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(Replaces SP-151002)



SPECIAL PROVISIONS
FOR
TRAFFIC SIGNALIZATION

Polk County
STP-U-1945(796)--70-77

Effective Date
November 15, 2016

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

TRAFFIC SIGNAL SPECIFICATIONS

**PARK AVENUE WIDENING, 56TH ST. TO SW 63RD ST.
06-2011-005**

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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. Iowa Department of Transportation Standard Specifications
- B. Specifications of the Underwriters Laboratories Inc.
- C. National Electrical Code.
- D. 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 3 feet or less in depth shall be removed completely. Foundations greater than 3 feet in depth shall be removed to 1 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 7 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, 1/2 inch wide, polyester cable pulling tape with a minimum 1200 pound 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 the Contractor.

A continuous orange tracer wire (1c No. 10 AWG) shall be included from each pole base to the controller cabinet. A separate orange tracer wire (1c No. 10 AWG) 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, Type III or Type IV 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, which ever 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:

<p>FIBER OPTIC CABLE, CITY OF DES MOINES</p> <p>48 FIBER – SM</p> <p>EAST – 63rd & HICKMAN</p> <p>WEST – WESTOVER & HICKMAN</p>
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- 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 $\pm 3\%$ 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 end-to-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 1 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:	<u>1.0 dB</u>
 Maximum allowable loss:	 7.0 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.

E. 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 – 63 rd & Univ.
C – East – MH & Hick.
D - West

F. 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 non-metallic 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 (F_p) minus the frequency of the loop with no vehicle present (F_c) divided by the frequency of the loop with no vehicle present $(F_p - F_c) / F_c$.

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. 14 AWG.

3.2 SIGNS

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

1. All blanks shall be 0.08 inches thick with 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 MUTCD.

The background sheeting used on all signs, with the exception of pedestrian pushbutton signs, shall be 3M DG3 or Iowa DOT approved equal 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 or Iowa DOT approved equal material. Pedestrian pushbutton signs shall be 3M Engineer Grade Prismatic or Iowa DOT approved equal 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 or Iowa DOT approved equal. 8 inch street name signs shall be made of 3M High Intensity Prismatic or Iowa DOT approved equal 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 shall 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 $\mu\text{m} \pm 1.0 \mu\text{m}$
Cladding Diameter:	125.0 $\mu\text{m} \pm 1.0 \mu\text{m}$
Core Concentricity:	$\pm 1\%$
Max. Attenuation:	6.03 dB/mile
2. Single-Mode Fiber

Typical Core Diameter:	8.3 $\mu\text{m} \pm 1.0 \mu\text{m}$
Cladding Diameter:	125.0 $\pm 1.0 \mu\text{m}$
Core Concentricity:	$\pm 1\%$
Attenuation Uniformity:	No point discontinuity greater than 0.1 μm 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-swallowable 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 12 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 one percent 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:

- a. Each fiber proof tested at a minimum load of 350 Mpa.
- b. 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:

- a. Fluid Penetration
- b. Compound Drip
- c. Compressive Loading Resistance
- d. Cyclic Flexing
- e. Cyclic Impact
- f. 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 inchesH by 18.5 inchesW by 11.25 inchesD. 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 or LC type connectors of ceramic ferrule and Physical Contact end finish shall be used to terminate fibers to equipment. ST, LC or mechanical connectors shall not be used to splice cables. All multimode fibers shall be terminated with ST connectors. All single mode fibers shall be terminated with LC connectors.

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-78-16, December 1978, with the following exceptions:

1. Any reference to the State of California shall mean the Jurisdiction.
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 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."
- a. A model 412C prom module shall be provided, configured to the following table:

Memory Socket	Address Range	Device Type	Chip No.*
U1	8000-FFFF	32K EPROM	INT 27256A
U2	3000-4FFF	8K ZPRAM	DAL 1225
U3	7010-7FFF	8K ZPRAM	DAL 1225
U4	1000-2FFF	8K RAM	HD 6264

*or approved equal

- 7. 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.
- 8. The Model 2010eclip Monitor Unit shall be provided.
- 9. A "PDA-2" Power Distribution Assembly shall be provided in lieu of the PDA-1 and the 24 volt D.C. Supply.
- 10. A standard print shelf drawer shall be provided and installed above the input file.
- 11. Four ACIA ports shall be provided.
- 12. One Model 400 internal modem shall be supplied for each controller when twisted pair communications is specified in the plans.
- 13. All components supplied shall be on CalTrans Qualified Product Listing and operate successfully with McCain 233 software.
- 14. 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.

15. Each cabinet shall be provided with devices to protect the control equipment from 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 1/2 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 stage clamp 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 inch by 12 inch, 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 one 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. Seven or eight data bit characters
 - c. Parity – odd, even, none
 - d. Stop bits: one or two
 - e. Control Signals: RTS/DCD, CTS
 - f. Flow Control: XON/XOFF, RTS/CTS
3. Temperature hardened (-40° to 167° F)
4. Password protection with 256 bit AES encryption for secure communications
5. Power requirements to be +12 volts and 12 volts $\pm 5\%$ @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 Posrt 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 light emitting diode (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 inch by 16 inch 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 133/4 inch 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 MICROWAVE 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 bicycles/vehicles by transmitting electromagnetic radar signals through the air. The signals bounce off bicycles/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 1foot 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 VII
SCHEDULE OF UNIT PRICES
TRAFFIC SIGNALIZATION
Park Avenue Widening
SW 56th St. to SW 63rd St.
06-2011-005

ITEM	UNIT	TOTAL QUANTITY	UNIT COST	EXTENSION
8 Phase Controller, 332 Cabinet, Aux Panel and Access.	EACH	1		
Controller Cabinet Riser	EACH	1		
Controller Cabinet Split Riser	EACH	2		
Pedestrian Pushbutton with Sign - APS	EACH	3		
2 ch. Inductive Loop Detector - Card Rack	EACH	20		
12" RA, YA, FYA, GA left w/backplate, m.a. mount, LED	EACH	3		
12" RA, YA, FYA, GA right side of pole mount, LED	EACH	1		
12" RA, YA, GA left w/backplate, mast arm mount, LED	EACH	1		
12" RA, YA, GA left, side of pole mount, LED	EACH	3		
12" RA, YA, GA right w/backplate, mast arm mount, LED	EACH	1		
12" RA, YA, GA right side of pole mount, LED	EACH	1		
12" R, Y, G w/backplate, mast arm mount, LED	EACH	15		
12" R, Y, G side of pole mount, LED	EACH	10		
16" Hand/Walking Person with Countdown Timer, LED	EACH	4		
Type I	EACH	9		
Type III	EACH	4		
Type IV	EACH	1		
Signal - 16c #14	LIN FT	1330		
Signal - 12c #14	LIN FT	102		
Signal - 7c #14	LIN FT	240		
Signal - 5c #14	LIN FT	1130		
Signal - 2c #14	LIN FT	338		
Detector - 1c #14 Loop	LIN FT	5552		

**SCHEDULE OF UNIT PRICES
TRAFFIC SIGNALIZATION
Park Avenue Widening
SW 56th St. to SW 63rd St.
06-2011-005**

ITEM	UNIT	TOTAL QUANTITY	UNIT COST	EXTENSION
Detector - 2c #14	LIN FT	5334		
Power - 1c #6	LIN FT	10		
Ground - 1c #6	LIN FT	1273		
Tracer - 1c #10, orange	LIN FT	6426		
Pull Tape	LIN FT	6426		
Fiber - 12 count multi mode	LIN FT	3670		
Fiber - 48 count single mode	LIN FT	4659		
1" PVC	LIN FT	487		
2" PVC	LIN FT	206		
3" PVC	LIN FT	5040		
2' Dia. X. 15' Footing	EACH	2		
Controller Cabinet Footing	EACH	1		
15' pedestal pole	EACH	2		
Combination Signal Mast Arm - 34'	EACH	1		
Combination Signal Mast Arm - 52'	EACH	1		
Street Name Sign - 18" x varies, Park Av	EACH	4		
Street Name Sign - 18" x varies, SW 63rd St	EACH	1		
Street Name Sign - 18" x varies, SW 56th St	EACH	2		
Traffic Sign - 36" x 36", R3-8L	EACH	1		
Traffic Sign - 30" x 36", R3-5L	EACH	5		
Traffic Sign - 30" x 36", R3-5R	EACH	1		
FO Termination Unit (closet)	EACH	1		
Multi Mode Fiber Terminations	EACH	60		
Locate Box	EACH	3		

**SCHEDULE OF UNIT PRICES
 TRAFFIC SIGNALIZATION
 Park Avenue Widening
 SW 56th St. to SW 63rd St.
 06-2011-005**

ITEM	UNIT	TOTAL QUANTITY	UNIT COST	EXTENSION
Signal Head/Pushbutton Removals	LS	1		
TOTAL SIGNALIZATION COST				