document. It is the responsibility of the Contractor to contact the City to determine which special provisions apply for a particular installation.

Contractor shall furnish all materials, implements, machinery, equipment, tools, supplies, transportation, labor and supervision required to construct the facilities as shown on contract drawings and specified herein. It shall be the responsibility of the Contractor to proceed with the work in the matter such limitations as may be prescribed by the Engineers. Construction methods should conform to the latest editions of PennDOT Publication 408 and Traffic Control 8800 Series, unless specified in the City of Allentown specifications.

It is the responsibility of the entity installing the traffic signal to secure all necessary PennDOT Highway Occupancy Permit and PennDOT Traffic Signal Permit approvals before work begins.

All traffic signal Contractors working in the City of Allentown must be PennDOT pre-qualified to perform traffic signal work. All Contractor personnel setting up work zone controls and performing flag duties must be IMSA Work-Zone Safety certified. All personnel performing electrical work must be IMSA Traffic Signal Technician Level I certified as a minimum requirement. A supervisor must be on-site during the installation of any electrical work and said supervisor must be IMSA Traffic Signal Technician Level II certified. Furnish the City with a copy of said certificates.

### UTILITY NOTIFICATION

The Contractor is responsible for notifying the Pennsylvania One-Call System in accordance with PA Act 181 of 2007. It is also the Contractor's responsibility to protect all utilities from damage during work that has been marked through the PA One-Call System. The Contractor shall notify the City of Allentown ten (10) working days prior to any excavation work to verify any local utilities which may be in the excavation area. When a utility is damaged the Contractor must stop all work and notify the appropriate utility and the City Representative. The Contractor shall be responsible for any damage caused to marked utilities and for any damage caused to unmarked utilities after the initial damage occurs.

### INSPECTION OF TRAFFIC SIGNAL WORK

It shall be the responsibility of the Contractor to arrange a pre-construction meeting with the City of Allentown Traffic Engineer on-site to spot signal poles, controller cabinet pad, and vehicle detector locations in the field. The City of Allentown Traffic Engineer will notify the appropriate parties at

PennDOT of the meeting. No work may begin until this meeting has been held and the intended scope of the signal installation is satisfactory to all parties.

Once work has begun, the Contractor shall be responsible for notifying the City of Allentown 24 hours prior to the following, so that a representative of the City may be on-site to inspect the following work:

- Installation of signal pole foundations before concrete is placed;
- Trenching and conduit installation before backfilling occurs;
- Saw cutting for loop detector installation before sealing;
- Installation of loop detector wire, prior to sealing;
- Completion of loop detector series, inductance, and resistance testing in accordance with PennDOT Publication 408 before splices are sealed within the junction box.

Contractor shall test all standard inductance loop detectors in the controller assembly in the presence of the City.

Contractor shall test all ground rods in the presence of the City. **Resistance to ground shall be 10 ohms or less.** Copies of the ground rod tests shall be provided to the City and shall be placed in the controller cabinet. Testing shall be performed with an approved ohm meter for testing earth-ground resistance.

Contractor shall test all switches and push buttons located within the switch compartment in the presence of the City.

## **REQUIRED SUBMITTALS**

1. Two (2) copies of the catalog cut sheets for all materials must be provided to the City before construction begins. In addition, send an electronic PDF file for each submittal to the City consultant engineer. Include the type of material, manufacturer's name, model number, and PennDOT Approval Numbers (where applicable) for each item to be supplied for review and approval.
2. Provide a minimum of five (5) copies of pole manufacturer mast arm shop drawing and calculations.
3. Provide malfunction management unit bench test certification.
4. Provide three (3) sets of as-built record plans to the City upon final inspection and acceptance of the signal.

5. Provide three (3) copies of the cabinet wiring diagram to the City as per PennDOT Form 408, Section 954.3(j) upon final inspection and acceptance of the signal.
6. Provide three (3) 8.5x11 copies of the following information for all equipment that has a PennDOT approval number, upon delivery of the controller assembly to the site: Brand name, model name/number, PennDOT approval number, and serial number, warranty date (beginning and end).

## ACCEPTANCE OF TRAFFIC SIGNAL INSTALLATION BY CITY

### 1. THIRTY-DAY (30) TESTING PERIOD

Upon completion of the Scope of Work, a **THIRTY-DAY (30) TESTING PERIOD** shall begin. The contractor shall hold a meeting with the PennDOT Traffic Unit and the City Traffic Engineer to begin the thirty-day testing period. During this period, the Contractor must commence repairs for signal flash or blackout within 1 hour of notification by the City. Also, the Contractor must correct all failures by repairing or replacing malfunctioning parts or equipment or faulty workmanship, regardless of the cause, within 24 hours after having been notified by the City. The contractor will be responsible to supply a spare controller unit, Conflict Monitor, master controller, and/or detectors or cameras during the repair period. In addition, during this period the Contractor must guarantee the satisfactory in-service operation of mechanical and electrical equipment, related components, signing, pavement markings, and the controller assembly, regardless of the cause for unsatisfactory operation. After correcting failures for any reason, the thirty (30) day testing period shall be re-started. Conduct the test for the remainder of the testing period or 15 days, whichever is the longer period.

### 2. PRE-DEDICATION MAINTENANCE PERIOD

Upon satisfactory completion of the Thirty-Day (30) Testing Period, a **MAINTENANCE PERIOD** shall begin. The Maintenance Period shall be effective for a minimum period of one-year or as described in the Land Development Agreement from satisfactory completion of the Thirty-Day (30) Testing Period or until satisfactory **completion of all necessary roadway improvements as part of the land development agreement process, whichever is longer**. During the Maintenance Period, the Contractor shall:

- Maintain equipment in the controller cabinet, using additional locks as necessary to prevent entry by others; supply a set of keys for the additional lock(s) to the City in case of an emergency;
- Repair faulty workmanship, repair or replace defective materials or equipment and correct malfunctions in the controller cabinet within 48 hours after commencing repairs;

- Commence repairs no later than the working day following notification of failures or malfunctions, except for failures or malfunctions which result in a signal flash or blackout in which case repairs must commence within 1 hour upon notification by the City;
- If the Contractor does not report on-site within 2 hours following notification of a signal flash or blackout, the City shall have the option to commence repairs through the City's Traffic Signal Contractor. The developer's escrow for the project shall then be billed accordingly for work performed by the City's Traffic Signal Maintenance Department;
- Guarantee repairs or replacements for the balance of the Pre-Dedication Maintenance Period; Provide the City's Director of Public Works: City Traffic Engineer and the Chief of Police with the name and telephone number of the person to be notified in the event of failures or malfunctions during the guarantee period or a period agreed to by the developer and made part of the Land Development Agreement.

## 2.1 DEVELOPER MAINTENANCE PERIOD

Maintenance in perpetuity by the developer or his representative will be in accordance with the standard Annual Preventative Maintenance Summary as outlined in the City's Traffic Signal Maintenance Guidelines. The developer as outlined in the Land Development Agreement will be responsible for the fee's associated with the daily maintenance, required upgrades by the Department of Transportation, Electrical service fees, insurance fee and all equipment and maintenance responsibilities associated with the approved PennDOT Traffic Signal Permit.

## 3. FINAL ACCEPTANCE

The following shall signify **FINAL ACCEPTANCE** of the work:

- Satisfactory completion of the Thirty-Day (30) Testing Period and Maintenance Period;
- Satisfactory completion of all outstanding construction items as outlined by the Engineer;
- Submission of all required documentation to the satisfaction of the Public Works Director and City Engineer.

### Required Documents

- As-built record plans (hard copy and electronic)
- Warranties
- Operation Manuals
- Certifications
- Test Results

## TECHNICAL SPECIFICATIONS

### GENERAL

The work supplied for traffic signal construction shall consist of furnishing all new equipment, supplies, labor, transportation, fuel and power, and performing all work as required by the project Contract and pursuant to this ordinance, in strict conformance with the specifications, schedules and drawings and applicable PennDOT specifications and standards. The item of work shall consist of furnishing and installing the traffic control equipment indicated in the contract documents, including: controller cabinets; Adaptive/traffic responsive system upgrades (closed loop); electrical distribution system; vehicular signal heads; standard traffic signal supports or ornamental traffic signal supports, as indicated; loop detectors; video detectors; on-street communication hardware; junction boxes; signs; sign posts; pavement markings; and all necessary appurtenant work and materials necessary to complete the work indicated.

**The contractor must contact the City or the scheduling of all meetings requiring representatives from the PennDOT.**

**The contractor must test each ground rod in each controller cabinet foundation and each pole foundation individually for the entire intersection. The contractor must also test the grounding system as a whole.**

### MATERIALS

All materials supplied shall be approved by the City Representative. The City Representative will require that all materials be in accordance with the Pennsylvania Department of Transportation (PennDOT) Publication 408 Specifications, National Electrical Manufacturer's Association Standards Publication No. TS1, or these specifications.

City of Allentown, in order to minimize maintenance costs, has established a standard **Material List** (See Appendix A) for use at all intersections within the City.

### CONSTRUCTION METHODS

Construction methods shall be in accordance with the applicable sections of PennDOT Publication 408, PennDOT Publication 148, PennDOT Publication 111M, and PennDOT Publication 149.

## A. TRAFFIC SIGNAL CONTROLLER ASSEMBLY

### NEMA TS1, TYPE 1 (WITH TYPE 2 CONTROLLER UNIT)

#### 1. General

This specification sets forth the minimum requirements for a TS1 Type 1 traffic control cabinet assembly. The cabinet assembly shall meet, as a minimum, all applicable sections of the NEMA Standard Publication No. TS1-2003. Where differences occur, this specification shall govern.

The following components shall be of the same manufacturer: McCain Controller Mechanism, EDI Conflict Monitor, Controller Back Panel, Detector Rack, and Power Supply.

All traffic signal controllers will be equipped with the required internal circuitry to facilitate communication through Ethernet.

#### 2. Cabinet Design and Construction

- 2.1 All Cabinets shall be Type 1 mounting (base mounting), unless otherwise identified on the plans and **specifications**.
- 2.2 The cabinet shall be constructed from type 5052-H32 aluminum with a minimum thickness of 0.125 inches.
- 2.3 The cabinet shall be designed and manufactured with materials that will allow rigid mounting, whether intended for pole, base or pedestal mounting. The cabinet must not flex on its mount.
  - 2.3.1 A rain channel shall be incorporated into the design of the main door opening to prevent liquids from entering the enclosure. The cabinet door opening must be a minimum of 80 percent of the front surface of the cabinet. A stiffener plate shall be welded across the inside of the main door to prevent flexing.
  - 2.3.2 The top of the cabinet shall incorporate a 1-inch slope toward the rear to prevent rain accumulation.
- 2.4 Unless otherwise specified, the cabinet shall be supplied with a natural aluminum finish. Sufficient care shall be taken in handling to ensure that

scratches are minimized. All surfaces shall be free from weld flash. Welds shall be smooth, neatly formed, free from cracks, blow holes and other irregularities. All sharp edges shall be ground smooth.

- 2.5 All seams shall be sealed with RTV sealant or equivalent material on the interior of the cabinet.
- 2.6 All cabinets shall be supplied with (2) two removable shelf manufactured from 5052-H32 aluminum. Shelf shall be a minimum of 10 inches deep.
- 2.7 The shelf shall have horizontal slots at the rear and vertical slots at the front of the turned down side flange. The shelf shall be installed by first inserting the rear edge of the shelf on the cabinet rear sidewall mounting studs, then lowering the shelf on the front sidewall mounting studs. The shelves shall be held in place by strut nuts.
- 2.8 The front edge of the upper shelf shall have holes punched every 6 inches to accommodate tie-wrapping of cables/harnesses.
- 2.9 Two set of vertical "C" channels shall be mounted on each interior wall of the cabinet for the purpose of mounting the cabinet components. The channels shall accommodate spring mounted nuts or studs. All mounting rails shall extend to within 7 inches of the top and bottom of the cabinets. Sidewall rail spacing shall be 7.88 inches center-to-center. Rear wall rail spacing shall be 18.50 inches center-to-center.
- 2.10 The main door and police door-in-door shall close against a weatherproof and dust-proof, closed-cell neoprene gasket seal. The gasket material for the main door shall be a minimum of 0.250 inches thick by 1.00 inch wide. The gasket material for the police door shall be a minimum of 0.250 inches thick by 0.500 inches wide. The gaskets shall be permanently bonded to the cabinet.
- 2.11 The lower section of the cabinet shall be equipped with a louvered air entrance. The air inlet shall be large enough to allow sufficient air flow per the rated fan capacity. Louvers must satisfy the NEMA rod entry test for 3R ventilated enclosures. A non-corrosive, vermin- and insect-proof, removable air filter shall be secured to the air entrance. The filter shall fit snugly against the cabinet door wall. The roof of the cabinet shall incorporate an exhaust plenum with a vent screen. Perforations in the vent screen shall not exceed 0.125 inches in diameter.

MINIMUM OF 2  
FANS REQUIRED  
PER NV 5-17-17



- 2.12 The main door on a size 3 or larger cabinet shall be equipped with a three-point latching mechanism with Nylon Rollers at top and bottom.
- 2.13 The handle on the main door of a size 4 or larger cabinet shall utilize a shank of 5/8 inches minimum diameter. The handle on the main door of a size 2 or 3 cabinet shall utilize a shank of 7/16 inches minimum diameter. The handle shall include a hasp for the attachment of an optional padlock. The cabinet door handle shall rotate counter-clockwise to open. The handle shall not extend beyond the perimeter of the main door at any time. The lock assembly shall be positioned so that the handle shall not cause any interference with the key when opening the cabinet door.
- 2.14 The main door hinge shall be a one-piece, continuous piano hinge with a stainless steel pin running the entire length of the door. The hinge shall be attached in such a manner that no rivets or bolts are exposed.
- 2.15 The main door of a size 3 or larger cabinet shall include a mechanism capable of holding the door open at approximately 90, 125, and 150 degrees under windy conditions. Manual placement of the mechanism shall not be required by the field technician. The main door of a size 2, 3, or 4 cabinet shall include a mechanism capable of holding the door open at approximately 90 and 150 degrees under windy conditions.
- 2.16 The main door shall be equipped with a Corbin tumbler lock number 1548-1. Three keys shall be supplied.
- 2.17 The police door-in-door shall be provided with a treasury type lock Corbin No. R357SGS or exact equivalent and three keys.
- 2.18 All base mounted cabinets shall be supplied with anchor bolts to properly secure the cabinet to its base. The cabinet flange for securing the anchor bolts shall not protrude outward from the bottom of the cabinet. When a size 1, 3, 6 or 7 cabinet is base mounted, two anchor bolts shall be provided. Size 1, 6 and 7 cabinets shall be provided with four anchor bolts.
- 2.19 Each cabinet shall be of sufficient size to accommodate all equipment. At a minimum, the minimal cabinet sizes are as follows:
- Size 1 cabinets - 58" H x 30" W x 17" D**
  - Size 3 cabinets - 50" H x 30" W x 18" D**
  - Size 6 cabinets - 55" H x 44" W x 26" D**
  - Size 7 cabinets - 71" H x 44" W x 26" D (Opt. Type 6 w/ 18" skirt)**

**The standard size controller cabinet for City of Allentown projects shall be a Size 6. Controllers in which master controllers or uninterruptible power supplies are specified shall be Size 6.** Other cabinet sizes and/or combinations may be used, upon approval by the City Traffic Engineer.

### **3. Terminals and Facilities/Main Panel Design and Construction**

- 3.1 The main panel shall be constructed from 5052-H32 brushed aluminum of 0.090 inches minimum thickness and formed so as to minimize any flexing when plug-in components are installed.
- 3.2 All 8-, 12- and 16-position main panels shall be hinged at the bottom to allow easy access to all wiring on the rear of the panel. All 8-position main panels may optionally be hinged on the right side. A minimum of 12-position main panels are required in City of Allentown.
- 3.3 The main panel shall be fully wired in the following configuration:
  - a. Configuration #1 - Twelve load switch sockets, six flash transfer relay sockets, one flasher socket, one 16-channel detector rack (expandable to 4) with one power supply, and one Type-12 CMU
  - b. Configuration #2 - Sixteen load switch sockets, six flash transfer relay sockets, one flasher socket, one 16-channel detector rack (expandable to 4) with one power supply, and one Type-16 CMU. Configuration #2 shall be provided with cabinet size #3, 6 and 7.
- 3.4 All load switch and flash transfer relay socket reference designators shall be silk-screen labeled on the front and rear of the main panel to match drawing designations. Socket pins shall be marked for reference on the rear.
- 3.5 All load switches shall be mounted in a single horizontal row.
- 3.6 All load switches shall be supported by a bracket or shelf extending at least half the length of the load switch.
- 3.7 Rack style mounting shall be provided to accommodate the required configuration listed in section 3.3 above.
  - 3.7.1 The 4- and 8-load switch position main panels may have all field wires contained within one horizontally-mounted terminal block.

- 3.8 The 12- and 16-load switch position main panels shall have all field wires contained on one row of horizontally mounted terminal blocks. The upper row shall be wired for the pedestrian and overlap field terminations.
- 3.9 All field output circuits shall be terminated on an unfused compression type terminal block with a minimum rating of 10 amps.
- 3.10 All field input/output (I/O) terminals shall be identified by permanent alphanumeric labels. All labels shall use standard nomenclature per the NEMA TS1 specification.
- 3.11 All field flash sequence programming shall be accomplished at the field terminals with the use of a screwdriver only. It shall also be possible to program which flasher circuit the phase shall be programmed to.
  - 3.11.1 Field terminal blocks shall be wired to use three positions per vehicle or overlap phase (green, yellow, red). It shall not be necessary to debus field terminal blocks for flash programming.
- 3.12 The main panel shall contain at least one flasher socket (silk screen labeled) capable of operating a 15-amp, 2-pole, NEMA solid state flasher. The flasher shall be supported by a bracket that extends at least half its length.
- 3.13 One RC network shall be wired in parallel with each flash-transfer relay and any other relay coils.
- 3.14 All logic-level, NEMA-controller and Conflict Monitor Unit input and output terminations on the main panel shall be permanently labeled. Cabinet prints shall identify the function of each terminal position.
- 3.15 At a minimum, four 20-position terminal blocks shall be provided at the top of the main panel to provide access to the controller unit's programmable and non-programmable I/O. Terminal blocks for DC signal interfacing shall have a number 6-32 x 7/32 inch screw as minimum.
- 3.16 All wiring, 14 AWG and smaller, shall conform to MIL-W-16878/1, type B/N, 600V, 19-strand tinned copper. The wire shall have a minimum of 0.010 inches thick PVC insulation with clear nylon jacket and rated to 105 degrees Celsius. All 12 AWG and larger wire shall have UL listed THHN/THWN 90 degrees Celsius, 600V, 0.020 inches thick PVC insulation and clear nylon jacketed.

- 3.17 All controller and Conflict Monitor Unit cables shall be of sufficient length to allow the units to be placed on either shelf or the outside top of the cabinet in the operating mode. Connecting cables shall be sleeved in a braided nylon mesh. The uses of exposed tie-wraps or interwoven cables are unacceptable.
- 3.18 All main panels shall be pre-wired for a Type-12 or 16 Conflict Monitor Unit.
- 3.19 All wiring shall be neat in appearance. All cabinet wiring shall be continuous from its point of origin to its termination point. Butt type connections/splices are not acceptable.
- 3.20 All connecting cables and wire runs shall be secured by mechanical clamps. Stick-on type clamps are not acceptable.
- 3.21 The grounding system in the cabinet shall be divided into three separate circuits (AC Neutral, Earth Ground, and Logic Ground). These ground circuits shall be connected together at a single point as outlined in the NEMA TS1 Standard.
- 3.22 All pedestrian push-button inputs from the field to the controller shall be opto-isolated and operate at logic ground.
- 3.23 All wire (size 16 AWG or smaller) at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. Lap joint soldering is not acceptable.

#### **4. Power Panel Design and Construction**

- 4.1 The power panel shall consist of a separate, wholly enclosed module, securely fastened to the right side wall of the cabinet. The power panel shall be wired to provide the necessary power to the cabinet, controller, cabinet power supply and auxiliary equipment. It shall be manufactured from 0.090-inch, 5052-H32 aluminum with a removable plastic front cover. The panel shall be of such design so as to allow a technician to access the main and auxiliary breakers without removing the front cover.
- 4.2 The power panel shall house the following components:
  - a. A 30-amp main breaker shall be used for 12, 8, or 4-position cabinets. This breaker shall supply power to the controller, conflict monitor, signals, cabinet power supply and auxiliary panels. Breakers shall be

thermal magnetic type, U.L. listed for HACR service, with a minimum of 10,000 amp interrupting capacity.

- b. A 15-amp auxiliary breaker. This breaker shall supply power to the fan, light, GFI outlet, and auxiliary outlet.
- c. A surge arrester **as per Material List**.
- d. A 35 amp, 125 VAC radio interference line filter.
- e. A normally-open, 60-amp, mercury contactor **as per Material List**.
- f. Two (2) 15-position neutral bus bars capable of connecting three #12 wires per position shall be provided.
- g. A 7-position ground bus bar capable of connecting three #12 wires per position.
- h. A NEMA type 5-15R GFCI convenience outlet.

## 5. Auxiliary Cabinet Equipment

- 5.1 The cabinet shall be provided with two (2) thermostatically controlled (adjustable between 80-150 degrees Fahrenheit) ventilation fan in the top of the cabinet plenum. The fan shall be a ball bearing type fan and shall be capable of drawing a minimum of 100 cubic feet of air per minute.
- 5.2 An LED lighting fixture shall be mounted on the inside top of the cabinet near the front edge. The lamp shall be wired to a 15-amp door-activated switch mounted near the top of the door.
- 5.3 An enclosed drawer, of sufficient size to accommodate one complete set of cabinet prints, shall be provided and mounted on the left side of the cabinet below the detector shelf.
- 5.4 Three sets of complete and accurate cabinet drawings shall be supplied with each cabinet.
- 5.5 One set of manuals for the controller, Conflict Monitor Unit and vehicle detector amplifiers shall be supplied with each cabinet. Supply the municipality with five additional sets.

- 5.6 If required by the City, the master cabinet shall be provided with a pre-wired telephone jack placed to facilitate connection of telephone lines.
- 5.7 The cabinet shall be furnished with an in-door switch to advise system/master/local controller of a “door-open” condition.
- 5.8 The cabinet shall be provided with a surge protection package. Surge protection to be solid state design, continuous service current – 15A at 120V RMS, rated at 20,000A (8 x 20 microseconds) 20 times, peak clamping voltage: 250V at 20kA. Provide terminals for AC line, AC neutral, AC equipment in, AC equipment out, neutral equipment out and ground.
- 5.9 A minimum five-position auxiliary outlet strip for optional equipment shall be installed vertically on the right side of the cabinet between shelves one and two.
- 5.10 Telephone connections shall be provided data line surge suppressor **as per Material List**.
- 5.11 At locations to be determined by the City, an external multi-modem **as per Material List**, meeting Caltrans roadside environmental standards, shall be supplied.

## 6. Vehicle Detection

**Note: All vehicle detection shall utilize non-invasive video detection for all intersection/stop bar detection unless otherwise approved by the City. All advanced detection (i.e., greater than 200 feet from the stop bar) shall utilize a non-invasive dilemma zone detection system as per the Material List, unless otherwise approved by the City.**

- 6.1 Vehicle detector amplifier rack(s) shall be provided in each cabinet with sufficient slots to provide the required channels of detection as per the project specifications. Detector racks shall be available in the following configuration:

Supporting at least 16 channels of loop detection, two 2-channel preemption devices and one (1) power supply.

When installing loop detectors, provide vehicle detector amplifier rack(s) as per **Material List**. Unless otherwise noted, GridSmart Camera detection will be required.

- 6.2 All detector positions shall be wired for dual output function. Each detector position shall have two presence and two count functions.
  - 6.3 Each cabinet shall contain detector interface panels for the purpose of connecting field loops and vehicle detector amplifiers.
  - 6.4 One 16-position interface panel shall be provided for a 16-channel rack cabinet. The interface panel shall be secured to a mounting plate and attached to the left sidewall of the cabinet.
  - 6.5 When loop detectors are utilized, each interface panel shall allow for the connection of sixteen independent field loops. A ground bus terminal shall be provided between each loop pair terminal to provide a termination for the loop lead-in cable ground wire.
  - 6.6 A lightning arrestor **as per Material List** shall be provided for each loop input position.
  - 6.7 A cable consisting of 20 AWG twisted pair wires shall be provided to enable connection to and from the panel to a detector rack. The twisted pair wires shall be color-coded red and white wire.
  - 6.8 All termination points shall be identified by a unique number and silk screened on the panel.
  - 6.9 Adequate loop detectors amplifiers **as per Material List** shall be supplied with each cabinet. Each loop at the project intersection shall be provided with a separate channel for detection and count function. A separate lead-in cable shall be provided for each channel of detection. One spare amplifier shall be provided for each cabinet rack.
  - 6.10 Each detector rack shall be powered by the cabinet power supply (refer to section 8.6 of this specification).
  - 6.11 The use of stacked detector racks is not acceptable. Spare loop detectors that are not dedicated to a phase or system assignment will have a plastic tag attached and stamped with the words "Not Used".
7. **Cabinet Test Switches and Police Panel**
- 7.1 A test switch panel shall be mounted on the inside of the main door. The test switch panel shall provide as a minimum the following:

- a. AUTO/FLASH SWITCH. When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall not be stop timed when in flash. If required by the plans and specifications, an optional RC network shall be provided to give the controller an external start pulse when switch is returned to the auto position. This will force the controller to initiate the startup sequence when exiting flash.
  - b. STOP TIME SWITCH. When applied, the controller shall be stop timed in the current interval.
  - c. CONTROL EQUIPMENT POWER ON/OFF. This switch shall control the controller, Conflict Monitor, and cabinet power supply AC power.
- 7.2 The police door switch panel shall contain the following:
- a. SIGNALS ON/OFF SWITCH. In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the Conflict Monitor shall not conflict or require reset.
  - b. AUTO/FLASH SWITCH. In the flash position, power shall not be removed from the controller and stop time shall be applied. If required by the plans and specifications, an optional RC network shall be provided to give the controller an external start pulse when switch is returned to the auto position. This will force the controller to initiate the startup sequence when exiting flash.
  - c. AUTO/MANUAL SWITCH. In the MANUAL position, the intersection shall be controlled by the provided momentary push button and hand cord. The cord and push button shall be stored within the closed police door when not in use.
- 7.3 All toggle type switches shall be heavy duty and rated 15 amps minimum. Single- or double-pole switches may be provided, as required.
- 7.4 Any exposed terminals or switch solder points shall be covered with a non-flexible shield to prevent accidental contact.
- 7.5 All switch functions must be permanently and clearly labeled.

- 7.6 All wire routed to the police door-in-door and test switch pushbutton panel shall be adequately protected against damage from repetitive opening and closing of the main door.
- 7.7 All test switch panel wiring shall be connected to the main panel via a 16-pin AMP type connector.

## **8. Auxiliary Devices**

### **8.1 Load Switches**

- 8.1.1 Load switches shall be solid state and shall conform to the requirements of the NEMA TS1 Standard.
- 8.1.2 Signal load switches shall have a minimum rating of 10 amperes at 120 VAC for an incandescent/LED lamp load.
- 8.1.3 The front of the load switch shall be provided with three indicators to show the input signal from the controller to the load switch.
- 8.1.4 Load switches shall be dedicated per phase. The use of load switches for other partial phases is not acceptable.

### **8.2 Flashers**

- 8.2.1 The flasher shall be solid state and shall conform to the requirements of the NEMA TS1 Standard.
- 8.2.2 Flashing of field circuits for the purpose of intersection flash shall be accomplished by a separate flasher.
- 8.2.3 The flasher shall be rated at 15 amperes, double pole with a nominal flash rate of 60 FPM.

### **8.3 Flash Transfer Relays**

- 8.3.1 All flash transfer relays shall meet the requirements of the NEMA TS1 Standard.

8.3.2 The coil of the flash transfer relay must be de-energized for flash operation.

8.3.3 The full complement of relays, a minimum of eight, shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

#### **8.4 CONFLICT MONITOR**

8.4.1 Each cabinet assembly shall be supplied with one Conflict Monitor as defined by the requirements of the NEMA TS1 Standard.

8.4.2 Where two or more cabinet assemblies are supplied on a project, one spare Conflict Monitor shall be supplied to the City.

### **9. Testing and Warranty**

#### **9.1 Testing**

9.1.1 Each controller and cabinet assembly shall be tested as a complete entity under signal load for a minimum of 48 hours. The signal load and detector loads shall simulate actual intersection conditions.

9.1.2 Each assembly shall be delivered with a signed document detailing the cabinet final tests results as results as performed.

9.1.3 The cabinet shall be assembled and tested by the controller manufacturer or authorized local distributor to ensure proper component integration and operation.

9.1.4 The City Traffic Engineer shall be notified, in writing, at least 48 hours in advance of the bench testing of the controller. No controller shall be released until an inspection of the controller assembly at the bench test site has been completed by the City Traffic Engineer.

#### **9.2 Warranty**

9.2.1 The controller shall be warranted by the manufacturer against mechanical and electrical defects for a period of 5 years. The manufacturer's

warranty shall be supplied in writing with each cabinet and controller. Second party extended warranties are not acceptable. This warranty shall be provided by the manufacturer/vendor/contractor with no regard to selection of other traffic signal components.

9.2.2 The cabinet assembly and all other components shall be warranted for a period of one year starting at the final acceptance of the project.

9.2.3 Any defects shall be corrected by the manufacturer or supplier at no cost to the City.

## 10. Spare Equipment

10.1 Supply spare(s) of the following equipment per cabinet:

10.1.1 Four load switches

10.1.2 Two relays

## B. TRAFFIC SIGNAL SUPPORTS

- 1.1 Where directed, all sites specifying the use of "Standard Traffic Signal Supports", shall meet the requirements set forth in PennDOT Publication 408, specifically Sections 950 and 951.
- 1.2 Manufacturer's requirements shall follow the guidelines found in PennDOT Publication 408, as well as manufacturer's requirements for the loadings. Compliance with bolt circles and bases are as set forth in PennDOT Publication 148, Traffic Standards - Signals (TC-8800 series).
- 1.3 All standard traffic signal supports shall be equipped with an overbuild for future highway lighting unless otherwise directed by the City. When a luminaire is to be provided, it shall be approved LED full cut-off type. The supplied davit arm shall match the finish of the mast arm, with a standard mounting height of 30' **As per Materials List.**
- 1.4 Vertical support poles and mast arms to be designed by manufacturer to adequately support loads as shown on the contract drawings with a luminaire arm or maximum load requirements established by AASHTO specifications for structural supports for highway signs, luminaires and traffic signals, whichever is greater.

- 1.5 All support poles are to be painted Black. Sherwin Williams polyamide epoxy primer to a DFT of 4-6 mils to all exterior surface. Finish paint with one (1) coat of Sherwin Williams polyurethane enamel Corothane, polane 2.8 plus or hi-solids polyurethane to a DFT of 2-3 mils. All poles are to be wrapped in ripple Kraft paper and packaged in corrugated cardboard prior to shipment.
- 1.6 When Ornamental poles are specified, the City will determine the specific design, style, color and base configuration. See Appendix C.

## C. VEHICULAR DETECTION

### 1. Video Detection

- 1.1 At all signalized intersections, the use of video detection **as per Material List** will be required for each approach.
- 1.2 Provide a video detection system which provides detection as shown on the approved permit plan and a minimum of four (4) additional detection zones.

### 2. Loop Sensor

- 1.1 At locations identified and approved by the City, inductance loop detectors will be installed.
- 1.2 Loop sensors shall be installed in accordance with PennDOT Form 408, Section 1104.07 and PennDOT Standard Drawing TC-8806.
- 1.3 The contractor must notify the City twenty four (24) hours prior to cutting and/or sealing of any loop detector included within any project to arrange for appropriate inspection.

The contractor will perform leakage resistance, series resistance and inductance tests as outlined in PennDOT Form 408, Section 956 in the presence of the City. The contractor shall place a record of test results in the controller cabinet.

- 1.5 Loop wire shall be 14AWG minimum, in accordance with IMSA specification 51-5 and PennDOT Form 408, dated 2011.

- 1.6 The contractor shall secure the loop wire in the bottom of the slot by use of backer rod or other means prior to the application of sealant. Backer rod will be 2" - 4" strips placed in saw cut at intervals of three feet.
- 1.7 When a loop sensor is crossing a crack of greater than 3/8" in the roadway, a 2" diameter hole will be drilled into the surface, and the loop wire installed with approximately 1" of slack in the hole. The hole is then sealed by acceptable means.
- 1.8 Saw cutting of curbs will not be permitted. Saw cuts across concrete joints shall have a 1/2-inch PVC sleeve installed to the proper depth that extends 4-inches in each direction from the joint.
- 1.9 All 90-degree corners where loop wires turn shall be made as two (2) 135-degree cuts. Saw cuts shall be cleaned, dried, and free from dust, grit, oil, and moisture before the placement of wire.
- 2.0 The loop sensor wire shall be clearly and permanently tagged in the junction box identifying the individual loop number from the Traffic Signal Construction Plan that shall match the loop number indicated on the rack mounted detector amplifier.

## 2. Loop Detector Lead-In Cable

- 2.1 Loop detector lead-in cable shall be #14AWG, 2 conductors twisted shielded cable, in accordance with IMSA specification 50-2 and PennDOT Form 408.
- 2.2 Loop detector lead-in cable shall be compatible with detector amplifier transceiver units furnished.
- 2.3 All loop splices in junction boxes shall be made by an approved waterproof, re-entenable splice kit or Silicone filler wire nut **as per Material List**. Wire cap minimum size shall be #5, UL listed.
- 2.4 All loop splices shall be soldered with an approved silver base solder.
- 2.5 Loop Wire Identification Tags: Tags shall be **as per Material List** and horizontal style. The tag shall read "Loop#1" "Blank" "Phase Symbol" "Phase Number." Provide button stops and two (2) 1-inch diameter (T-1) E-2 ties, one to loop through the tag and one to attach to the loop wire.

### 3. Loop Detector Amplifier

- 3.1 Install rack assemblies in accordance with current NEMA standards.
- 3.2 Provide amplifiers **as per Material List**. Each loop sensor shall have a separate dedicated channel of detection.
- 3.3 The amplifiers shall be clearly labeled with loop number, detector input, and phase called.
- 3.4 Supplier shall be responsible for insuring that the rack power supply is rated sufficiently for the amount and types of cards being used.
- 3.5 Loop, slot assignments, detector input, and card type shall be approved by the Owner prior to cabinet set-up.

### 4. Infrared Detection

- 4.1 At locations identified and approved by the City, the use of infrared detection **as per Material List** will be required.

### 5. Advanced Detection, Radar

- 5.1 At locations identified by the City, the use of radar detection **as per Material List** will be required.

### 6. Alternate Detection Methods

- 6.1 Alternate detection methods may be accepted upon review by the City.

## D. PAVEMENT MARKINGS

All pavement markings shown on the plans shall be either thermoplastic or epoxy pavement markings. Thermoplastic markings shall not be installed on concrete pavement. Furnish and install pavement markings as shown on the PennDOT approved permit plan. Any pavement marking removal will be considered incidental to the application of the new markings, and should be completed in accordance with section 963 of PennDOT Form 408.

The contractor will be responsible to maintain all pavement markings installed under a contract for a period of 180 days from the conclusion of the 30-day test period. If during this period, the City Traffic Engineer or PennDOT determines the pavement markings are in need of

replacement, it will be the responsibility of the prime contractor to complete this work at no cost to the City.

All pedestrian crosswalks within the City limits shall be continental style crosswalks.

#### **E. SIGNAL HEAD ASSEMBLIES**

Conforming to PennDOT Sections 955 and 1104.06, one way, 12" adjustable, sectional, LED, complete with all brackets and rigid mounting attachments.

1. All signal wiring must terminate on terminal strips. Splices are only permitted in the traffic signal support hand hole, and must be made with silicone-filled wire nuts **as per Material List**. Complete encapsulation of the individual conductors is required.
2. All signals shall have a drip loop attached with UV stabilized nylon wire ties.
3. All signal brackets shall be attached with 3/4-inch stainless steel banding
4. Back plates shall be black, one-piece, aluminum, if requested on the Traffic Signal Permit Plan. All hardware shall be stainless steel. Back plates shall be designed to properly fit the signal manufacturer's heads that will be furnished.
5. Provide vehicular and pedestrian signal heads **as per Material List**.

#### **F. FIBER OPTIC TRAFFIC CONTROL INTERCONNECT CABLE**

##### **1. Fiber Optic Cable**

- 1.1 All fiber optic cable within the City of Allentown must be installed in a dedicated conduit system. Fiber optic cable installation should be coordinated with PennDOT for connection to the Regional Fiber Optic Network.
- 1.2 The Fiber Optic cable shall be single-mode tight buffered to provide storage and operating stability over the temperature range of -40C to +70C. The cable shall consist of a minimum of 96 to 144 optical fibers stranded around an all-dielectric central strength member. Each strand within a sub group will be color coded with 12 different colors.
- 1.3 Each fiber shall be single-mode and have a core/clad diameter of 9/125 micrometer. The fiber shall have an attenuation of not more than 1.0 dB/km at 1310 NM, and a bandwidth of 100 MHZ/km. The fiber and cladding shall be

jacketed with a PVC buffer tube. A second jacket shall envelope the fibers and dielectric strength member. This second jacket shall be wrapped with Kevlar/aramid reinforcement and the completed cable shall be encased in a polyethylene outer jacket.

- 1.3 The cable shall have a minimum diameter of .93 inches and a nominal weight of 309 pounds per 1000 feet. The cable shall withstand tensile loads of 600 pounds during installation and 80 pounds long term. The cable shall accommodate a seven-inch (13.9") radius of bending during installation and a six-inch (13.9") radius long term. Cable for underground installation in conduit need not be armored. Cable for overhead installations will be figure 8 type with a ¼" minimum galvanized steel messenger. The messenger shall be sized in accordance with the manufacturer's recommendations. The messenger will be terminated at the last pole, and under no circumstance will it enter the control cabinet.
- 1.4 Fiber Wire Identification Tags: Tags shall be manufactured/supplied by the fiber optic cable manufacturer. The tag shall read "City of Allentown Fiber Optic Cable". Provide button stops and two (2) 1-inch diameter (T-1) E-2 ties, one to loop through the tag and one to attach to the fiber wire.
- 1.6 Within the cabinet, the cable shall be broken out a minimum of three feet (3') or as required to allow easy attachment to a rack or wall mounted fiber tray. The fiber tray shall be sized to facilitate all fibers within the cabinet. The ends of the fiber shall be terminated using type ST connectors. These connectors shall have a metal body with either a stainless steel or a ceramic ferrule. Installation of the connector and attached to the bulkhead in the patch panel. Dust caps shall be used to protect the ends of all spare fibers. Connection between the Data Link and the patch panel will be made using manufactured ST type duplex patch cords. Patch cords shall be of sufficient length for proper connection and routing within the cabinet.

Test each fiber optic strand in the presence of the City to determine dB loss of each fiber optic cable. Test each strand by a certified fiber optic testing technician utilizing standard light measuring instruments. If dB loss is found to be unacceptable by the City, then OTDR testing must be conducted. Test each fiber optic strand using a certified fiber optic testing technician utilizing standard OTDR instruments. Replace fiber optic cable run if OTDR testing reveals unsatisfactory dB loss, as per manufacturer's recommendation, for the individual run, based on length of run.

## **2. Fiber Optic Break-out Box**

Furnish and install a fiber optic break-out box as necessary with a capacity for full splice storage and connection functions for a minimum of 48 fiber optic connections and meeting the following requirements:

- 2.1 Provide on the outside surface of the breakout box a minimum of 48 ST-type female optical connectors in order to plug in jumper cables that connect to the equipment. Provide twist-lock design for connectors. Provide dust caps for all connectors.
- 2.2 Connector insertion loss: +/- 0.25dB
- 2.3 Provide a removable top panel to protect the splices and pigtails in the breakout box.
- 2.4 Type 1, 3, 6 and 7 cabinets shall be supplied with a 19" EIA rack or wall mount tray with a minimum of 48 positions.

## **G. FIBER OPTIC DATA LINK**

### **1. Transceiver**

- 1.1 The fiber optic link shall be a dual mode, double duplex, multi-drop, communications link designed to interconnect traffic control equipment using RS-232 ports via fiber optic cable. It shall be a stand along device and shall not be incorporated into the controller.
- 1.2 The front panel shall contain two sets of fiber optic receptacles, designed to accept ST, SC or LC type connectors. Style to be determined by the City. There shall also be transmit and receive indicator lights, and a Master/Local Mode switch. In the Master Mode, the data link will receive and regenerate the signal prior to transmission to the next data link.
- 1.3 The data link will operate in a multi-drop operation utilizing an RS-232 interface with a 25 pin D DTE/DEC Select connector. It shall operate at a wavelength of 1310 nm single mode. To insure uninterrupted systems operation, the data link will be equipped with a rechargeable NiMH battery for 12-hour backup. It shall be capable of communications at speeds of up to 100 kbps. Minimum power budget shall be 15db.

- 1.4 The transceiver shall have a lifetime warranty.

## H. EMERGENCY PRE-EMPTION SYSTEM

### 1. Emergency Preemption

Furnish and install a complete emergency preemption system as per **Material List** that operates in accordance with the PennDOT approved traffic signal permit, and as follows:

- 1.1 Emergency Preemption equipment shall include GPS receiver detector, verification/confirmation beacons, preemption card rack, preemption cards, and wiring as required for proper operation of the system. Provide front panel connector for an auxiliary detector input.
- 1.2 The receiver shall detect approaching emergency vehicles for all of the approaches at a minimum range determined by the manufactures field survey. Additional detectors shall be required if minimum required distance is not met.
- 1.3 The traffic controller shall activate the confirmation lights, because only the traffic controller can determine accurately if entry into preemption mode has actually occurred.
- 1.4 The preemption system must be field tested in the presence of the City. Following testing, the detector head may need to be relocated and/or adjusted in the field to provide acceptable operation as deemed appropriate by the City and PennDOT.
- 1.5 Provide to the City a compatible combination optical/GPS transmitter emitter installed in the City emergency vehicle designated for each new emergency pre-emption system installed in the City.
- 1.6 All components of the GPS preemption system shall have full 10-year warranties against defects in material and workmanship, except for the GPS receivers, which shall have a 5-year warranty.

## I. UNINTERRUPTIBLE POWER SUPPLY

- 1. Provide a battery back-up system as per **Material List** in the controller cabinet.

2. Provide sufficient field-hardened batteries to run the intersection in normal operation for a minimum period of six hours from the time of AC power loss, minimum three (3) batteries rated at 105AH. Provide a recharge rate of 24 hours maximum to reach full charge from a complete discharge.
3. Provide a 0.25 inch-0.50 inch red LED indication light normally off on the cabinet exterior to indicate the battery back up in use, and loss of AC power. Install the light at a point visible from a vehicle traveling on the main street of the intersection. Provide watertight seal at LED installation point. Top of cabinet mounting is not permitted.

#### J. TRAFFIC CONTROL SIGNS

Contractor shall provide and install traffic control signs as shown on the plans and in accordance with PennDOT Publication 408, sections 930 through 936 and 1103 and as follows:

1. Contractor shall install all mast arm mounted signs with a Kelly Bracket or Astro Bracket with a minimum of two (2) Z-Type brackets on pipes that allow adjustment of the signs or on extruded aluminum stiffeners. All signs using stiffeners shall be installed in accordance with PennDOT Publication 111M, TC-8600/8700 Series.
2. All banding for structure-mounted signs shall be ¾-inch stainless steel banding. On painted poles provide epoxy paint coated stainless steel banding. Pedestrian pushbutton signs may use ½-inch stainless steel banding.
3. All post-mounted signs shall be installed on breakaway square sign posts. Two posts shall be provided for any signs over 48" wide.
4. Overhead Street Name Signs shall be white legend on green background and shall conform to PennDOT Publication 236M Standards for Series D3-4 and/or D3-5 signs.
5. Provide illuminated street name signs as per **Material List** for all traffic signals which are located along major arterials designated by the City.

#### K. WIRING, CONDUIT, AND JUNCTION BOXES

1. At all locations within the City, all traffic signal wiring shall conform to PennDOT Pub. 408 and IMSA 20-1 for cable in conduit systems. IMSA 19-1 shall be used for overhead span wire installations. All cable splices in base of traffic signal poles shall be connected by a waterproof type electrical connector. King Connectors, or approved equal shall be

used. All wiring for video detection systems and spread spectrum radio system shall be required.

2. Rigid Polyvinyl Chloride Conduit for direct burial shall be Schedule 40; 90C with a UL-651 Listing for rigid nonmetallic conduit; UL-514 Listing for fittings. Exposed conduit shall be galvanized steel rigid metal conduit (RMC) or RPCC, Schedule 80. UL Listed.
3. Conduit for fiber optic cable, as noted on the plans, shall be 3-inch diameter. Inter-duct will be required for each new cable installed. A suitable fiber optic locator tape shall be placed between 12–18” above the top of the conduit with a single 14 awg copper cable installed within the conduit system. All fiber optic conduits shall be installed at a minimum depth of 36” below finished grade.
4. Conduit installed across any roadway shall be a minimum 3-inch diameter. A minimum of two 3-inch conduits and one spare 3-inch conduit shall be installed in the controller cabinet foundation to allow for future expandability. One-inch conduit can only be used from a junction box to the loop sensor in the roadway, loop lead-in cables shall be installed in a minimum 2-inch diameter conduit. **Conduit for advanced loop detection (volume-density or system) shall be located 36” below finished grade.** Where conduit is only occupied by fiber optic cable, supply a 14 gauge copper wire trace for the entire conduit run. Where fiber optic cable and traffic signal cable occupy the same conduit, supply a plastic tag at each junction box or controller cabinet with the words *Fiber Optic Cable* stamped on the tag.
5. Install a spare 2-inch conduit from all pole bases to the adjacent junction box.
6. Provide junction boxes **as per Material List**. Junction box lids shall be labeled “Traffic Signal” or “Fiber Optic Cable” as appropriate and as directed by the City. All junction boxes must conform to all test provisions of the latest version of the ANSI/SCTE 77 “Specification For Underground Enclosure Integrity” for Tier 15 applications, as a minimum. In areas of deliberate and non-deliberate vehicular traffic and as determined by the City, junction boxes meeting greater load requirements will be provided.

#### L. GENERATOR/UTILITY TRANSFER ASSEMBLY

Provide to the City a generator **as per Material List** for each new traffic signal installation in the City.

1. An assembly shall be provided that will allow an automatic transfer between Utility and local fed electrical power in a manner that is both safe and simple to execute. No tools shall be used to affect the transfer. The assembly shall be installed inside of a NEMA 3R

cabinet measuring 14"x10"x7", and will be keyed to accommodate a standard traffic cabinet "police door" key.

2. The transfer action shall involve the de-energizing of a 10 amp relay to provide a seamless transition from utility to generator power. When the utility service is active the relay shall energize to supply a seamless transition to utility power. The generator shall be grounded to the controller assembly by a three prong NEMA L5-30 plug.
3. All elements of the assembly shall be designed to carry single phase 120vac 60 Hz. electrical current at 20 amperes. The transfer assembly shall be so constructed to physically prevent either power source from back-feeding the other. Only one power source may be connected to the load at any one time. All electrical connections shall be covered or recessed within insulating materials. Instructions & schematic detailing the transfer procedure and connections shall be attached to the assembly.
4. The Utility power shall enter the transfer assembly from a fused or breaker disconnect box. The generator power shall enter the transfer assembly from a compatible three-conductor industry standard inlet (NEMA L5-30P). A breaker, of amp city not to exceed the inlet's rated current, shall be connected between the inlets "hot" leg and the transfer assembly. A compatible surge protection device shall be connected between the load side of this breaker and an Earth connection. The common leg of the inlet shall be connected directly to the load's Neutral bus. The ground leg of the inlet shall be connected to an Earth connection.

## MATERIALS LIST

- Traffic Signal Controller: McCain Model ATCx, NEMA TS-2, Type 1, (McCain ATCx Controller shall operate in TS1, Type 1 configuration, with a Type 2 timer unit)
- System Software: McCain Transparency/QuicTrac. Current Version
- Conflict Monitor Unit: EDI, 12 -16 Channel, as per back panel positions
- Power Supply: EDI Power Supply with Test Jacks
- Traffic Signal Heads: McCain Polycarbonate Traffic Signal Heads (8" - only for signs and 12") with GE Lighting Solutions LED Lenses (Red, Yellow, and Green including LED Arrows)
- Pedestrian Signal Heads: McCain Aluminum signal heads, with Countdown, Upraised Hand, and Walking Person LED meeting ITE PTCSI Part-2: LED Pedestrian Traffic Signal Modules and PennDOT Publication 35 (Bulletin 15)
- Accessible Pedestrian System (APS): Polara Navigator AAPS
- Emergency Preemption: GTT Model 700 series GPS
- Fail Safe Indication: McCain – LED Enforcer
- Cabinet Door, Main Lock: Corbin tumbler lock # 1548-1
- Cabinet Door, Police Lock: Corbin # R357SGS or exact equivalent
- Power Panel Surge Arrestor: EDCO Model SHA-1250 or latest version
- Power Panel Mercury Contactor: Durakool Model BBC-7032 or solid state relay
- Data Line Surge Suppressor: HESCO Model DLP-4.2-3
- Ethernet Line Surge Suppressor: EDCO Model FAS-1-043 or equal

- External Multi-Modem: MultiTech Systems, Inc., external multi-modem Model IND or approved equal
- Detection Lighting Arrestor: EDCO SRA- 6LC approved equal
- Video Detection: GridSmart detection system or its latest version
- Loop Wire Identification Tags: ALMETEK Industries, Inc., Mini-Tag Series 4300 or approved equal
- Loop Detector Amplifiers: EDI C-1203, Oracle 2, or approved equal
- Infrared Detection: FLIR Model GridSmart or approved equal
- Radar Detection: Wavetronix Model 200 Dilemma Zone Detection or equal
- Detector Surge Suppressor: EDCO SRA 6LC or approved equal
- Cable Splice Connector: King Connectors or approved equal re-enterable silicon based connector
- Junction Boxes: Old Castle Brand or approved equal
- Battery Backup System: Signal Sense Development Model SSP 1000 or approved equal  
Minimum (2) 100AH Rated, AGM gel filled or approved equal
- Generator: Honda Model EF2000 generator, or approved equal
- Mast arm Signs: Kelly or Astro Bracket
- Luminaire: LED Everlast, Model - Wellworth, Type 3 Cobra Head or as directed by City
- Durable Pavement Markings: Alkyd Thermoplastic or Epoxy Resin
- CCTV System: Bosch Model VG5-724-ECE2 - MG<sup>2</sup> Lowering Device
- Broadband Communication: Encom - 5.8GHz. Model COMMPAK BB58

- LED Street Name Signs: TCS Model Edge Lite - T-8 Light Engine
- Fiber Optic Modem: MultiTech Systems Model IND
- Ethernet Switch: CommNet Model CNGE5MS
- Fiber Optic Patch Panel: Radiant Model Wall24, SC, ST, LC Connectors
- Fiber Optic Splice Enclosure: 3M Model 2178-S
- Fiber Optic Cable: 12 – 144 strand single mode tight buffered tube or as specified by the City
- Traffic Signal Structures: Valmont Industries, See Shop Drawing 255173P1
- Traffic Signal Base Plate Cover: Valmont – Renaissance AC-1