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(NEW)

Iowa Department of Transportation

SPECIAL PROVISIONS
For
TRAFFIC SIGNALIZATION

Polk County
NSHX-U-1945(408)--8S-77

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

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PART I GENERAL REQUIREMENTS

This part consists of the general provisions necessary when furnishing a traffic signal installation complete, in place and operational as described in the project plans and these special provisions.

1.1 Related Specifications and Standards

Unless otherwise specified in the project plans and special provisions the traffic signal installed under this specification shall comply with:

A. Urban Standards for Public Improvements latest edition.
B. Iowa Department of Transportation Standard Specifications
C. Specifications of the Underwriters Laboratories Inc.
D. National Electrical Code.
E. Manual on Uniform Traffic Control Devices latest edition.

1.2 Local Requirements

The Contractor shall notify and receive approval from the City prior to any operational shutdown of any existing traffic signal installation. Adherence to the City Electrical Code shall be required for service to the Controller.

The Contractor is responsible for locating all equipment installed as part of the project within the City right-of-way until project acceptance. Any damage as a result of failure to locate this equipment shall be the responsibility of the Contractor to replace with no additional cost to the City.

Contractor shall provide to the City “as-built” drawings that identify all changes made to the contract plans.

1.3 Removals

All existing traffic signal pole foundations that become unused for the new traffic signal shall be removed. Foundations three feet or less in depth shall be removed completely. Foundations greater than three feet in depth shall be removed to one foot below grade

All existing traffic signal handholes that become unused for the new traffic signal shall be removed and discarded by the contractor.

Unless otherwise indicated on the plans, all existing wiring that becomes unused in this project shall be removed and discarded of by the contractor.

All holes shall be filled and surface restored.

Removals and restoration are incidental to the other pay items unless otherwise specified in the contract documents.

PART II INSTALLATION REQUIREMENTS

This part consists of the installation details necessary during the construction of a traffic signal complete, in place, and operational as described in the project plans and these special provisions.

An anti-seize compound shall be used in the installation of all mechanical connections and fasteners, including all nuts and bolts.

2.1 FOUNDATIONS

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

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

The contractor shall provide designs for all concrete bases where mast arms are longer than 70 feet or when it is called for on the plans. The cost for the design shall be considered as part of the cost of the mast arm pole. This design would then be used as a substitute for footing design as shown on the signal detail sheet of the plans. The use of the ground rod and the number of conduits as indicated on the signal detail sheet of the plans shall remain the same.

When installing a conduit bend in an existing base the conduit size shall be equivalent to the conduit in the ground. The steel in the base shall not be cut or damaged and the concrete shall be broken away in the shape of a “U” with an approximate depth of at least 12 inches below the depth of the surrounding ground surface. Enough concrete shall be removed so the conduit will be inside the anchor bolts of the foundation. The conduit shall be placed in the “U” with concrete added in the “U” and finished to match the base.

2.2 CONDUIT

Conduit buried in open trenches shall be placed a minimum of 36 inch deep and a minimum of 2 feet from the back of curb unless otherwise directed by the Engineer. Open trench methods of placing conduit will be permitted except where the conduit is to be placed under existing pavement. Conduit in pavement areas shall be placed to a minimum depth of 48 inches below the finished pavement surface or as directed by the Engineer.

When underground conduits parallel an existing facility, maintain at least 1 foot of separation.

All conduit shall include one polypropylene Pull Rope with a minimum 600 pound proper tensile strength when installation is complete. All conduits shall include a tracer wire as specified in the Wiring and Cable section.

All conduit will be proofed by the Contractor upon completion to verify continuity and integrity of the duct.

2.3 WIRING AND CABLE

Each vehicle and pedestrian signal head shall have a separate cable from the signal head to the pole base. A signal head cables shall be spliced in the pole base. Within the cabinet, all signal cables shall be labeled as to their direction of origin.

All splices in the handhole compartment of a signal pole shall be made using silicone filled, screw-on wire connectors. Wires shall be twisted before the connector is added. Cable connections in signal heads and controller cabinets shall be made at the terminal blocks provided for that purpose, without using crimp-on connectors.

The Contractor shall also provide and install wiring from the end of the luminaire arm to the pole base. The Contractor shall connect the cables in the pole to the intersection lighting cable using fused connectors. Fused connectors shall be used for all connections. Unless otherwise indicated on the plans, luminaires will be supplied and installed by others.

A continuous orange tracer wire (1c #10) shall be included from each pole base to the controller cabinet. A separate orange tracer wire (1c #10) shall be included in all conduits with all fiber optic communication cable. A yellow tracer wire shall be used in conduits with only streetlight circuits. Tracer wire for the signal system shall terminate in the controller cabinet and shall be labeled with the direction of origin. Tracer wire for the communication/fiber system shall terminate in the locate box. The Contractor shall install, splice, and test the tracer wire for continuity. Every tracer wire run shall be grounded at one end.

2.4 FIBER OPTIC CABLE

The cable end shall be secured inside the controller cabinet so that no load is applied to the exposed fiber strands. The minimum bend radius for static storage shall not be less than ten times the diameter of the cable measuring the cable on the outside, or as recommended by the manufacturer.

The minimum bend radius during installation shall not be less fifteen times the diameter of the cable measuring the cable on the outside, or as recommended by the manufacturer. The Contractor should not use tie wrap devices on fiber optic cable.

A. Cable Slack: Slack shall be left in each handhole, at the top of any conduit riser, in each junction box, in each controller cabinet, and at each equipment rack or other point of termination. Slack in handholes shall be 100 feet in Type II and Type III handholes, 30 feet in Type I handholes, and 10 feet in 18 inch handholes. This slack cable requirement may be deleted where existing handholes or through points lack sufficient area to maintain the minimum bend requirements. Where slack has been deleted, extra slack equal to the amount that would have been distributed in the through points shall be equally divided between the two controller cabinets and shall be in addition to the slack mandated at the cabinets. Slack in each handhole type shall be provided as designated on the plans. Slack cable shall be coiled and the coils bound at three points around the coil perimeter and supported in their static storage position.

B. Cable Installation in Conduits: A suitable cable feeder guide shall be used between the cable reel and the face of the conduit. The cable feeder shall be designed to protect the cable and guide the cable directly into the conduit off the reel. During the installation, the cable jacket shall be carefully inspected for jacket defects. If defects are found, the Engineer shall be notified prior to any additional cable being installed. The Contractor shall take care in the pulling of the cable to insure that the cable does not become kinked, crushed, twisted, snapped, etc. A pulling eye shall be attached to the cable and be used to pull the cable through the conduit. A pulling swivel shall be used to preclude twisting of the cable. The cable shall be lubricated prior to entering the conduit with a lubricant recommended by the manufacturer. Dynamometers or break away pulling swing shall be used to insure that the pulling tension does not exceed the specified force of 600 pounds

or the cable manufacturer's recommendations, whichever is less. The mechanical stress on the cable shall not allow the cable to twist, stretch, become crushed, or forced around sharp turns which exceed the bend radius or scar or damage the jacket. The pulling of the cable shall be hand assisted at each pull point.

Cable shall not be pulled through any intermediate junction box, manhole, pull box, pole base or any other opening in the conduit unless specifically required by the Engineer in specific facilities. The necessary length of cable to be installed shall be pulled from one junction box, manhole, pull box, pole base, or cabinet to the immediate next downstream manhole, box, pole base, or cabinet. The remaining length of cable to be installed in the next conduit shall be carefully stored in a manner that is not hazardous to pedestrian or vehicular traffic yet ensures that no damage to the cable shall occur. The cable shall be stored in a manner that shall allow that length of cable to be safely pulled into the next conduit. The Engineer shall approve the storing methods to be used.

At each hand hole or through point and at the cabinet, the cable shall be visibly and durably marked or tagged with the type of cable (single mode or multi-mode), the fiber count, and "FIBER OPTIC CABLE, CITY OF DES MOINES". Additionally, each cable shall be marked with the adjacent intersection of origin and destination. In cases where cables are spliced in a splice enclosure only the intersection of origin is needed.

Example:

FIBER OPTIC CABLE, CITY OF DES MOINES

48 FIBER – SM

EAST – 63rd & HICKMAN
WEST – WESTOVER & HICKMAN

C. Communications Cable Testing: All fibers from each tube in the fiber optic cable shall be tested, both on-the-reel prior to installation and after installation using a high-resolution optical time domain reflectometer (OTDR). All cable readings/measurements shall be compared to the maximum allowable deviations in the cable specification and the levels of acceptance recommended by the manufacturer in their printed documentation. Any cable having measurements outside the allowable range shall be replaced and shall not be acceptable for installation on this project.

1. On-Reel Testing: Prior to the installation, the Contractor shall perform on-site, on-reel testing. This testing shall be for both attenuation and continuity. The tests shall be conducted at 850 nm for multi-mode fibers and at 1310 nm and 1550 nm single mode fibers. The testing shall be performed by means of a pigtail splice. All test results shall be within ± 3% of factory-supplied attenuation measurements. Testing shall be done in one direction only. Except for the access to and the test preparation of any one end of the newly furnished cable to be tested, the Contractor shall preserve the cable in its originally-shipped condition. If any fiber of the cable fails the on-reel attenuation test, the cable shall be rejected and shall not be used on this project. The rejected cable shall be replaced at the Contractor's expense.

2. System Testing: As each cable segment is terminated, the Contractor shall perform an endto-end attenuation (power loss) test of each terminated fiber of each FO cable. This testing shall be performed using hand-held optical test sets. Overall loss

for each link shall not exceed the cumulative specified maximum losses of the components. For example, at 850 nm, a one mile link with two splices and a connector on each end shall not exceed 7.0 dB:

1.0 mile x 5.6 dB/mile:	5.6 dB
0.2 dB per splice x 2:	0.4 dB
0.5 dB per connector x 2:	1.0 dB

A cable segment shall be rejected for use on this project if any terminated fiber of the cable segment fails the attenuation test. Rejected cables shall be replaced by the Contractor at the Contractor's expense. The Contractor shall retest all fibers of any replaced cable segment.

After the complete fiber optic system is installed and terminated, an OTDR reading shall be performed on all fibers to insure that each section is in compliance with the issued specification. All fibers shall be tested.

D. Fiber Optic Termination Unit: All fibers, unless stated otherwise in the plans, shall be terminated in the fiber optic termination unit.

The enclosure shall be mounted on an EIA 19 inch rack in an area that does not interfere with the normal maintenance of the cabinet electronics

The field cable shall be secured to the enclosure in a manner that does not degrade the fiber optic cable but insures a firm and secure mount. Sufficient lengths of every loose fiber shall be coiled within the enclosure to provide spare distance and reach the fiber interface panel. Sprial wrap each individual fiber in the fan out kit.

Each fiber shall be labeled on the bulkhead by direction and intersection of origin.

Example:

A – North

B – South – 63rd & Univ.

C – East – MH & Hick.

D - West

E. Documentation: The Contractor shall submit a table showing all entrance and exiting footages at each handholes, pole base, splice case and controller cabinet. This table shall include “tip-to-tip” footages at each location. This table shall be submitted in electronic, spreadsheet format.

The Contractor shall record the identification, location, length, and attenuation measurements of each tested fiber and shall furnish all test reports to the Engineer. Test reports include all cable segment attenuation tests; OTDR signature traces for all fibers; and an attenuation test for the installed fibers using the insertion loss test procedure and the transmitter/receiver power level test and the Continuity Test. Fibers which have been terminated shall be indicated in the reports. Such documentation shall be submitted in either hardcopy (written) form or in Engineer-approved electronic format.

2.5 BONDING AND GROUNDING

Metal conduit, service equipment, anchor bolts, metal poles, pedestals, controller cabinets, interconnect cable shields, and all other electrical equipment shall be made mechanically and

electrically secure to form a continuous system, and shall be effectively grounded. The grounding conductor shall be a No. 6 AWG copper, non-insulated wire.

Grounding shall be accomplished by bonding the grounding circuits to copper clad metal, driven electrodes. All electrodes shall be as a minimum, 5/8 inch in diameter by 10 feet long. The electrodes shall be driven vertically until the top of the rod is minimum of 4 inches below grade. Bonding to the ground rod shall be made by means of suitable screw type positive ground rod clamps. The controller cabinet ground shall measure 10 ohms or less.

Grounding to existing water lines will not be permitted.

Bonding of standards and pedestals shall be by means of a bonding strap attached to an anchor bolt or to 1 inch, or longer, brass or bronze bolt installed in the lower portion of the shaft.

The service meter and socket shall be bonded to a ground electrode by use of a ground clamp and a No. 6 AWG copper wire.

Bonding of metallic conduit in concrete pull boxes and manholes shall be by means of galvanized grounding bushings and bonding jumpers. Where there is a change, at a pull box or manhole, from nonmetallic conduit to metallic conduit, the grounding wire in the non-metallic conduit shall be bonded to the metallic conduit. Saddle clamps are not acceptable.

Existing ungrounded metal poles on which cabinets are mounted shall be grounded by means of a driven ground rod.

The interconnect cable shield shall be bonded to the controller ground buss at one controller termination point for each interconnect run.

2.6 TRAFFIC SIGNAL DISPLAYS

All Overhead traffic signal heads shall have backplates. Universally adjustable brackets and cable banding shall be used to mount all pole-mounted and mast arm-mounted overhead signals. All overhead displays located on each mast arm shall have each red indication set at approximately the same elevation, unless otherwise directed by the Engineer. All optically limited signal heads shall be properly masked to limit their field of view as directed by the Engineer.

During the course of construction and until the signals are placed in operation, signal faces shall be covered or turned away from approaching traffic. When ready for operation, they shall be securely fastened in position facing toward approaching traffic.

2.7 CONTROLLER CABINET

The aluminum rack edge shall be labeled for each detector amplifier, load switch, and isolator.

2.8 PAINTING

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

2.9 LOOP DETECTORS

The Contractor is responsible for replacing any loops found unacceptable after testing. An acceptable loop is defined as follows:

a. Inductance: equal to or greater than the calculated value
b. Leakage to ground: greater than 100 megohms
c. Loop Frequency: equal to or greater than 0.0350. Loop frequency is defined as the frequency of the loop with a vehicle present (Fp) minus the frequency of the loop with no vehicle present (Fc) divided by the frequency of the loop with no vehicle present (Fp-Fc)/Fc.

All loop detectors in new pavement shall be preformed. No saw-cut loops will be accepted in new pavement.

2.10 LOCATE BOXES

An outdoor-rated, single gang box to house communications/interconnect tracer wire shall be installed on the exterior of the controller cabinet. The location on the cabinet shall be determined by the project engineer. The locate box shall be constructed of die-cast aluminum with a die-cast zinc weatherproof cover and self-closing lid. The box shall be 2 3/4 inches by 4 1/2 inches by 2 5/8 inches D. A 12 inch long ground wire shall be attached to a lug within the box.

PART III MATERIAL REQUIREMENTS

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

3.1 TRAFFIC SIGNAL CABLE

Detector lead-in cable shall be No. 14AWG.

3.2 SIGNS

A. Traffic Sign Blanks: All sign blanks shall be aluminum allow 6061-T6 conversion coated with Alodine 1200. 5052-H38 alloy is an acceptable alternative.

1. All blanks shall be 0.08 inches thick will the following exceptions:
   a. If either the length or width dimension of a sign is 36 inches or greater, the blank shall be 0.125 inches thick.
   b. Overhead mounted street name signs shall be 0.125 inches thick.
2. Blanks shall be finished free of any surface or edge burrs, cut marks, or other irregularities.
3. Standard signs shall be pre-drilled with standard hardware holes (0.375 inch diameter) and have no burrs or excess material retained in or around the hole. Holes placement and radii shall conform to the Standard Highway Signs Manual, current edition.
4. A diagram showing the location of holes for specialty signs will be provided at the time of order.
5. Street name signs shall not be pre-drilled.

B. Traffic Sign Faces: Shall meet all requirements of the latest edition of the "Manual on Uniform Traffic Control Devices" (MUTCD).

The background sheeting used on all signs, with the exception of pedestrian pushbutton signs, shall be 3M DG3 material. Any other applied material, including legends, letters, numbers, or borders, again with the exception of pedestrian push-button signs, shall also be 3M DG3 material. Pedestrian pushbutton signs shall be 3M Engineer Grade Prismatic reflective sheeting.

This material shall have a standard warranty to be free from any defects for a period of not less than 7 years from the date of manufacture. A copy of the standard warranty shall be provided as a part of the bid package.

C. Street Name Signs:

1. All street name signs shall be single-sided
2. The length of the street name sign shall be in 6 inch increments and will vary based on the legend.
3. Lettering shall be white and the background shall be blue or green “EC” film. The background color will be specified at the time of order.
4. Lettering shall be Series B as outlined in the Standard Highway Signs Manual.
5. All 12 inch or larger signs shall have a white border as shown in the attached detail.
6. Letter size and spacing shall conform to the MUTCD and the attached details. In cases

where descending lower-case letters (g, j, p, q, and y) cannot be accommodated on the specified blank, the next larger blank size shall be used..

7. 12 inch or larger street name signs shall be made of 3M Diamond Grade DG3 reflective sheeting. 8 inch street name signs shall be made of 3M High Intensity Prismatic reflective sheeting.

D. Completed Signs: Sign faces shall be firmly attached to the aluminum sign blanks, with no air bubbles, wrinkles, creases, tears or other surface blemishes. The faces shall be neatly trimmed to match the edge of the sign blank. The sign faces shall be properly positioned to provide a uniform border around all sides of the sign.

The signs shall be handled carefully and packaged to prevent any damage to the sign faces. Any sign faces which are damaged at the time of delivery will be rejected and returned to the manufacturer. Undamaged replacement signs shall then be promptly sent, at no extra cost to the City of Des Moines.

E. Sign Mounting Brackets: All signs shall be supplied with a sign bracket. The traffic sign bracket shall be an articulated serrated bracket assembly that includes top, middle, and bottom sign mounting brackets and provides a rigid-mount for the traffic sign. All necessary hardware for a complete installation on a mast arm shall be included. The mounting assembly shall be of a cable type. Approval of other bracket supports shall be based on specifications and/or test data about their physical properties and performance properties.

All pedestrian pushbutton signs shall be mounted to the signal pole using stainless steel bolts. Bolts shall be 5/16 inch flanged with plastic washer. Holes shalled be drilled and tapped.

3.3 FIBER OPTIC CABLE AND ACCESSORIES

A. Fiber Optic Cable: Furnish and install the loose tube fiber optic cable(s) of the type, size, and number of fibers specified on the plans and all associated accessories.

The cable shall meet the latest applicable standard specifications by American National Standards Institute (ANSI), Electronics Industries Association (EIA), and Telecommunications Industries Association (TIA) for the and size specified and the specifications herein.

1. Multimode Fiber - Grade Index

Core Diameter:	62.5 um ± 1.0 um
Cladding Diameter:	125.0 um ± 1.0 um
Core Concentricity:	± 1%
Max. Attenuation:	6.03 dB/mile

2. Single-Mode Fiber

Typical Core Diameter:	8.3 um ± 1.0 um
Cladding Diameter:	125.0 ± 1.0 um
Core Concentricity:	± 1%
Attenuation Uniformity:	No point discontinuity greater than 0.1 um at either 1310nm or 1550nm
Max. Attenuation:	0.40 dB/mile

The coating shall be a dual layer UV cured acrylate applied by the fiber manufacturer. The coating shall be mechanically or chemically strippable without damage to the fiber.

The central member of the cable shall be a glass reinforced plastic rod designed to prevent the buckling of the cable. The cable core interstices shall be filled with water blocking tape to prevent water infiltration.

Dielectric fillers may be included in the cable core where needed to lend symmetry to the cable cross-section.

Buffer tubes shall be of dual layer construction with the inner layer made of polycarbonate and the outer layer made of polyester. Each buffer tube shall be waterblocked with a water-swellable yarn or tape. Buffer tubes shall be stranded around the central member using reverse oscillation, or "SZ", stranding process.

The buffer tubes shall meet TIA/EIA-598A, "Color coding of fiber optic cables". The fiber cable shall include loose tubes with twelve fibers in each tube.

The cable tensile strength shall be provided by a high tensile strength aramid yarn and/or fiber glass.

All dielectric cables, without armoring, shall be sheathed with medium density polyethylene. The minimum nominal jacket thickness shall be 0.055 inches. Jacketing material shall be applied directly over the tensile strength members and flooding compound. The jacket or sheath shall be marked with the manufacturer's name and the words "Optical Cable", the year of manufacture, and sequential feet marks. The markings shall be repeated every 2 feet. The actual length of the cable shall be within the range plus 1% of the length marked. The marking shall be in a contrasting color to the cable jacket. Additionally, the jacket marking shall have a durable weather proof label which shows the actual attenuation of each fiber expressed in dB/mile.

The cable shall be fabricated to withstand a maximize pulling tension of 600 pounds during installation (Short term) and 135 pounds upon installation (Long term).

The shipping, storing, installing and operating temperature range of the cable shall be -40°F to +158°F.

The manufacturer shall test at the 100% level all fiber optic cable for the following tests:

- Each fiber proof tested at a minimum load of 350 Mpa.
- Each fiber tested for attenuation and the reading shall be part of cable labeling.

The cable shall meet the appropriate standard Fiber Optic Test Procedure for the following measurements:

- Fluid Penetration
- Compound Drip
- Compressive Loading Resistance
- Cyclic Flexing
- Cyclic Impact
- Tensile Loading and Bending

The cable ends shall be available for testing. The cable ends must be sealed to prevent

moisture impregnation.

B. Fiber Optic Jumpers/Patch Cords: All fibers entering the traffic signal controller cabinet shall be terminated in the fiber optic termination unit within the traffic controller cabinet.

Length of patch cord will vary according to distribution unit to traffic signal controller, fiber optic modem, or video modem location within controller cabinet and shall provide for 2 feet of total slack. A sufficient number of patch cords shall be installed to provide a fully-operational communications system.

Controller cabinet patch cords shall consist of factory-assembled patch cords, each containing two fibers. Each such fiber shall have a connector with ceramic ferrule on each end. Each patch cord shall have a dielectric strength member and a durable outer jacket designed to withstand handling.

C. Fiber Optic Termination Unit: The unit shall be a rack mount, drawer type enclosure that is dust and moisture repellent. The unit shall provide easy front access with removable rear tray for easy rear access and shall have a maximum dimension of 3.5 inches(H) by 18.5 inches(W) by 11.25 inches(D). The size of the unit shall be adequate for the number of fibers, proper winding area, and splices. The unit shall provide for cable entry from the side and be capable of accomodating up to 48 connections

D. Connectors: Only ST connectors of ceramic ferrule and physical contact end finish shall be used to terminate fibers to equipment.

Maximum attenuation per connector shall be 0.75 dB.

E. Splices: Fusion splices shall be used for all splices.

The fiber cable shall be installed in continuous runs as designated on the plans. Splices shall be allowed only in the splice enclosures and controller cabinets as located on the plans. Maximum attenuation per splice shall be 0.3 dB.

F. Fan Out Kits: Fan out kits shall be provided for separation and protection of individual fibers with buffer tubing and jacketing materials suitable for termination of the fiber and fiber optic connector as specified.

G. Splice Enclosure: Ends of continuous fiber cable runs and/or traffic signal controller branch circuit points will be spliced in an outside plant splice enclosure located in handholes as shown on plans.

Enclosure shall accept a minimum of six cables and provide enough trays to splice all fibers. All fiber cables shall enter the enclosure at one end.

Enclosure shall be watertight and re-enterable using gel-compressed cable connections and a re-enterable gasket.

PART IV EQUIPMENT REQUIREMENTS

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

4.1 TYPE 170, TRAFFIC SIGNAL CONTROLLER SYSTEM

A. Related Specifications: Unless otherwise stated herein, all equipment furnished under this specification shall be new, meeting the requirements of "California/New York Type 170, Traffic Signal Controller System-Hardware Specification," U.S. Department of Transportation, Publication FHWA-IP-7816, December 1978, with the following exceptions:

1. Any reference to the State of California shall mean the Contracting Authority.

2. Chapter 1, Section II "General" paragraph 3, the second sentence shall be deleted.

3. Chapter 1, Section VIII "Electrical, Environmental and Testing Requirements" shall be modified as follows:
   a. Any reference to the Contractor shall mean equipment manufacturer or supplier.
   b. Paragraph 5.2 shall be changed to read "Two manuals containing the flow chart, listing, and instructions of the test program shall be furnished to the Jurisdiction when the controller unit is delivered."
   c. Paragraph 6.1 the words "State Approval" shall be deleted.
   d. Paragraph 6.2 shall be deleted.
   e. Paragraph 6.3.6 shall be deleted.

4. When specified, the Model 332A Cabinet furnished for the project shall meet the requirements of Chapter 11 "Specifications for Cabinet Model 332A," and the Model 336 Cabinet shall meet the requirements of "Specifications for Cabinet Model 336" dated February 1982, except that the color specified in Section 1, paragraph 3 shall be changed to silver. Molex Flash Blocks shall be provided for all eight vehicle phases to program either red or yellow flashing indications. A detector input panel shall be provided on the rear left side of the cabinet. Cabinet locks as specified in Section I, paragraph 4 shall be changed to Corbin Type 2 locks. An aluminum cabinet shall be furnished.

   The aluminum surface shall have an anodic coating applied. The anodic coating and anodic coating process shall meet the requirements of Section 2.4.1 and 2.4.2 of the "Traffic Signal Control Equipment Specifications," California Business, Transportation and Housing Agency, Department of Transportation, January 1989. Alternative aluminum surface treatments, which produce an equivalent uniformly textured surface, may be substituted as approved by the Jurisdictional Engineer.

5. All loop detector amplifier units furnished for this project shall be Model 222, Two-Channel Loop Detector Sensor Units meeting the requirements of Chapter 4 with the following exceptions:
   a. Digital design capable of normal operation when operated with a grounded loop.
   b. Shall comply with all performance requirements when connected to an inductance of from 50 to 1500 microhenries.
   c. Each detector channel shall respond to an absolute inductance change (Delta L)

rather than as a percentage of the total inductance (Delta L/L).

6. In Chapter 11, Section III "Cabinet Accessories" paragraph 4, a new subsection will be added "Each vehicular and each pedestrian phase shall be provided with a separate switch pack."

Memory Socket	Address Range	Device Type
U1	8000-FFFF	32K EPROM
U2	3000-4FFF	8K ZPRAM
U3	7010-7FFF	8K ZPRAM
U4	1000-2FFF	8K RAM

a. A model 412C prom module shall be provided, configured to the following table:

*or approved equal

8. A Model 242 Two-Channel Isolator shall be provided to introduce stop timing to the controller from the conflict monitor and the manual flash switch.

9. The Model 210e Monitor Unit shall meet the requirements of Chapter 3 with the following additional requirements:
   a. The Monitor Unit shall be capable of RED FAILURE detection in accordance with NEMA specifications. Following a long power outage, (greater than two seconds) the Monitor Unit shall be capable of disabling the RED FAILURE detection, until the signal heads are energized (approximately four seconds).
   b. The Monitor Unit shall have the required circuitry to allow the early detection of a conflict caused by a green or yellow signal "hang up" and shall preclude the presentation of the conflicting signal display at the intersection.
   c. Any additional harnesses or hardware required shall be furnished with the Monitor Unit.
   d. The conflict monitor unit shall be capable of ignoring the watchdog and placing intersection in flash if line voltage is less than 98 (+/-2) VAC RMS.

10. A "PDA-2" Power Distribution Assembly shall be provided in lieu of the PDA-1 and the 24 volt D.C. Supply.

11. A standard print shelf drawer shall be provided and installed above the input file.

12. Four ACIA ports shall be provided.

13. One Model 400 internal modem shall be supplied for each controller when twisted pair communications is specified in the plans.

14. All components supplied shall be on CalTrans Qualified Product Listing and operate successfully with McCain 233 software.

15. Each cabinet shall include two fluorescent lighting fixtures mounted inside the front and back portion of the cabinet. These fixtures shall include a cool white lamp with protective cover and shall operate by a normal power UL listed ballast. Two door actuated switches shall be installed to turn on the cabinet light when the door is open, front door front light back door back light. Each switch should work each individual light.

16. Each cabinet shall be provided with devices to protect the control equipment form surges and over voltages. This shall include incoming power lines, the Input File, the Output File, and communication lines.

Each inductive loop detector input wire shall be protected with a 30V MOV with (30 Joule Rating) P/n ERZ-C20 KE 470 or equal. The output of all load switch outputs shall be protected with a 150V MOV (80 Joule Rating). P/n ERZ-C20 DK 241U or equal. The MOVs shall be connected from the AC positive field terminal to the chassis ground.

For the 332A cabinet, appropriate input surge protection shall be mounted on the Lower Input Termination Panel (LIP). The power distribution assembly (PDA#2) of each controller cabinet shall include a surge protection unit on the AC Service Input. The protector shall be installed between the applied line voltage and earth ground. The surge protector shall be capable of reducing the effect of lightning transient voltages applied to the AC line. The protection device shall be a two stage series parallel device. It shall include the following features and functions:

a. Maximum AC line voltage: 140 VAC.
b. Twenty pulses of peak current, each of which will rise in 8 microseconds and fall in 20 microseconds to half the peak: 20,000 Amperes.
c. The protector shall be provided with the following terminals:
    1) Main line (AC line first stage terminal).
    2) Main Neutral (AC Neutral input terminal).
    3) Equipment Line Out (AC Line second stage output terminal, 10 Amps.).
    4) Equipment Neutral Out (Neutral terminal to protected equipment).
    5) GND (Earth connection).
    6) The Main AC line in and the Equipment Line out terminals shall be separated by a 200 Microhenry (minimum) inductor rated to handle 10 Amp AC Service. The first stageclamp shall be between Main Line and Ground terminals.
    7) The second stage clamp shall be between Equipment Line out and Equipment Neutral.
    8) The protector for the first and second stage clamp must have a MOV or similar solid state device rate at 20 KA and be of a completely solid stage design (i.e., no gas discharge between tubes allowed).
    9) The Main Neutral and Equipment Neutral Out shall be connected together internally and shall have an MOV similar solid state device or gas discharge tubes rated at 20 KA between Main Neutral and Ground terminals.
    10) Peak clamp voltage: 350 Volts at 20 KA (Voltage measured between Equipment Line Out and Equipment Neutral Out terminals. Current applied between Main Line and Ground Terminals with Ground and Main Neutral terminals externally tied together.). Voltage shall never exceed 350 volts.
    11) The Protector shall be epoxy encapsulated in a flame retardant material.
    12) Continuous service current, 10 Amps at 120 VAC RMS.
    13) The Equipment Line Out shall provide power to the Type 170 and to the 24 V power supply.
    14) Provide communications line protector with a mounting connector for incoming and outgoing communication line.

B. Manufacturers: The controller units, cabinets, and auxiliary control equipment furnished under this specification shall be from a manufacturer whose Type 170 Controller System has been approved and purchased by either the State of California or the State of New York. The Engineer may allow exceptions to this requirement provided that the equipment to be furnished has been successfully operated on the street by a public agency for more

than one year and has been certified by an independent testing laboratory as meeting the requirements of Chapter 1, Section VIII, U.S. Department of Transportation, Publication FHWA-IP-78-16.

C. Software: The software for this project will be provided by the Engineer. The Contractor shall supply two blank 27256 PROM chips per controller.

D. Auxiliary Control Equipment:

1. Cabinets shall be furnished with all necessary auxiliary control equipment to properly operate eight signal phases and four pedestrian phases, which includes conflict monitor unit, isolation modules, detector sensing units as specified on contract documents, and load switch packs.

2. A heavy-duty clear plastic envelope, minimum dimensions of 9 inches by 12 inches, shall be attached inside the cabinet for storing timing and maintenance records, electrical prints, etc.

E. Certification: In addition to the testing certification required in Chapter 1, Section VIII "Electrical, Environmental and Testing Requirements," paragraph 6, the Engineer shall be furnished with a certification from the equipment manufacturer or supplier stating that the equipment furnished under this specification complies with all provisions of this specification. With prior approval of the Jurisdictional Engineer, minor exceptions to this specification may be allowed, provided these exceptions are detailed on the certification.

F. Warranty: All Type 170 Controllers and auxiliary equipment furnished under this specification shall be provided with a standard industry warranty. Any parts found to be defective shall, upon concurrence of the defect by the manufacturer, be replaced free of charge.

G. Manufacturer or Supplier: A representative from the manufacturer and/or supplier of the Type 170 Controllers shall be at the project site when the controllers are ready to be turned on, to provide technical assistance including, as a minimum, programming of all necessary input data. All required signal timing data shall be provided by the Engineer.

A minimum of 1 week prior to the scheduled "turn-on", the Contractor or supplier shall deliver the controller(s), (not including the cabinets), to the Traffic Signal Shop located at 2000 SE Scott. It is the responsibility of the deliverer to call ahead to schedule delivery.

The City of Des Moines will install and verify the specified software and timings. Should any controllers be found faulty at the shop, the person/company who delivered the equipment will be contacted. The Signal Shop is not responsible for trouble shooting this equipment nor is any part of this process intended to replace "burn-in" responsibilities of the manufacturer.

The Contractor/Supplier is responsible for picking up the controller(s) from the Signal Shop and is solely responsible for bringing the controller(s) to full operation at the intersection(s). No assistance will be provided by the Signal crew once the software is working correctly and the signal timings have been verified in the Signal Shop. Having a knowledgeable representative at the project site(s) when the controller(s) is ready to be turned on is paramount to the safety and efficiency of this operation.

4.2 FIBER OPTIC DATA LINK OR ETHERNET CARD

A. Fiber Optic Data Link

When specified in the plans, a fiber optic data link shall be provided. It shall be of the type that will install in Type 170 controller chassis and provide a dual mode, double duplex, multi-drop communications link designed to interconnect traffic control equipment. Data links shall include the following functional requirements:

1. Master or Local operation mode set by board mounted switch.

2. Two sets of front mounted fiber optic receptacles with ST type connectors.

3. Accommodate 850nm, Multimode fiber optic cable.

4. Complies with 170 and NEMA Environmental specifications.

5. Includes a rechargeable NiCad battery backup to maintain communications in case of power disruption. Battery assembly shall be secured to board and charge circuit shall be built in.

6. Expansion port, which will allow for up to two additional fiber optic ports for directional branching of communication circuits.

7. Status LED's which provide visual signal indicators associated with communications between the modems and can be easily viewable by a maintenance technician. Signals displayed shall include:
   a. Transmit Data 1 (TD-1)
   b. Receive Data 1 (RD-1)
   c. Transmit Data 2 (TD-2)
   d. Receive Data 2 (RD-2)
   e. Power (PWR)
   f. Built-In Test Fail (Fault)

B. Ethernet Card

When specified in the plans, an internal 170 Ethernet Card shall be provided to allow for Ethernet connection via the City's network. It shall be of the type that will install in a Type 170 controller chassis, connecting via RJ45 cable to an Ethernet switch located elsewhere within the controller cabinet. It shall include the following functional requirements:

1. Network interface to provide the following:
   a. 10Base-T/100Base-TX Ethernet Connection
   b. RJ45 connector
   c. Protocols: TCP/IP, UDP/IP, ARP, SNMP, TFTP, Telnet, DHCP, BOOTP, HTTP, and AutoIP

2. Serial interface to provide the following:
   a. 300 to 230, 400 bps data rate
   b. 7 or 8 data bit characters
   c. Parity – odd, even, none
   d. Stop bits: 1 or 2
   e. Control Signals: RTS/DCD, CTS

f. Flow Control: XON/XOFF, RTS/CTS

3. Temperature hardened (-40º to 75º C)
4. Password protection with 256 bit AES encryption for secure communications
5. Power requirements to be +12 volts and 12 volts ± 5% @A 75mA
6. Embedded webserver
7. E-mail alert capability
8. Full TCP/IP protocol stack
9. Provide two serial ports that communicate via a single communications channel. The host Interface connects through the card edge to the local controller. The Auxiliary Port utilizes a DB9 connector and can be used to bring copper or wireless communications into the main data stream. The Auxiliary Port is to be switch selectable, so that it can operate as either a DCE or DTE interface. IN DCE mode, it will operate in parallel with the Host interface, and can be used to configure the Etherport via a PC terminal program. In DTE mode, it will provide an external interface for the host which can be connected to another DCE device such as a FSK modem. Full “handshaking” is to be provided to facilitate interoperability across different transmission systems.
10. Management shall be SNMP, Telnet, serial, internal Web server, and Microsoft Windows®based utility configuration.
11. Indicators shall be provided to show 10Base-Tconnection, 100Base-T connection, and link & activity-full/half duplex.

4.3 VEHICULAR TRAFFIC SIGNAL HEADS

The purpose of the specification is to describe minimum acceptable design and operating requirements for vehicular traffic signal heads with including all fittings and brackets as specified on the Plans. All vehicular signal heads shall be light emitting diode (LED).

A. Main body Assembly: Each section shall be complete with a one-piece, hinged door with water tight gaskets and two stainless steel locking devices. All screws, latching bolts, and hinge pins shall be stainless steel to prohibit rust and corrosion.

All sections of the vehicle signal head housings shall be of the black in color including the visor and door. The black color shall be permanently molded into the components.

B. Traffic Signal Mounting Brackets: The traffic signal mounting bracket shall universally adjustable. It shall include internal wiring capability, and three axes of traffic signal adjustment, as well as vertical height adjustment. All necessary hardware for complete installation on a mast arm shall be included. The mounting assembly shall be of a cable type.

4.4 PEDESTRIAN SIGNAL HEADS

The purpose of this specification is to describe minimum acceptable design and operating requirements for pedestrian traffic signal heads including all fittings and brackets, as specified

on the plans.

All pedestrian signal heads shall be LED.

The signal head shall be designed so that all components are readily accessible from the front by opening the signal door.

The housing shall be one piece, 16 inches by 16 inches in size. The housing case shall include four integrally- cast, hinged lug pairs; two at the top and two at the bottom of each case. The case, when properly mated to other pedestrian signal components and mounting hardware, shall provide a dustproof and weatherproof enclosure and shall provide for easy access to and replacement of all components.

The door frame shall be one piece, complete with two hinged lugs cast at the bottom and two latch slots cast at the top of each door. The door shall be attached to the case by means of two, type 304 stainless steel spring pins.

All screws, latching bolts, and hinge pins shall be stainless steel to prohibit rust and corrosion.

The countdown pedestrian indicator unit shall fit in a traditional 16 inch by 16 inch pedestrian signal head housing.

4.5 ALUMINUM TRAFFIC SIGNAL PEDESTALS

The purpose of this specification is to describe minimum acceptable design, material, and fabrication requirements for aluminum traffic signal pedestals and/or aluminum shafts.

Bases shall have a four bolt pattern uniformly spaced on a 13 3/4 inches diameter bolt circle.

4.6 GALVANIZED STEEL TRAFFIC SIGNAL SUPPORTS

The purpose of this specification is to describe minimum acceptable design, material, and fabrication requirements for galvanized steel traffic signal supports.

The mast arms shall be of the length specified and shall be designed to support traffic signals as shown in the standard load detail on the plans. All mast-arms shall have a 4% rise when in-place and fully loaded.

Mast arms shall be continuous to 50 feet in length. Vertical pole configuration shall provide for two-piece combination pole with internal tapped plate connection to allow for addition or removal of luminaire pole extension. Poles shall be vertical under normal load.

4.7 PEDESTRIAN PUSH-BUTTON DETECTORS

The purpose of this specification is to describe minimum acceptable design and operating requirements for side-of-pole mount, pedestrian push-button detectors, including all fittings and brackets as specified on the plans.

A. Construction: Pedestrian push-button detectors shall be of the direct push type without levers, handles, or toggle switches. Each detector shall consist of a solid state electronic switch with no moving plunger or moving electrical contacts. The case shall

have one outlet for a 1/2 inch pipe. The operating button shall be made of stainless steel and shall be of sturdy design. This button shall not protrude out from the case. The entire assembly shall be weather tight, secure against electrical shock and of such construction as to withstand continuous hard usage. The contact shall be normally open and no current flowing except at the moment of actuation. The push-buttons supplied shall be ADA accessible push button assembly with momentary LED indicator. The push-button casing shall be black in color, oval with a raised directional arrow.

B. Accessible Pedestrian Signal Pushbutton (APS): When APS pushbuttons are specified in the plans they shall meet the following specification. Pushbutton assembly shall be black in color, have an integrated R10-4b sign and ADA compliant pushbutton with raised directional arrow. The pushbutton shall provide confirmation through latching LED light, sound and tactile bounce. Pushbutton shall provide the option of sounds or messages during the WALK interval as well as vibration, sounds during the clearance interval, adjustable volume locator tone during the DON'T WALK interval, direction of travel messages, and special messages determined by the user. The pushbutton shall have a control unit that mounts in the associated pedestrian signal head. All wiring and components to create a functional system are included in the unit price for this item.

4.8 RADAR PRESENCE DETECTION SYSTEM

A. General: This item shall govern the purchase and installation of an above ground radar presence detector (RPD) system. An RPD detects vehicles by transmitting electromagnetic radar signals through the air. The signals bounce off vehicles in their paths and part of the signal is returned to the RPD. The returned signals are then processed to determine traffic parameters.

B. Sensor Outputs: The RPD shall present real-time presence data for the approach to be detected. It shall support a minimum of eight zones and a minimum of four channels. The RPD algorithms shall mitigate detections from wrong way or cross traffic.

The RPD system shall have fail-safe mode capabilities for contact closure outputs if communication is lost.

C. Detectable Area: The RPD shall be able to detect and report presence individually in all approach lanes The RPD shall be able to detect and report presence in up to six lanes. It shall be able to detect and report presence in curved lanes and areas with islands and medians.

D. System Hardware: For each approach to be detected, one RPD shall be used. Each RPD shall have either a traffic cabinet preassembled backplate with AC/DC power conversion, surge protection, terminal blocks for cable landing, and communication connection points; or a rack-mounted sensor interface board that operates on 24VDC with communications to the sensing unit via an Ethernet interface with Power-over-Ethernet (POE).

Any preassembled backplate for the RPD shall be a cabinet side mount or rack mount.

The RPD shall use contact closure input file cards with two or four channel capabilities. The contact closure input file cards shall be compatible with industry standard detector racks.

E. Maintenance: The RPD shall not require cleaning or adjustment to maintain performance. It shall not rely on battery backup to store configuration information, thus eliminating any need for battery replacement.

Once the RPD is calibrated, it shall not require recalibration to maintain performance unless the

roadway configuration changes.

The mean time between failures shall be 10 years, which is estimated based on manufacturing techniques.

F. Physical Properties: The RPD unit shall not exceed 6 pounds in weight. The general dimensions of the unit shall not exceed 13.2 inches by 10.6 inches by 8 inches in its physical dimensions.

All external parts of the RPD shall be ultraviolet-resistant, corrosion-resistant, and protected from fungus growth and moisture deterioration. The enclosure shall be rated for outdoor weatherability in accordance with UL standards. The unit shall be classified as watertight.

The RPD enclosure shall include a connector that meets the UL standards for outdoor weatherability connections. The connector shall provide contacts for all data and power connections.

G. Electrical: The RPD shall consume less than 10 W. It shall operate with a DC input between 9 VDC and 28 VDC and have onboard surge protection.

H. Communications Ports: The RPD system shall have a communication port, allowing it to be used for configuration, verification and traffic monitoring without interrupting communications on the dedicated data port serving the controller operation. The RPD shall support the upload of new firmware into the RPD's nonvolatile memory over either communication port.

I. Radar Design: The RPD shall be designed to provide detection over a large area and to discriminate lanes. The circuitry shall be void of any manual tuning elements that could lead to human error and degraded performance over time.

During operation, the RPD shall strictly conform to FCC requirements and the radar signal quality shall be maintained for precise algorithmic quality. The RPD must not experience unacceptable frequency variations which may cause it to transmit out of its FCC allocated band and thus will be non-compliant with FCC regulations.

The RPD shall transmit a signal with a bandwidth of at least 245 MHz. This translates directly into radar resolution, which contributes directly to detection performance.

The RPD shall provide at least five RF channels so that multiple units can be mounted in the same vicinity without causing interference between them.

The RPD shall have a self-test that is used to verify correct hardware functionality. It shall also have a diagnostics mode to verify correct system functionality.

J. Configuration: The RPD shall have a method for defining traffic lanes, stop bars and zones. It may have an auto-configuration process that would execute on a processor internal to the RPD. If equipped, the auto-configuration process shall work under normal intersection operation and may require several cycles to complete.

The auto-configuration method shall not prohibit the ability of the user to manually adjust the RPD configuration.

The RPD shall support the configuring of lanes, stop bars and detection zones in 1 foot increments.

The RPD shall include graphical user interface software that displays all configured lanes and the current traffic pattern using a graphical traffic representation.

The graphical interface shall operate on Windows Mobile, Windows XP, Windows Vista and Windows 7 in the .NET framework.

The software shall support the following functionality:

- Operate over a TCP/IP connection
- Give the operator the ability to save/back up the RPD configuration to a file or load/restore the RPD configuration from a file
- Allow the backed-up sensor configurations to be viewed and edited
- Provide zone and channel actuation display
- Provide a virtual connection option so that the software can be used without connecting to an actual sensor
- Local or remote sensor firmware upgradability

K Operating Conditions: The RPD shall maintain accurate performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog and changes in temperature and light, including direct light on sensor at dawn and dusk. Its operation shall continue in rain up to 1 inch per hour. It shall be capable of continuous operation over an ambient temperature range of -40°F to 165.2°F, and over a relative humidity range of 5% to 95% (non-condensing).

L. Testing: Each RPD shall be certified by the Federal Communications Commission (FCC) under CFR 47, part 15, section 15.249 as an intentional radiator. The FCC certification shall be displayed on an external label on each RPD according to the rules set forth by the FCC. The RPD shall comply with FCC regulations under all specified operating conditions and over the expected life of the RPD.

The RPD shall comply with the applicable standards stated in the NEMA TS 2-2003 standard.

M. Manufacturing: The RPD shall undergo a rigorous sequence of operational testing to insure product functionality and reliability. Testing shall include the following:

- Functionality testing of all internal sub-assemblies
- Unit level burn-in testing of 48 hours' duration or greater
- Final unit functionality testing prior to shipment

Test results and all associated data for the above testing shall be provided for each purchased RPD by serial number, upon request.

N. Support: The RPD manufacturer shall provide both training and technical support services. The manufacturer provided training shall be sufficient to fully train installers and operators in the installation, configuration, and use of the RPD to insure accurate RPD performance.

Manufacturer provided technical support shall be available according to contractual agreements, and a technical representative shall be available to assist with the physical installation, alignment, and configuration of each supplied RPD. Technical support shall be provided thereafter to assist with troubleshooting, maintenance, or replacement of RPDs should such services be required.

O. Documentation: RPD documentation shall include an instructional training guide and a comprehensive user guide as well as an installer quick-reference guide and a user quick-reference guide.

P. Warranty: The RPD shall be warranted free from material and workmanship defects for a period of 18 months from date of shipment.

Q. Installation Requirements: The RPD shall be mounted directly onto a mounting assembly fastened to a mast arm, pole or other solid structure. The mounting assembly shall provide the

necessary degrees of rotation to ensure proper installation. The mounting assembly shall be constructed of weather-resistant materials and shall be able to adequately support the sensor unit provided.

The RPD shall be mounted at a height that is within the manufacturer's recommended mounting heights. The UNIT shall be mounted at an offset from the first lane that is consistent with the RPD's minimum offset. It shall be mounted so that at least 20 feet along the farthest lane to be monitored is within the field view of the RPD.

The RPD shall be mounted with its cable connector down and shall be tilted so that the RPD is aimed at the center of the lanes to be monitored.

The RPD shall be mounted on a vertical signal pole or on the horizontal mast arm, and mounted so that its field of view is not occluded by poles, signs or other structures.

RPDs must be capable of being configured to operate on different RF channels.

The cable end connector shall be an environmentally sealed shell that offers excellent immersion capability. All conductors that interface with the connector shall be encased in a single jacket, and the outer diameter of this jacket shall be within a weatherproof cover to ensure proper sealing. The cable shall have a strain relief with enough strength to support the cable slack under extreme weather conditions.

The cable shall be terminated only on the two farthest ends of the cable.

Both communication and power conductors can be bundled together in the same cable.

The input file cards shall meet the following specifications:

The input file cards shall be compatible with 170, 2070, NEMA TS 1, and NEMA TS 2 style input racks.
The input file card shall translate data packets from the RPD into contact closure outputs.

The input file card shall support presence detection.

The input file card shall comply with the NEMA TS 2-1998 Traffic Controller Assemblies with NTCIP Requirements (Section 2.8 spec).

PART V VIDEO VEHICLE-DETECTION CAMERA SYSTEM

This part consists of the functional specifications of the equipment and installation requirements necessary for the construction of a video vehicle detection system complete, in place, and operational as described in the project plans and these Special Provisions.

The system shall provide full video detection at the intersection and transmit live video and video-data to the city Traffic & Transportation Division's offices (about 10 miles) through the existing fiber optic cable connecting the two sites, in accordance with the plans and these special provisions. The computer workstation is provided by the city. The contractor shall make the entire necessary fiber optic connections both at the intersection and the office in accordance with the plans and these special provisions.

The system shall consist of but not be limited to the video camera system, machine vision processor (selfcontained with sensor or separate), in-cabinet sensor interface panel, detector port master, and data and video transceivers. Depending on the system proposed by the contractor, the system may also include video transmitter/multiplexer, video receiver/demultiplexer, and 4-chanel video switcher. All supervisor, coaxial, twisted pair, and any other cables and connectors (optic, power, video) necessary to install and connect the complete system both at the intersection (inside the traffic signal cabinet) and in the office shall also be provided by the contractor.

The system shall show real-time detector actuations superimposed on the live video as viewed on the workstation computer monitor in the office. The detectors shall flash or otherwise visually indicate actuations on the live video when a vehicle passes over them in the designated direction of travel. The video refreshment rate shall be more than five frames per second.

5.1 VIDEO CAMERA SYSTEM

Machine Vision Processor (MVP) Sensor All system components shall be ISO 9002 and CE certified. The MVP may be self-contained with the camera in one enclosure or separate provided it comply with the plans and these special provisions.

a. The MVP sensor shall be:
   (1) An integrated imaging CCD array with optics, high-speed, image-processing hardware and a general-purpose CPU bundled into a sealed enclosure.
   (2) Equipped with a sunshield to reflect solar heat and to shield the CCD array from direct exposure to the sun.
   (3) Equipped with a faceplate heater to melt accumulated ice, snow, or fog from the view of the camera.
b. The CCD array shall provide high video quality for detection that has virtually no noise to degrade detection performance.
c. The optics and camera electronics shall be directly controlled for optimal illumination for traffic detection.
d. The lens shall be pre-focused at the factory, as required for operation.
e. It shall be possible for the user to focus the lens, as required for operation.
f. The MVP sensor shall operate at a maximum rate of 30 frames per second when configured for the NTSC (US) video standard.
g. The MVP sensor shall process a minimum of twenty detector zones placed anywhere in the field of view of the sensor.
h. The video output shall have the ability to selectively show overlaid graphics indicating the

current real-time detection state of each individual detector defined in the video.

i. The sensor output NTSC or PAL video shall be viewed with any compatible video-display device.

MVP Sensor Detector Types The MVP sensor shall be able to be programmed with a variety of detector types that perform specific functions. The general functions performed by the detectors shall include:

a. Presence/passage detection of moving and stopped vehicles.
b. Enable detection based on the direction of travel and/or exclusively for stopped vehicles.
c. Each of the detector types shall optionally be made visible in the live video output of the sensor.

The allocation of these functional detection capabilities to programmable detector types is described below. Different detector types shall be selectable via software. Detector types shall include:

a. Count detectors outputs traffic volume statistics. Generates traffic counts and occupancy.
b. Presence detectors indicate presence of a vehicle, stopped vehicle, or vehicles traveling in the wrong direction.
c. Contrast Loss detectors monitor the quality of the video image that the MVP is processing.

MVP Sensor External interfaces The external interfaces to the MVP sensor shall include:

a. A detector port specifically to exchange detector state data with the Detector Rack Card.
b. Differential video out.
c. 24 VAC/DC power to operate the sensor.

Supervisor Communications Port

a. There shall be a supervisor communications port to configure and provide general communications.
b. The MVP sensor shall use an RS-485 multi-drop network protocol to facilitate communications via a network of Rack Cards or detector port master to a remote or local PC client / server application.
c. The communications port shall allow the user to update the embedded software with a new software release and interact with a PC client / server application for all of the various detection requests supported by the MVP sensor.

Detector I/O Port

a. The MVP sensor detector port shall provide a dedicated interface between the MVP sensor and a detector port master such as a Rack Card.
b. The real-time state of phase inputs shall be transmitted to the MVP sensor.
c. The MVP sensor shall exchange input and output state data with the detector port master every 100 ms.
d. A detector port master shall subsequently translate the detection states, in an electrically compatible manner, to a traffic signal controller.

Differential Video The MVP sensor shall output full motion video using a differential video port in either NTSC or PAL format.

Power The MVP sensor shall operate on 24 VAC/DC, 50/60 Hz at a maximum of 25 watts.

MVP Sensor Operations Log The MVP sensor shall maintain a non-volatile operations log, which minimally contains:

a. Revision numbers for the current MVP sensor hardware and software components in

operation.
b. Title and comments for the detector configuration.
c. Date and time the last detector configuration was downloaded to the MVP sensor.
d. Date and time the operation log was last cleared.
e. Date and time communications were opened or closed with the MVP sensor.
f. Date and time of last power-up.
g. Time-stamped, self-diagnosed hardware, and software errors that shall aid in system maintenance and troubleshooting.

MVP Sensor Vehicle Detection Performance Following the set of guidelines shall optimize the real time detection performance of the MVP sensor:
a. The traffic application to perform.
b. MVP sensor mounting location.
c. The number of traffic lanes to monitor.
d. The sizing, placement, and orientation of vehicle detectors.
e. Traffic approaching and/or receding from the sensor's field of view.
f. Minimizing the effects of lane changing maneuvers.

Detection Zone Placement
a. The video detection system shall provide flexible detection zone placement anywhere and at any orientation within the field of view of the MVP sensor. Preferred detector configurations shall be:
   (1) Detection zones placed across lanes of traffic for optimal count accuracy.
   (2) Detection zones placed parallel to lanes of traffic for optimal presence detection accuracy of moving or stopped vehicles.
b. A single detection zone shall be able to replace one or more conventional detector loops connected in series.
c. Detection zones shall be able to be overlapped for optimal road coverage.
d. In addition, selective groups of detectors shall be able to be logically combined into a single output by using optional delay and extend timing and signal state information.

Detection Zone Programming
a. Placement of detection zones shall be by means of a portable or desktop computer using the Windows 98, Millennium, or Windows NT 4.0, or 2000 operating systems, a keyboard, and a mouse.
b. The VGA monitor shall be able to show the detection zones superimposed on images of traffic scenes.
c. The mouse and keyboard shall be used to:
   (1) Place, size, and orient detection zones to provide optimal road coverage for vehicle detection.
   (2) Modify detector parameters for site geometry to optimize performance.
   (3) Edit previously defined detector configurations.
   (4) Adjust the detection zone size and placement.
   (5) Add detectors for additional traffic applications.
   (6) Reprogram the sensor for different traffic applications, changes in installation site geometry, or traffic rerouting. It shall be possible to:
      a) Download detector configurations from the computer to the MVP sensor.
      b) Upload the current detector configuration that is running in the MVP sensor.
      c) Back up detector configurations by saving them to the computer's removable or fixed disks.
      d) Perform the above upload, store, and retrieve functions for video snapshots of the MVP sensors' view.

Detection Zone Operation The MVP sensor real-time detection operation shall be verifiable through the following means:

a. View the video output of the sensor with any standard video display device (monitor).
b. The video output of the MVP sensor shall be capable of selectively transmitting:
   (1) Camera video only.
   (2) Video overlaid with the current real-time detection state of each detector.
   (3) Individual detectors shall have the option of being hidden.
c. Electrically monitor assigned contact closure pin outs from a detector port master interface card or Detector Rack interface card. Each pin of an interface card shall have one associated LED output to reflect its output state.
d. View the associated output LED state on the detector port master:
   (1) An LED shall be ON when its assigned detector output or signal controller phase input is on.
   (2) An LED shall be OFF when its assigned detector or signal controller input is off.

Optimal Detection

a. The video detection system shall provide optimal detection of vehicle passage and presence when the:
   (1) MVP sensor is mounted 30 feet or higher above the roadway.
   (2) Image sensor is adjacent to the desired coverage area.
   (3) Distance to the farthest detection zone locations is not greater than ten times the mounting height of the MVP sensor.
b. The recommended deployment geometry for optimal detection also requires that there be an unobstructed view of each traveled lane where detection is required. Although optimal detection may be obtained when the MVP sensor is mounted directly above the traveled lanes, the MVP sensor shall not be required to be directly over the roadway.
c. The MVP sensor shall be able to view either approaching or receding traffic or both in the same field of view. The preferred image sensor orientation for optimal detection shall be to view approaching traffic since there are more high contrast features on vehicles as viewed from the front rather than the rear.
d. The MVP sensor, when placed at a mounting height that minimizes vehicle image occlusion and equipped with a lens to match the width of the road, shall be able to monitor a maximum of six to eight traffic lanes simultaneously.

Count Detection Performance Using a MVP sensor installed within the optimal viewing specifications described above for count station traffic applications; the system shall be able to accurately count vehicles with:

a. At least 96% accuracy under normal operating conditions (day and night).
b. At least 93% accuracy under artifact conditions.

Artifact conditions are combinations of weather and lighting conditions that result from shadows, fog, rain, snow, etc.

Demand Presence Detection Performance

a. Using a MVP sensor installed within the optimal viewing specifications described above for intersection control traffic applications; the system shall be able to accurately provide demand presence detection.
b. The demand presence accuracy shall be based on the ability to enable a protected turning movement on an intersection stop line, when a demand exists.
c. The probability of not detecting a vehicle for demand presence shall be less than 1- percent error under all operating conditions.

(1) In the presence of artifact conditions, the MVP sensor shall minimize extraneous (false) protected movement calls to less than 7 %.
(2) To ensure statistical significance, the demand presence accuracy and error shall be calculated over time intervals that contain a minimum of 100 protected turning movements.

d. The calculation of the demand presence error shall not include turning movements where vehicles do not pass through the presence detectors, or where they stop short or stop beyond the combined detection zones.

Sensor Hardware

Sensor

The sensor shall:

a. Use medium resolution image sensors as the video source for real-time vehicle detection using either NTSC or PAL formats. As a minimum, each image sensor shall provide the following capabilities:
(1) Images shall be produced with a CCD sensing element with horizontal resolution of at least 500 lines and vertical resolution of at least 350 lines. Images shall be output as video conforming to NTSC or PAL specifications.
b. Provide software JPEG video compression.
c. Provide useable video and resolvable features in the video image shall be produced when those features have luminance levels as low as 0.1 lux at night.
d. Provide useable video and resolvable features in the video image shall be produced when those features have luminance levels as high as 10,000 lux during the day.
e. Provide useable video and resolvable features in the video image shall be produced when the ratio of the luminance of the resolved features in any single video frame is 300:1.
f. Provide direct real-time iris and shutter speed control:
g. Provide an optical filter and appropriate electronic circuitry shall be included in the image sensor to suppress “blooming” effects at night.
i. Have gamma for the image sensor present at the factory to a value of 1.0.

Sensor Optics

The MVP sensor shall be equipped with an integrated zoom lens with zoom and focus capabilities that can be changed using either configuration computer software or hand-held controller.

Sensor Enclosure

The MVP sensor and lens assembly shall be housed in an environmental enclosure that provides the following capabilities:

a. The enclosure shall be waterproof and dust-tight to NEMA-4 specifications, and shall have the option to be pressurized with dry nitrogen to 5 ± 1 psi.
b. The enclosure shall allow the MVP sensor to operate satisfactorily over an ambient temperature range from -34°C to +74°C while exposed to precipitation as well as direct sunlight.
c. The enclosure shall allow the image sensor horizon to be rotated during field installation.
d. The enclosure shall include a provision at the rear of the enclosure for connection of the factory-fabricated power, communications and video signal cable. Input power to the environmental enclosure shall be 24 VAC/DC and either 50 or 60 Hz.
e. A heater shall be at the front of the enclosure to prevent the formation of ice and condensation in cold weather, as well as to assure proper operation of the lens' iris mechanism. The heater shall not interfere with the operation of the image sensor electronics, and it shall not cause interference with the video signal.

f. The enclosure shall be light-colored and shall include a sun shield to minimize solar heating and glare. The front edge of the sunshield shall protrude beyond the front edge of the environmental enclosure and shall include provision to divert water flow to the sides of the sunshield. The amount of overhang of the sunshield shall be adjustable to prevent direct sunlight from entering the lens or hitting the faceplate.
g. The total weight of the image sensor in the environmental enclosure with sunshield shall be less than 6 pounds.
h. When operating in the environmental enclosure with the power, communication and video signal cable connected, the image sensor shall meet FCC class B and CE requirements for electromagnetic interference emissions.

Sensor Electrical

a. The video output of the MVP sensor shall be isolated from earth ground.
b. All video connections from the sensor to the interface panel shall also be isolated from earth ground.
c. The video output, communication, and power stages of the sensor shall include transient protection to prevent damage to the sensor due to voltage transients occurring on the cable leading from the MVP sensor to other field terminations.
d. Connections for video, communications and power shall be made to the image sensor using a single metal shell connector.
e. The mating cable shall use a right-angle shell.
f. The MVP sensor shall have passed requirements for and received the CE mark.

MVP Sensor Field Interface Equipment

Communications Panel Requirements

A communications panel shall be provided with each MVP sensor for installation.

The communications panel shall provide:

a. A terminal block for terminating power.
b. Terminated, wiring to the image sensor.

MVP Sensor Power Requirements

The MVP sensor communications interface panel shall provide 24 VAC input power, at less than 25 Watts, 50/60 Hz.

5.2 DETECTOR PORT MASTER

Description

The detector port master shall provide a simple and reliable interface between multiple camera MVP and any standard traffic controller or other device. It shall monitor phase colors and gather detection information from up to five MVPs.

The detector port master shall be a single-card device that can stand-alone or slide easily into a detector rack. It shall have an advanced microcontroller based communication circuitry that passes real-time detection states or camera traffic alarms as discrete detector outputs to a traffic controller or other control system. The camera MVPs shall configure the input and outputs on the detector port master automatically.

The detector port master shall be suitable for the camera detection system Type 170, and 2070 cabinets.

The real-time detector outputs from the rear edge connector or front connector shall be fully compatible with existing loop detector systems. The design shall use a single circuit board and faceplate to allow easy insertion into a 4-channel slot of a standard detector rack or equivalent enclosure. It quickly install in any existing traffic cabinet.

The detector port master shall have visual indications to show the operational status and health of the port and the networked MVPs connected at the Communications Interface Panel (CIP). Together, they form a single point of maintenance for the video detection system by providing connection for a laptop computer and optional video monitor.

Compatibility
All input and output signals shall be fully compatible with Type 170, and 2070 traffic controllers. Red and green phase color inputs to the front connector increase stop line detection effectiveness. As an alternate to the front panel I/O connector, it shall be possible to divert four inputs and eight outputs to the rear edge connector for custom applications.

The detector port master shall support up to five camera MVPs by regular polling for the current state of detectors in each MVP. This data shall then be relayed to the controller via discrete out-puts.

Hardware

The detector port master shall slide freely into rack card guides having a nominal slot width of 0.075 inches and a maximum slot width of 0.125 inches. The front panel shall be minimally 0.090 inch sheet aluminum finished with a durable protective coating. It shall have an aluminum handle on the front panel to allow easy removal from rack. Nominal outer dimensions of the handle shall be 1 inch by 2 1/2 inches. The unit may be inserted or removed from a powered detector rack.

Visual queues for easy set up and maintenance shall include:
a. Four tri-color indicators showing the operational status of communications and the health of the first four camera MVPs
b. Five red LED indicators showing the state of each of the five inputs.
c. Ten red LED indicators showing the state of each of ten outputs.

Inputs
Five optically-isolated inputs to monitor signal controller phases or other conditions

Power
20 to 28 VDC, 100 milliamps, not exceeding 5 watts (Operates at 24 VDC)

Dimensions
Not to exceed 4.5 inches by 2.335 inches by 7 inches (H x W x D)

Environmental
The detector port master shall operate under temperatures ranging from 34°C to 74°C and 0 to 95% relative humidity (non-condensing over the entire temperature range)

Warranty
The detector port master shall have a minimum of 2 year manufacturer warranty

5.3 POINT-TO-POINT DATA TRANSCEIVERS

Description
Data transceivers shall meet EIA RS-232/422 Specifications (Simplex or Duplex), Caltrans Specifications (Temperature/Humidity, Shock/Vibration, and Voltage Transient Protection). It shall be suitable for use with traffic signal control equipment. Shall have data rates up to 100 kbps without in-field electrical or optical adjustments. The data transceiver shall be of a Plug and Play design ensuring ease of installation and requiring no electrical or optical adjustments.

Hardware
Data transceiver shall include Power, Transmit and Receive Data Status LED Indicators, Integrated WDM for Greater Product Reliability, Automatic Resettable Solid-State Current Limiters, Hot-Swappable Rack Modules. It shall be able to transmit and receive without repeaters for distances up to 11 Miles with 13 dB optical power budget over one single mode fiber (50/125µm) (1300 nm wavelength). The data transceiver shall be rack mounted. A PS-12VDC 12 Volt DC Plug-in Power Supply shall be supplied with the equipment. The circuit boards shall be Conformally Coated Printed Circuit Boards. The contractor shall provide and install repeaters at no extra cost to the city if the proposed transceiver is not capable to transmit and receive without repeater for a distance of up to 11 miles

Connectors
Optical: ST
Data and Power: Terminal Plug with screw clamps

Electrical & Mechanical
Surface Mount: 12 VDC @ 150 mA
Rack: From Rack
Number of Rack Slots: 1
Current Protection: Automatic Resettable Solid-State Current Limiters
Circuit Board: Meets IPC Standard

Environmental
MTBF: > 100,000 hours
Operating Temp: -40°C to +74°C
Relative Humidity: 0% to 95% (non-condensing)

Warranty
The point-to-point data transceiver shall have a minimum of 2 year manufacturer's warranty

5.4 VIDEO MULTIPLEXER

Description
The video transmitter/multiplexer and video receiver/demultiplexer shall utilize state-of-the-art 8-bit digital-encoding and decoding for high-quality video transmission that exceeds the requirements of EIA RS250C for Medium-Haul Video Transmission. These units shall be environmentally-hardened to provide transmission of four independent video channels over one multi mode or single mode optical fiber and shall be suitable for use in unconditioned roadside or out-of-plant installations. They should be completely transparent to and universally compatible with any NTSC, PAL, or SECAM CCTV camera system.

Hardware

The video transmitter/multiplexer and video receiver/demultiplexer should have a plug-and-play design to ensure ease of installation and shall not require electrical or optical adjustments. The video transmitter/multiplexer shall be able to transmit without repeaters for distances up to 38 Miles with 20 dB optical power budget over one single mode fiber (9/125µm) (1300 nm wavelength). The video receiver/demultiplexer shall be able to receive without repeaters for distances up to 48 Miles with 26 dB optical power budget over one single mode fiber (9/125µm) (1300 nm wavelength). LED indicators shall be provided indicating equipment operating status. The unit shall be available in either stand-alone or rack-mount configurations. Solid-state current limiters shall be provided on all power lines to protect equipment

Video
Video Input: 1 volt pk-pk (75 ohms)
Input/Output Channels: 4
Bandwidth (minimum): 10 Hz - 6.5 MHz
Differential Gain: <2%
Differential Phase: <0.7 degrees
Tilt: <1%
Signal-to-Noise Ratio (SNR): 60 dB @ mMaximum Optical Loss Budget

Optical Emitter
Laser Diode

LED Indicators
Video Transmitter/Multiplexer Unit:
- Video Input Sync Presence for Each Video Channel
- Video Input Overload for Each Video Channel
- Optical Carrier Detect/ Link-Lock
- Operating Power

Video Receiver/Demultiplexer Unit:
- Video Output Sync Presence for Each Video Channel
- Video Output Overload for Each Video Channel
- Optical Carrier Detect/ Link-Lock
- Operating Power

Connectors
Optical: ST, SC or FC
Power: Terminal Block with Screw Clamps
Video: BNC (Gold Plated Center-Pin)

Electrical & Mechanical
Power: +12 VDC @ 500 mA
Number of Rack Slots: 2
Current Protection: Automatic resettable solid-state current limiters
Circuit Board: Shall meet IPC Standard

Environmental
MTBF: > 100,000 hours
Operating Temp: -40° C to +74° C
Relative Humidity: 0% to 95% (non-condensing)

Warranty

The video transmitter/multiplexer and video receiver/demultiplexer shall have a minimum of 2 year manufacturer's warranty.

PART VI POLE FINISH

6.1 GENERAL

This section specifies requirements for coating systems for certain items on the project; including light poles, light pole mast arms, and luminaires.

6.2 SURFACE PREPARATION

Prior to being incorporated into an assembled product, steel plates 3/4 inch or more in thickness shall be blast cleaned to removed rolled-in mill scale, impurities and non-metallic foreign materials. After assembly, all weld flux shall be mechanically removed. The iron or steel product shall be degreased by immersion in an agitated 4.5%-6% concentrated caustic solution elevated to a temperature ranging from 150 to 190°F. It shall then be pickled by immersion in a heated sulfuric acid solution of 6%-13% concentration, with a controlled temperature between 150 to 190°F. It shall next be rinsed clean from any residual effects of the caustic or acid solutions by immersion in a circulating fresh water bath. Final preparation shall be accomplished by immersion in a concentrated zinc ammonium chloride flux solution heated to 130°F. The solution's acidity content shall be maintained between 4.5-5.0 pH. The assembly shall be air dried to remove any moisture remaining in the flux coat and/or trapped within the product.

6.3 ZINC COATING

The product shall be hot-dip galvanized to the requirements of either ASTM A 123 (fabricated products) or ASTM A 153 (hardware items) by immersion in a molten bath of prime western grade zinc maintained between 810-850°F. The entire product shall be totally immersed with no part of it protruding out of the zinc (no double dipping). This is to limit a risk of trapped contaminates containing chlorides and reduce the risk of bare spots (bare spots can occur when flux on the steel surface is burned away by heat of the first dip). Maximum aluminum content of the bath shall be 0.01%. Flux ash shall be skimmed from the bath surface prior to immersion and extraction of the product to assure a debris free zinc coating.

6.4 EXTERIOR COATING

All galvanized exterior surfaces shall be coated with a Urethane or Triglycidyl Isocyanurate (TGIC) Polyester Powder to a minimum film thickness of 0.002 inch. Prior to application, the surfaces to be powder coated shall be mechanically etched by brush blasting (Ref. SSPC-SP7) and the zinc coated substrate preheated to 450°F for a minimum of one hour in a gas fired convection oven by heating the zinc coated substrate to a minimum of 350°F and a maximum of 400°F. The thermosetting powder resin shall provide both intercoat as well as substrate fusion adhesion that meets 5A or 5B classifications of ASTM D 3359.

6.5 QUALITY CONTROL

The galvanizing and powder coating facilities shall be owned and operated by the pole manufacturer to ensure a quality coating system.

6.6 PACKAGING

Prior to shipment, small poles shall be wrapped in 0.188 inch thick Ultraviolet-inhibiting plastic backed foam. Larger poles shall be cradled in a 1.0 inch rubberized foam base.

6.7 FIELD REPAIR PROCEDURES

Where factory applied coatings have become damaged or abraded due to handling, transport, installation, welding or other circumstances, they shall be repaired by the field painting crew or miscellaneous metal contractor.

All damaged areas shall be thoroughly wire brushed. All dirt, oil, grease, or other contaminants shall be removed in accordance with SSPC-SP1 and SP5. Touch-up paint

supplied the galvanizer or steel fabricator, identical in color and composition to that used in the plant, shall be applied to all prepared surfaces to a dry film thickness of at least 4.0 mils.

6.8 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Combination Coating – Galvanized-Powder Top Coat shall be considered incidental to the price bid per each pole and shall be considered incidental to the lump sum bid for the traffic system.

SCHEDULE OF UNIT PRICES
SOUTHEAST CONNECTOR TRAFFIC SIGNALS
NHSX-U-1945(408)—8S-77
ACTIVITY ID: 2010-18

ITEM DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	EXT.
MAST ARM SIGNAL, TYPE VALMONT CB16-45+13-AB-FP/GV-SPECIAL-MLK	1	EA		
COMBINATION MAST ARM SIGNAL AND LIGHTING POLE, TYPE VALMONT CB16-50+13-AB-FP/GV-SPECIAL-MLK	1	EA		
MAST ARM SIGNAL POLE, TYPE VALMONT CB16-50+13-AB-FP/GV-SPECIAL-MLK	1	EA		
COMBINATION MAST ARM SIGNAL AND LIGHTING POLE, TYPE VALMONT CB16-60+13-AB-FP/GV-SPECIAL-MLK	1	EA		
MAST ARM SIGNAL POLE, TYPE VALMONT CB16-60+13-AB-FP/GV-SPECIAL-MLK	1	EA		
MAST ARM SIGNAL POLE, TYPE VALMONT CB16-65+13-AB-FP/GV-SPECIAL-MLK	1	EA		
COMBINATION MAST ARM SIGNAL AND LIGHTING POLE, TYPE VALMONT CB16-70+13-AB-FP/GV-SPECIAL-MLK	1	EA		
LIGHTING POLE, TYPE VALMONT 13-AB-FP/GV-SPECIAL-MLK	1	EA		
PEDESTAL POLE, 13'	2	EA		
PEDESTAL POLE, 5'-6"	1	EA		
SIGNAL FACE, 3-SECTION HEAD WITH TUNNEL VISORS, 12" LED WITH BACKPLATE (RED, YELLOW, GREEN)	16	EA		
SIGNAL FACE, 4-SECTION HEAD WITH TUNNEL VISORS, 12" LED WITH BACKPLATE (RED, YELLOW, GREEN, LT GREEN ARROW)	1	EA		
SIGNAL FACE, 5-SECTION HEAD WITH TUNNEL VISORS, 12" LED WITH BACKPLATE (RED, YELLOW, GREEN, RT YELLOW ARROW, RT GREEN ARROW)	2	EA		
SIGNAL FACE, 4-SECTION HEAD WITH TUNNEL VISORS, 12" LED WITH BACKPLATE (LT RED ARROW, LT YELLOW ARROW, LT YELLOW FLASHING ARROW, LT GREEN ARROW)	17	EA		
SIGNAL FACE, 2-SECTION HEAD WITH TUNNEL VISORS, LARGE FORMAT LED (PEDESTRIAN COUNTDOWN)	8	EA		
3" CONDUIT, MOUNTED	100	LF		
3 CONDUIT, TRENCHED	9262	LF		
3 CONDUIT, BORED/JACKED	200	LF		
1c #6 DETECTOR CABLE	3888	LF		
1c #8	2000	LF		
2c #14 DETECTOR LEAD-IN CABLE	4871	LF		
2c #14 PB LEAD-IN CABLE	3962	LF		
5c #14 TRAFFIC SIGNAL CABLE	70	LF		
16c #14 TRAFFIC SIGNAL CABLE	2154	LF		
1c #6 BARE GROUNDING WIRE	1609	LF		

1c #10 TRACER WIRE	11446	LF		
PULL ROPE	5481	LF		
48 SINGLE-MODE FIBER OPTIC CABLE	8436	LF		
12 SINGLE-MODE FIBER OPTIC CABLE	7236	LF		
170 ETHERNET CARD	3	EA		
6'x8' PREFORMED LOOP DETECTOR (VEHICLE)	8	EA		
6'x20' PREFORMED LOOP DETECTOR (VEHICLE)	16	EA		
ACCESSIBLE PEDESTRIAN SIGNAL PUSH BUTTON (APSPB)	12	EA		
PULLBOX, TYPE I	6	EA		
PULLBOX, TYPE II	4	EA		
PULLBOX, TYPE III	16	EA		
TYPE 332 SIGNAL CONTROLLER, CABINET, AND ACCESSORIES (INCLUDING FIBER DISTRIBUTION PANEL)	2	EA		
TRAFFIC SIGN: R3-5L 30"x36"	6	EA		
TRAFFIC SIGN: R3-5R 30"x36"	2	EA		
TRAFFIC SIGN: R3-5S 30"x36"	1	EA		
TRAFFIC SIGN: R10-3EL 9"x15"	3	EA		
TRAFFIC SIGN: R10-3ER 9"x15"	3	EA		
TRAFFIC SIGN: R10-3ELR 9"x15"	2	EA		
INSTALL STREET SIGN ON MAST-ARM	7	EA		
CONCRETE FOOTING: 24" DIA. x 3' DEPTH	9	EA		
CONCRETE FOOTING: 36" DIA. x 10' DEPTH	1	EA		
CONCRETE FOOTING: 36" DIA. x 12' DEPTH	3	EA		
CONCRETE FOOTING: 36" DIA. x 14' DEPTH	1	EA		
CONCRETE FOOTING: 36" DIA. X 16' DEPTH	2	EA		
PAN TILT ZOOM (PTZ) CAMERA AND ACCESSORIES	1	EA		
CAMERA CABLE	150	LF		
ETHERNET CABLE	150	LF		
1" RISER AND JUNCTION BOX	1	EA		
TYPE 336S CABINET & FOOTING, ACCESSORIES (INCLUDING FIBER DISTRIBUTION PANEL)	1	EA		
MODIFY TRAFFIC SIGNAL FACE	12	EA		

EQUIPMENT AND MATERIAL LIST
SOUTHEAST CONNECTOR TRAFFIC SIGNALS
NHSX-U-1945(408)—8S-77
ACTIVITY ID: 2010-018

PLAN QUANTITY	UNIT	ITEM DESCRIPTION	MANUFACTURER	CATALOG NUMBER
1	EA	MAST ARM SIGNAL POLE	VALMONT	CB16-45+13-AB-FP/GV-SPECIAL-MLK
1	EA	COMBINATION MAST ARM SIGNAL AND LIGHTING POLE	VALMONT	CB16-50+13-AB-FP/GV-SPECIAL-MLK
1	EA	MAST ARM SIGNAL POLE	VALMONT	CB16-50+13-AB-FP/GV-SPECIAL-MLK
1	EA	COMBINATION MAST ARM SIGNAL AND LIGHTING POLE	VALMONT	CB16-60+13-AB-FP/GV-SPECIAL-MLK
1	EA	MAST ARM SIGNAL POLE	VALMONT	CB16-60+13-AB-FP/GV-SPECIAL-MLK
1	EA	MAST ARM SIGNAL POLE	VALMONT	CB16-65+13-AB-FP/GV-SPECIAL-MLK
1	EA	COMBINATION MAST ARM SIGNAL AND LIGHTING POLE	VALMONT	CB16-70+13-AB-FP/GV-SPECIAL-MLK
1	EA	LIGHTING POLE	VALMONT	13-AB-FP/GV-SPECIAL-MLK
2	EA	PEDESTAL POLE, 13'		
1		PEDESTAL POLE, 5'-6"		
16	EA	SIGNAL FACE, 3-SECTION HEAD WITH TUNNEL VISORS, 12" LED WITH BACKPLATE (RED, YELLOW, GREEN)		
1	EA	SIGNAL FACE, 4-SECTION HEAD WITH TUNNEL VISORS, 12" LED WITH BACKPLATE (RED, YELLOW, GREEN, LT GREEN ARROW)		
2	EA	SIGNAL FACE, 5-SECTION HEAD WITH TUNNEL VISORS, 12" LED WITH BACKPLATE (RED, YELLOW, GREEN, RT YELLOW ARROW, RT GREEN ARROW)		
17	EA	SIGNAL FACE, 4-SECTION HEAD WITH TUNNEL VISORS, 12" LED WITH BACKPLATE (LT RED ARROW, LT YELLOW ARROW, LT YELLOW FLASHING ARROW, LT GREEN ARROW)		

14	EA	SIGNAL FACE, 2-SECTION HEAD WITH TUNNEL VISORS, LARGE FORMAT LED (PEDESTRIAN COUNTDOWN)		
100	LF	3" CONDUIT, MOUNTED		
9262	LF	3" CONDUIT, TRENCHED		
200	LF	3" CONDUIT, BORED/JACKED		
3888	LF	1c #6 DETECTOR CABLE		
2000	LF	1c #8		
4871	LF	2c #14 DETECTOR LEAD]IN CABLE		
3962	LF	2c #14 PB LEAD-IN CABLE		
70	LF	5c #14 TRAFFIC SIGNAL CABLE		
2154	LF	16c #14 TRAFFIC SIGNAL CABLE		
1609	LF	1c #6 BARE GROUNDING WIRE		
11446	LF	1c #10 TRACER WIRE		
5481	LF	PULL ROPE		
8436	LF	48 SINGLE-MODE FIBER OPTIC CABLE		
7236	LF	12 SINGLE-MODE FIBER OPTIC CABLE		
3	EA	170 ETHERNET CARD		
8	EA	6'x8' PREFORMED LOOP DETECTOR (VEHICLE)		
16	EA	6'x20' PREFORMED LOOP DETECTOR (VEHICLE)		
12	EA	ACCESSIBLE PEDESTRIAN SIGNAL PUSH BUTTON (APSPB)		
6	EA	PULLBOX, TYPE I		
4	EA	PULLBOX, TYPE II		
16	EA	PULLBOX, TYPE III		
2	EA	TYPE 332 SIGNAL CONTROLLER, CABINET, AND ACCESSORIES (INCLUDING FIBER DISTRIBUTION PANEL)		
6	EA	TRAFFIC SIGN: R3-5L 30"x36"		
2	EA	TRAFFIC SIGN: R3-5R 30"x36"		
1	EA	TRAFFIC SIGN: R3-5S 30"x36"		

3	EA	TRAFFIC SIGN: R10-3EL 9"x15"		
3	EA	TRAFFIC SIGN: R10-3ER 9"x15"		
2	EA	TRAFFIC SIGN: R10-3ELR 9"x15"		
7	EA	INSTALL STREET SIGN ON MAST-ARM		
9	EA	CONCRETE FOOTING: 24" DIA. x 3' DEPTH		
1	EA	CONCRETE FOOTING: 36" DIA. x 10' DEPTH		
3	EA	CONCRETE FOOTING: 36" DIA. x 12' DEPTH		
1	EA	CONCRETE FOOTING: 36" DIA. x 14' DEPTH		
2	EA	CONCRETE FOOTING: 36" DIA. X 16' DEPTH		
1	EA	PAN TILT ZOOM (PTZ) CAMERA AND ACCESSORIES		
150	LF	CAMERA CABLE		
15	LF	ETHERNET CABLE		
1	EA	1” RISER AND JUNCTION BOX		
1	EA	TYPE 336S CABINET & FOOTING, ACCESSORIES (INCLUDING FIBER DISTRIBUTION PANEL)		
12	EA	MODIFY TRAFFIC SIGNAL FACE		

6.3 "E MLK & SE 12th STREET"
ACTIVITY ID: 2010-018

FIELD WIRING DIAGRAM

Phase/No.	Field Terminal	Indication	Signal Head	Phase/No.	Field Terminal	Indication	Signal Head	Phase/No.	Field Terminal	Indication	Signal Head
04	101	Red	WBT	02 Ped	113	Don't Walk	SB	01	125	Red	
04	102	Yellow	WBT	02 Ped	114	-		01	126	Yellow Arrow	
04	103	Green	WBT	02 Ped	115	Walk	SB	01	127	Green Arrow	
04 Ped	104	Don't Walk	WB	03	116	Red	EBL	02	128	Red	SBT
04 Ped	105	-		03	117	Yellow Arrow	EBL	02	129	Yellow	SBT
04 Ped	106	Walk	WB	03	118	Green Arrow	EBL	02	130	Green	SBT
08	107	Red	EBT	06 Ped	119	Don't Walk	NB	05	131	Red	
08	108	Yellow	EBT	06 Ped	120	-		05	132	Yellow Arrow	
08	109	Green	EBT	06 Ped	121	Walk	NB	05	133	Green Arrow	
08 Ped	110	Don't Walk	EB	07	122	Red	WBL	06	134	Red	NBT
08 Ped	111	-		07	123	Yellow Arrow	WBL	06	135	Yellow	NBT
08 Ped	112	Walk	EB	07	124	Green Arrow	WBL	06	136	Green	NBT

FIELD WIRING DIAGRAM (OVERLAPS)

Phase/No.	Field Terminal	Indication	Signal Head	Phase/No.	Field Terminal	Indication	Signal Head	Phase/No.	Field Terminal	Indication	Signal Head
O8 OL	A101	Red		O6 OL	A114	Red		O4 OL	A124	Red	
O8 OL	A102	Yellow Arrow		O6 OL	A115	Yellow Arrow		O4 OL	A125	Yellow Arrow	
O8 OL	A103	Green Arrow		O6 OL	A116	Green Arrow		O4 OL	A126	Green Arrow	
	A104	Red		O2 OL	A121	Red					
	A105	Yellow		O2 OL	A122	Yellow Arrow					
	A106	Green		O2 OL	A123	Green Arrow					
	A111	Red				Red					
	A112	Yellow				Yellow					
	A113	Green				Green					

Note: NBT=North Bound Through Signals, NBL=North Bound Left Signals, NBR=North Bound Right Signals, etc.