SP-096047
(NEW)

Iowa Department of Transportation

SPECIAL PROVISIONS

FOR

TRAFFIC SIGNALIZATION

Scott County

Project Number
STP-U-1827(662)--70-82

Effective Date:
May 15, 2012

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

1. PURPOSE. It is the purpose of these specifications to set forth the general requirements and administrative details governing the purchase and installation of traffic signal equipment and materials. All equipment and materials shall be furnished and installed in accordance with the contract documents.

2. COMPLIANCE WITH CONTRACT DOCUMENTS.
The requirements of the Iowa DOT Standard Specifications shall apply to work on this project when such work is not otherwise defined by the contract documents. For estimated quantities, see exhibit A of these special provisions.

3. TECHNICAL CERTIFICATION. A minimum of one contractor technician or craftsman on the job at any time must be certified by the International Municipal Signal Association (IMSA) as a Level I and Level II Traffic Signal Technician/Electrician. Proof of certification must be provided prior to notice to proceed.

4. WORK ZONE TRAFFIC CONTROL. The Signal Contractor shall prepare a traffic control plan. This plan must be approved by the Traffic Engineering Division one month prior to beginning work. All signs, barricades and their placement and use shall be in accordance with the Manual on Uniform Traffic Control Devices.

5. WORK SITE. The Contractor shall maintain the worksite in a neat and orderly manner. All operations and storage of materials shall be limited to the right-of-way. Operations that interfere with traffic movement will be kept to a minimum. The Contractor shall remove all excavated earth and debris from the worksite in a timely manner. All surfaces shall be restored to their original or improved state upon completion of the project. Any existing traffic signals shall remain in operation at all times during construction. The existing traffic signals shall be turned off and removed only at the direction of the Traffic Engineering Division.

6. INSPECTION. A project inspector will visit the site daily. Any actions in conflict with the Specifications or Plans shall be cause for the issuance of a "Stop Work Order" until such time that any discrepancies are corrected.

7. EQUIPMENT AND MATERIALS. The equipment and materials required in this specification are intended to be those which are standard items from reputable manufacturers of these products. When it is necessary to modify requirements for these items to fit the proposed traffic signal installation, the modified requirements will be noted in the Special Provisions. Equipment and materials shall be of new stock unless the contract provides for the relocation or the use of fixtures furnished by others. New equipment and materials shall be the product of reputable manufacturers of electrical equipment, and shall meet the approval of the Traffic Engineering Division.

A. Equipment List. The Contractor shall submit to the Traffic Engineering Division a list of equipment and materials to be furnished. This list shall include equipment manufacturer and catalog number for each item listed that the Contractor proposes to install. The list and catalog cut sheets shall be submitted in duplicate to the Traffic Engineering Division for written concurrence before any equipment or materials are ordered. No construction work of any nature will be permitted on the signal project until concurrence has been received.

B. Operating Instructions. Before acceptance of the work, the Contractor shall furnish the Traffic Engineering Division with two copies of the manufacturer's instructions for maintenance and operation of all signal equipment, wiring diagrams of the installation or system and a parts list sufficient for the ordering of any parts.

C. Guarantee. The Contractor shall guarantee all equipment and work against defective quality or workmanship, for a period of 6 months from date of final acceptance of the work by the Traffic Engineering Division. A manufacturer's guarantee may be required for a longer period if so required by other sections of this specification.

8. ELECTRICAL UNDERGROUND MATERIAL.

A. Description. The work under this section shall consist of furnishing and installing electrical conduit, conductors, and pull boxes for traffic signals and highway lighting including pushing, drilling, excavating, backfilling, and compacting at locations designated on the project plans and in accordance with the requirements of these specifications.

B. Materials:

1) Electrical Conductors. All conductors shall conform to the National Electric Code (NEC) and Underwriters Laboratories (UL) standards and other applicable industry standards.

a) Power and Highway Lighting Cable. Power cable shall comply with 4185.12 of the Iowa DOT Standard Specifications and shall be UL listed for type THHN. Insulation colors shall be as follows:

Street Lighting Hot:	Black
Street Lighting Common:	White
Power Hot:	Black
Power Common:	White

b) Signal Cable. Signal cable shall meet the requirements of the International Municipal Signal Association (IMSA) 19-1, or latest revision thereof. The number and size of conductors shall be as specified on the Plans. All signal cable shall utilize stranded conductors.

c) Detector Lead-In Cable. Detector lead-in cable shall meet the requirements of IMSA Specification 50-2, latest revision thereof for polyethylene jacketed loop detector lead-in cable. Conductors shall be No. 14 AWG unless otherwise specified on the Plans.

d) Tracer Wire. A tracer wire shall be installed in all conduits as shown on the plans. The tracer wire shall be a No. 8 AWG conductor, stranded copper, Type THHN, UL with orange colored insulation. The tracer wire shall be identified in the controller cabinet, pull boxes, and poles by means of nylon "ty-wrap" identification tags and indelible ink. The tracer wire shall be spliced in the pull boxes to form a continuous network. Splices shall be protected with a wire nut spring connector. A signal generated at the cabinet end of the network shall be capable of being traced through the entire conduit system which contains the tracer wire.

e) Communication Cable. The communication cable for traffic signal interconnection circuits shall be 3 pair, No. 19 AWG, solid copper conductor, twisted pairs unless otherwise specified on the Plans. The cable shall meet the requirements of IMSA Specification 40-2, latest revision thereof for 300 volt polyethylene insulated, polyvinyl chloride jacketed communication cable with copper tape shielding.

f) Preemption Cable. Preemption cable shall be per Section 2525 of the Standard Specifications.

g) Loop Detector Wire. Loop detector wire is defined as loop detector wire with vinyl tubing. The loop detector wire shall be 600 volt stranded copper, No. 14 AWG THHN, with UL approval. It shall be protected by a flexible vinyl plastic tubing 3/16 inch ID and 1/4 inch OD. The Loop detector wire shall conform to IMSA Specification 51-5.

h) Video Cable. Video cable for power, control, and video feed shall be supplied per requirements of video equipment manufacturer.

2) Electrical Conduit. All conduit and fittings shall be listed by UL, and conform to NEC standards. All conduit to be installed underground or in concrete structures shall be galvanized rigid steel, PVC, or HDPE as shown on Plans. All non-metallic conduit used must conform to the requirements of UL 651 for Rigid Non-Metallic Conduit. All non-metallic conduit and fittings installed under roadways shall be schedule 80, heavy wall, manufactured from high-impact material. Schedule 40 PVC may be used in other areas as directed. All exposed conduit and fittings to be installed above ground shall be the rigid metal type manufactured of galvanized shell conforming to requirements of UL 6 for Rigid Metallic Conduit. Non-threaded couplings shall not be used.

Intermediate metal conduit may be used in place of rigid metal conduit except for service risers. Galvanized intermediate metal conduit shall conform to requirements of UL 1242. Intermediate metal conduit and fittings shall be manufactured from steel and work hardened to provide high strength. The exterior wall shall be hot-dip galvanized. Threads shall be fully cut and galvanized after cutting. All threaded fittings shall be the same as fittings approved for galvanized rigid steel conduit.

Sampling and testing procedures shall conform to UL Standards. Samples for testing, when requested by the Traffic Engineering Division, shall be furnished at the contractor's expense. Samples of conduit shall be tested by UL standards and be approved for use by the Traffic Engineering Division prior to installation on the project.

3) Pull Boxes. Pull boxes, as shown on the plans, may be one of two designs: Precast reinforced concrete or precast fiberglass reinforced polymer concrete.

a) Precast Reinforced Concrete Pull Boxes. Precast reinforced concrete pull boxes 18 inch diameter or 24 inch diameter, extensions and steel covers shall be installed and located as shown on the project plans.

b) Precast Fiberglass Pull Boxes. Precast fiberglass reinforced polymer concrete pull boxes, extensions and covers 12 inch by 12 inch or 13 inch by 24 inch shall be installed as shown on the project plans. Chipped or cracked pull boxes, covers or extensions will not be accepted.

C. Construction Requirements.

1) Installation of Electrical Conduit and Pull Boxes. Conduit runs shown on the plans shall be changed to avoid underground obstructions as directed by the Traffic Engineering Division.

The contractor may at his option and expense, use a larger size conduit than specified provided the larger size is continuous for the entire length of the run from outlet to outlet. Reducing couplings will not be permitted. Changes in the location and/or size shown on the project plans shall be documented by the contractor and submitted to the Traffic Engineering Division. All conduit runs shall be of the same material from outlet to outlet. No transitional couplings will be allowed. When PVC conduit is used, it shall be cut square and trimmed to remove all rough edges. Conduit connections shall be of the solvent weld type. The joint cement shall be the gray PVC cement conforming to the requirements of ASTM D 2564.

Back fill containing large rock, paving materials, cinders, large or sharply angular substance, or corrosive material, shall not be placed in an excavation where materials may damage raceways, cable or other substructures or prevent adequate compaction of fill or contribute to corrosion of raceways, cables or other substructures.

Where necessary to prevent physical damage to the raceway or cable, protection shall be provided in the form of granular or selected material, suitable running boards, suitable sleeves, or other approved means.

All PVC conduit shall be stored and handled in an approved manner to minimize deterioration due to exposure to sunlight.

Conduits in protected areas such as behind curbs, in sidewalks and other areas that are not subject to vehicular traffic shall be at a minimum depth of 24 inches. Conduits installed under roadways, driveways or any open areas where it is possible for vehicles to drive and conduits with conductors that have voltages over 250 volts shall be at a minimum depth of 30 inches. When conduit in open areas cannot be installed at the minimum depths, it shall be encased in concrete.

Where specified due to shallow trenching depths, the conduit shall be encased in a minimum of three inches of concrete. The conduit shall be supported with masonry block or brick on ten-foot centers during encasement, so the conduit will be completely encased.

Installation of conduit for underground electrical distribution service shall conform to utility company requirements, local codes and these specifications.

Conduit installed in railroad right-of-way shall be to the depth specified by the railroad company.

Except for factory bends, conduit bends shall have a radius of not less than that specified in the NEC. Conduit shall be bent without crimping or flattening, using the longest workable radius.

Existing underground conduit to be incorporated into a new system shall be cleaned with a swab and blown out with compressed air.

Conduit entering pull boxes shall terminate a minimum of three inches inside the box wall. The conduit entering through the bottom of a pull box shall extend three inches above the drain material.

All conduit bends used for entering pull boxes shall be of the same diameter as the connecting conduit. All 90 degree bends shall be factory made.

Approved insulated grounding bushings shall be used on all steel conduit ends.

Conduit shall be installed under existing pavement by pushing or drilling methods approved by the Traffic Engineering Division. Open trench excavation across an existing roadway shall not be permitted without written permission from the Traffic Engineering Division. Pushing and drilling pits shall be kept two feet clear of the edge of the pavement when possible.

Pull boxes shall be installed in accordance with the details shown on the project plans. Pull boxes shall be installed flush with the finished grade.

2) Wiring Procedures.

a) General. Wiring shall conform to the regulations listed in the National Electrical Code, latest revision. The conductors and cables shall be pulled into runs in a smooth continuous manner, avoiding contact with sharp objects that might damage the insulation. Only approved lubricants may be used for inserting conductors in conduit. Before installation, conductor ends shall be taped for moisture protection until connections are made. Conductors shall be spliced only in terminal compartments, pole bases or cabinets.

b) Splices. In circuits where the voltage does not exceed 600 volts AC, splices shall be made utilizing approved spring-type wire connectors. Soldered connections will be permitted on loop splices only. Cable used for detector lead-in, preemption devices and communications circuits shall be run continuous and unspliced to the controller cabinet. Conductors for each signal assembly shall be continuous without splicing from the signal head to the pole base and pole base to controller cabinet.

3) Bonding and Grounding. All metallic enclosures such as cabinets, pedestals, poles, and conduit shall be bonded to form a continuous grounded system. Non-metallic portions of the system such as PVC conduit shall have a bare copper bond wire or a green insulated copper bond wire installed with suitable connections to form a continuous grounded system. The insulation shall be removed from the bond wire in pull boxes from the point at which the wire leaves the end of the conduit. At each service disconnect, cabinet foundation, or where otherwise specified, an approved copper-plated ground rod shall be installed. Each ground shall be a one piece solid rod of copper weld type or approved equal and shall be a minimum of 5/8 inch in diameter and ten feet in length. The rod shall be driven vertically into the ground to a minimum of nine feet below the surface. The neutral and system grounding bond shall be connected to the grounding with a copper plated bolt or a brass bolt on the ground clamp.

Pole foundations shall have a one-piece solid rod of copper weld type or approved equal and shall be a minimum of 5/8 inch in diameter and two feet longer than the depth of the foundation. The conductor shall be connected to the pole grounding screw in the hand hole with an approved lug connector.

4). Service. Electrical Service components and their installation shall conform to regulations and codes listed in NEC, UL, Davenport Electrical Code and the requirements of Iowa-Illinois Electric Company.

Service risers shall be galvanized steel. Fastening of service risers shall be done through the use of suitable straps and wood screws a minimum of 1 1/2 inches in length. Tape, nails or other means of attachment shall not be used. All safety switch and multi-breaker enclosures shall be provided with a means to padlock to prevent unauthorized persons from operating disconnect equipment. Meter sockets shall be approved by the serving utility company. These shall be furnished and installed by the contractor. The meter socket shall be located as shown on the project plans.

9. SIGNAL INDICATIONS AND MOUNTING ASSEMBLIES.

A. Description. The work under this section shall consist of furnishing and installing or modifying traffic signal indication assemblies, countdown pedestrian signal indications, flashing beacons, and mounting assemblies at the locations shown on the project plans and in accordance with the details shown on the plans and the requirements of these specifications.

B. Materials. All new traffic signals, except the pedestrian signals, installed at any one intersection shall be of the same manufacturer and the same material. All pedestrian type signals shall be of the same manufacturer and be of the countdown style.

All traffic signal indication housings, pedestrian indication housings, backplates, visors, mounting assemblies and push button stations shall be black in color.

1) Standard Signal Faces. Each vehicle signal face shall be adjustable vertical type with the number and type of sections specified on the plans. Adjustment shall permit rotation of 360 degrees about a vertical axis. Each vehicle signal face shall provide an indication in one direction only. Unless otherwise shown on the plans, all vehicle signal faces shall be arranged vertically, red-top, yellow-center, green-bottom. Signal faces shall be standard 12-inch lens size.

a) Optical Equipment. Each optical unit shall consist of a lens, a reflector or reflector assembly, a lamp holder, and a clear traffic signal lamp of the appropriate size and type as specified herein. The optical units shall conform to ITE Standards and ANSI Standard D 10.1.

(1) Lenses. Polycarbonate lenses shall be supplied and installed in all indications. Red, yellow and green arrow lenses shall be made of polycarbonate with aluminum cutout inserts. Lenses shall be of the color indicated, circular in shape, with a nominal visible diameter of 12 inches and of such design as to give an outward and downward distribution of light with a minimum above the horizontal. Each lens shall be true to color, free from imperfections and give high illumination transmission. Lenses shall conform to ITE Standards. Polycarbonate lenses shall be made of ultraviolet stabilized polycarbonate conforming to the specifications of ASTM D 2473. Polycarbonate lenses shall not distort due to heat from a 150 watt signal lamp.

(2) Reflectors. Each reflector shall be a single piece of specular aluminum with an anodic coating. Reflectors shall conform to ITE Standards. An opening in the back of the reflector for the lamp holder shall be constructed so that there will be no dark spots cast on the lens.

(3) Lamp Holders. The lamp holder shall have a heat-resistant molded phenolic housing and be designed to accommodate up to a 150 watt standard A-21 traffic signal lamp, in the proper focal position.

(4) Lamps shall meet the requirements of the Iowa DOT Standard Specifications. Lamps shall be new and furnished with each new traffic or pedestrian signal.

(5) L.E.D. indications shall be required on this project for all indications. All indications shall meet the minimum I.T.E. requirements.

b) Housing. The housing for each signal section shall be made of a one piece black polycarbonate material conforming to ITE Standards. The housing of each section shall be designed to permit access to the section for relamping without use of tools. The reflector, reflector ring, lamp holder, and spring wire bail shall be designed so they may be removed or replaced without the use of tools.

c) Door. The door shall be suitably hinged and securely held to the housing by hinge pins and locking devices.

d) Gasketing. Lamp holder gaskets shall be of material not affected by heat. All other gaskets, including door, lens and reflector gaskets, shall be of weather-resistant neoprene.

e) Terminal Blocks and Wiring. The terminal block for a standard three section signal shall be a four position, eight terminal barrier type strip mounted in the back of the middle unit. To the left of each terminal strip shall be attached the white, red, yellow, and green signal section leads and the opposite terminals shall be for field wires. The wires from the terminal block to the lamp socket shall be minimum size number 18 AWG, type TFF, 30 mil insulation thickness and rated at 105°C.

f) Visors. Each signal section shall have an 11 to 12 inch long tunnel type visor which shall be fabricated from black polycarbonate material. Visor shall conform to ITE Standards.

g) Backplates. Backplates shall be furnished and installed on all vehicular signal sections. Black polycarbonate material shall be used.

2) Optically Programmable Signal Heads. The signal section shall be a self-contained assembly consisting of an optical unit, section housing, housing door, terminal block, and necessary gaskets to ensure a weatherproof unit. It shall be capable of separate mounting or inclusion in a signal face containing two or more signal sections. If existing housings are to be combined with new housings, the new housing shall be adaptable to the existing. All new signal sections shall meet the following requirements:

a) Housing. Each signal housing shall be die cast aluminum having a chromate preparatory treatment. The signal housing and lens holder shall be predrilled for backplates and visors. All access openings shall be sealed with weather resistant gaskets. Hinge and latch pins shall corrosion resistant metal. The lens holder and interior of the housing shall be optical black. The housing shall mount to standard 1-1/2 inch fittings as a single section, as multiple section faces, or in combination with conventional signals. The signal housing shall be provided with an adjustable connection that permits incremental tilting from zero to ten degrees above or below the horizontal while maintaining a common vertical axis through the mounting assembly. Housing connection shall permit external adjustment about the mounting axis in five degree increments. Attachments such as visors, backplates or adapters shall readily fasten to mounting surfaces without affecting weatherproof characteristics or light intensity of the signal.

b) Optical System. The optical system shall consist of an objective lens, optical limiter-diffuser, lamp, lamp fixture, and optical masking tape.

(1) Objective Lens. The objective lens shall be a high resolution planar incremental lens, hermetically sealed within a flat laminate of weather resistant acrylic or approved equivalent. The lens shall be symmetrical in outline and, if rotated to any 90-degree orientation about the optical axis, shall not displace the primary image.

(2) Optical Limiter. The optical limiter-diffuser shall provide an accessible imaging surface at focus on the optical axis for objects up to 1200 feet distant, and permit an effective veiling mask to be applied as determined by the desired visibility zone. The optical limiter-diffuser shall be provided with positive positioning and composed of heat resistant glass.

(3) Lamp. The lamp shall be 150 watt, 120 volt AC, sealed beam with an average rated life of at least 6000 hours. It shall have a three prong base and an integral reflector. The lamp shall be attached to the diffusing element with a collar having a specular inner surface.

(4) Lamp Fixture. The lamp fixture shall consist of a separately accessible housing and integral lamp support, adjustable ceramic socket, and self-aligning, quick release lamp retainer. Electrical connection between section housing and lamp housing shall be accomplished with an interlock assembly which disconnects the lamp holder when the door is opened.

(5) Masking. Each signal section shall be installed and directed, and the optical limiter masked, in accordance with manufacturer's instructions to provide indications in accordance with the plans.

3) Mounting Assemblies. All side of pole mounted traffic and pedestrian signals shall utilize one-piece black polycarbonate mounting arms banded to the pole. All mast arm mounted vehicular signals shall utilize signal bracket assemblies.

C. Construction Requirements.

Construction shall be such that all conductors are concealed within assemblies. Cable guides or grommets shall be used to support and protect conductors entering through poles. All threads shall be coated with rust-preventative paint during assembly.

Each vehicle or pedestrian signal assembly shall be mounted at the location and in the manner shown on the project plans.

Materials removed and not designated to be salvaged or incorporated into the work shall become the property of the contractor.

All traffic signal heads not in use shall be covered and shall be unmistakably out of service when observed by an approaching driver.

10. TRAFFIC CONTROLLER ASSEMBLY.

A. Description. The work under this section shall consist of furnishing traffic controller assemblies at the locations shown on the project plans and in accordance with the details and requirements of these specifications.

A traffic controller assembly shall consist of a complete assemblage of electrical equipment and components for controlling the operation and timing of traffic control signals.

B. Materials. The controller assembly shall include the controller unit, all necessary auxiliary equipment, the controller cabinet, concrete foundation, conduits and anchor bolts.

The auxiliary equipment shall include all appurtenances such as flasher controls, loop detector amplifiers, power assemblies, signal load switches, conflict monitors and preemption units.

The entire surface area of each circuit board shall be sealed to protect against moisture.
The following equipment shall be furnished with the wired traffic controller assemblies:

Controller
Power Panel
Signal Load Switches-(12ea in type P, 8ea in type M, 4ea in type B)
Signal Conflict Monitor
Detectors(if used, 12ea in type P, 4ea in type M)
EV Phase Selectors-(2ea in type P and M cabinets only)
Controller Flasher Assembly
Flash Transfer Relays
Surge Protectors-Power and Communications
Lightning Arrestor
Radio Interference Suppressor
Cabinet Ventilation Fan
Terminal Tie Points
Field Terminals
UPS System

1) General Requirements. The traffic controller assembly equipment shall conform to the requirements of the current edition of NEMA Publication TS-1 at the date of advertisement of the project.

a) Documentation. The contractor's material proposal shall include complete technical information, shop drawings, photographs, circuit diagrams, instructional manuals, or any other necessary documents to fully describe the proposed traffic controller assembly items.

At the time of delivery, the contractor shall furnish three sets of instruction books and an itemized price list for each type of equipment, their sub-assemblies, and their replacement parts.

The instruction books shall include the following information:

-Table of contents
-Operating procedure
-Theory of operation
-Step-by-step maintenance and trouble-shooting information for the entire assembly and for all adjustable components.
-Circuit Wiring Diagrams
-Pictorial diagrams of parts locations
-Parts Numbers

The instructional manuals shall include itemized parts lists. The itemized parts list shall include the manufacturer's name and part number for all components (such as transistors, integrated circuits, diodes, switches, resistors, capacitors, relays, etc.) used in each circuit module. The list shall also include cross-references to parts numbers of other manufacturers who make the same replacement part.

b) Warranties. Each controller unit and all of its auxiliary equipment shall be warranted by the supplier against all defects in materials and workmanship.

The warranty for the controller unit and its auxiliary equipment shall provide that in the event of malfunction during the warranty period, a like controller unit, module, or auxiliary equipment shall be furnished, within three working days, for use while the warranted unit is being repaired. The isolation of any malfunction and the repair and/or replacement of any device within the warranty period shall be the responsibility of the supplier.

The City reserves the right to reject equipment of a specific model type in which the City has determined that it’s past field performance has been unsatisfactory. The City's rejection of an item shall be final.

c) Certificate of Analysis. The contractor or supplier shall submit a Certificate of Analysis for each NEMA specified component stating that all applicable NEMA tests have been performed and results comply with the requirements of NEMA Standards. The Certificate of Analysis shall be signed by an agent having the legal authority to bind the manufacturer or supplier.

The City reserves the right to perform tests on any equipment supplied by the contractor in the City's designated testing facilities.

2) Traffic Signal Controllers and Field Master Controllers. A traffic signal controller shall consist of an electronic device dedicated to the selection and timing of traffic movements. The traffic signal controller shall be compatible with the system closed-loop software that the city is currently operating.

A field master controller shall be supplied complete with all necessary wiring, modems and communications equipment necessary to function as a field master, integral with other local control equipment in the same control cabinet as the local intersection controller.

The field master controller shall be compatible with the City’s current traffic signal controllers and system software without modification or conversion devices, and capable of controlling 32 intersections in two subareas.

a) Solid State Digital Controllers. All controllers shall be actuated solid state digital controllers. The actuated solid state digital controllers shall utilize solid state circuitry and digital timing techniques. Integrated or discrete semiconductor devices shall be used exclusively.

Controller logic shall have high noise immunity.

Solid state components shall be standard production types and shall be readily available.

Components shall be properly rated with respect to heat dissipating capacity and rated voltage.

The minimum rated life of all components shall be ten years under 24-hour-a day operation.

Components shall be clearly identifiable by markings on circuit boards or parts numbers on pictorial diagram. Each controller shall be furnished with the required number of phases, phase timing features and all other control functions that are specified herein and on the Project Plans.

The NEMA Menu Driven controller shall designate a digital microprocessor controller that conforms to NEMA Standards, and shall include special programmable applications as specified.

b) Frame Sizes. The controller unit frames shall be two through eight phase, not exceeding NEMA specified dimensions, except height which shall be 11 inches maximum. Equipment shall be interchangeable in the controller cabinet.

c) Controller Input-Output Functions and Connectors. The controller shall provide all the NEMA input/output functions. The A, B, and C connectors and their pin assignments shall be the same as shown in Table 13-3 of 1989 NEMA for eight phase controller units and their cables.

All A and B connectors and cables shall include specified four and eight phase functions, for future use.

d) Standard Functions. Standard controller functions specified by NEMA, and as specified in these specifications shall be furnished.

The controller unit functions shall include NEMA TS-1, Sections 13 and 14.

The standard functions shall be the NEMA specified features on a per phase, per ring, and per unit basis.

e) NEMA Menu Driven Controller Minimum Phase Requirements. The NEMA Menu Driven Controller shall be an eight-phase dual ring operation and shall have the following special programming applications:

-Computer Supervised Unit- Interconnected
-Computer Supervised Unit- Dial up
-Programmed for preemption
-Programmed for Time Based Coordination
-Programmed for TM Coordination- Traffic actuated Coordination

The controller shall include the following features:

-Programming and module for Time Base Coordination with a front panel "D" connector, or auxiliary connector for all non-NEMA functions.

-Printer interface and port. The printer interface shall permit printout of all controller, coordination, and preemptor data entered by an operator.

-The "D" connector shall be located on the front panel.

-Fully prompted English menu driven programmability. The display shall be an illuminated backlit liquid crystal display screen.

The screen shall be capable of displaying a minimum of 8 lines by 40 characters per line alphanumeric.

f) Time Base Coordination. The program for time base coordination shall be included in the controller unit. The program shall consist of the hardware, software, and cabinet wiring to provide coordinated traffic flow without the use of interconnect cable between controller units in a dedicated geographic area. The program shall be supervised by its own clock, which will monitor the program's memory so as to implement routine time of day, day of week, and week of year programs as well as automatic daylight savings selection.

The program shall include the following functions:

-Capable of being system interfaced (intertie or dial-up) for program monitoring and data down-loading and system data up-loading. The data down-loading and clock updating shall also be accomplished by a hand-held device.

-Coordination system "D" connector. System connector shall function as input/output port and auxiliary output connector. All outputs shall be NEMA compatible.

-All time-base coordination, user program data input, and status readouts, including cycle countdown and program data display, on the front panel.

g) Controller Cabinet Wiring. The cabinet shall be wired for call to non-actuated mode I for the main street and mode II for cross street, unless otherwise specified the Project Plans.

h) Preemption Programming. The controller shall include all the required hardware and CPU software to operate emergency vehicle preemption.

The removal of the selector unit shall not interfere with the normal operation of the controller unit.

3) Control Cabinets.

a) General. The control cabinets covered in this section shall be used to house all traffic actuated signal controller assemblies. The cabinets shall be wired for all additional future phases and all associated equipment for the future phases shall be furnished and installed.

The following cabinet types shall be supplied, as shown on the plans:

Type "P" (W44.5 inch x D26 inch x H55.5 inch nominal dimension).
Type "M" (W30 inch x D17 inch x H52 inch nominal dimension).
Type "B" (W17 inch x D15 inch x H26 inch nominal dimension).

The controller cabinet housing shall be of a NEMA 3 weather-resistant construction. The Type "M" cabinet shall be reinforced sufficiently to support the cabinet in side of pole installation or to support the cabinet in a pad mount installation as required on the plans.

The cabinet housings shall be constructed with No. 10 gauge welded sheet aluminum. The cabinet finish shall be clean and not painted.

b) Hardware.

(1) Doors. The door shall have a neoprene gasket around the perimeter of each door frame. The door hinge pins shall be stainless steel. The main controller cabinet door shall have a two position steel bar type door stop. The main door of the type P and type M controller cabinet shall be secured by a three point locking device.

(2) Locks. The main door of controller cabinet shall have a standard traffic signal self-locking tumbler lock. The three point door latch cam shall be steel.

The police panel door shall have a standard police type lock. The police type lock key shaft shall be a minimum of 1-3/4 inches in length. A minimum of two keys per lock shall be furnished with each cabinet.

(3) Shelves. Each controller cabinet shall be furnished with metal shelves capable of supporting all shelf mounted equipment without bending or sagging. The shelves shall not restrict the free flow of air. The cabinets shall contain adjustable support brackets. A minimum shelf height of 15 inches shall be provided for 8-phase NEMA controllers.

c) Cabinet Accessories.

The following accessories shall be provided with each controller cabinet as specified herein:

(1) Cabinet Light. The controller cabinet shall contain an incandescent light fixture and lamp. The fixture shall be mounted in the lower half of the cabinet on either side of the cabinet.

(2) Switches. The switches described in this section shall be provided for all controller cabinets. Each switch shall be a commercial grade switch properly rated for the circuit it controls. Each switch shall be individually labeled to identify its function.

The following switches shall be mounted on the cabinet switch panel inside the controller cabinet housing:

(a) Auto/Flash Switch. A toggle switch to transfer to flashing operation. During the flash operation the AC power shall be maintained to the controller.

(b) Detector Call Test Switches. A test switch shall be furnished to simulate a vehicle and pedestrian actuation. Each switch shall be a momentary contact push button. Each switch shall be labeled to identify its function and phase.

(c) Stop Time/Run/Normal Switch. A separate three position toggle switch shall be provided to permit stop timing/automatic mode of the controller's stop time function.

The following switch shall be mounted in the police panel:

Auto/Flash Switch - shall be a toggle switch to transfer from automatic control to flashing operation. During the flash operation the controller goes to stop time, unless the Stop/Run/Normal Switch is in the run position.

(3) Convenience Outlet. A 120 volt AC, 15 Amp NEMA 5-15 G.F.I. convenience duplex outlet shall be mounted in each cabinet for energizing test equipment or tools. The outlet shall be fuse-protected.

d) Cabinet Ventilation Equipment.

Controller cabinets shall be ventilated by means of a 120 VAC, 60 Hz, tube axial compact type fan. The fan's free delivery air flow shall be not less than 100 cubic feet per minute.

The fan housing shall be approximately 4 inches square by 1-1/2 inches deep.

The magnetic field of the fan motor shall not affect the performance of the control equipment.

The fan bearings shall operate freely within the environmental standards specified herein.

The fan unit shall not crack, creep, warp, or have bearing failure within a 5 year rated duty cycle. The maximum noise level shall be 40 decibels. The fan unit shall be corrosion resistant.

The cabinet fan shall be controlled by an adjustable snap action thermostat. The thermostat's turn-on setting shall be adjustable from 90° to 120° F. The fan shall run until the cabinet temperature decreases to approximately 29° F below the turn-on temperature setting. The fan shall be fused.

The cabinet fan assembly shall be mounted either inside the control cabinet or inside a rainproof housing on the top of the control cabinet.

The cabinet shall have louvered air inlets in the lower portion of the main door. A standard furnace filter shall be mounted behind all the louvered air inlets.

The air outlets shall be screened on the exhaust side unit.

e) Electrical Devices.

(1) Legend Plates. Each fuse and circuit breaker shall be labeled to identify its rating and circuit function.

(2) Power Panel. The power supplied to the controller cabinet shall be 120 VAC, 2 wire, 60 Hz single-phase unless otherwise specified. The power leg to the controller and the signal load circuits shall be protected by a single pole, 120 VAC, circuit breaker. The breaker shall have a 10,000 amp. interruption rating, a trip indicator, and shall be the bolt-on type. The ampere rating shall be properly sized for the traffic signal intersection's load.

(3) Radio Interference Suppressor. Each control cabinet shall be equipped with a single radio interference suppressor of sufficient ampere rating to handle the load requirements. The RIS shall be installed at the input power point. It shall minimize interference in both the broadcast and the aircraft frequencies, and shall provide a minimum attenuation of 50 decibels over a frequency range of from 200 kilohertz to 75 megahertz, when used in connection with normal installations.

The RIS shall be hermetically sealed in a substantial metal case with brass studs of sufficient external length to provide space to connect on No. 8 AWG wires, and shall be so mounted that they can not be turned in the case. Ungrounded terminals shall be properly insulated from each other, and shall maintain a surface leakage distance of not less than 1/4 inch between any exposed current conductor and any other metallic parts. The terminals shall have an insulation factor of 100-200 megohms dependent upon external circuit conditions. The RIS shall not be rated less than 50 amperes.

The RIS shall be designed for operation on 120 VAC 60 Hz., single phase circuits, and shall meet the standards of UL and the Radio Manufacturers Association.

(4) Surge Protector. Each controller cabinet shall be provided with a 350 volt surge protector at the input power point. The surge protector shall reduce the effects of power line voltage transients and shall have ratings as follows:

-Impulse Breakdown of less than 1,000 volts in less than 0.1 microseconds at 10 kilovolts per microsecond.

-Standby Current of less than 1.0 milliampere.

-Striking Voltage of 350 Volts D.C.

The unit shall be capable of withstanding 15 pulses of peak current each of which will rise in 8.0 microseconds to one half the peak voltage at 3 minute intervals. The peak current rating shall be 20,000 amperes.

The communications termination shall also be provided with lightning protection.

(5) Inductive Suppressors. Each 120 VAC circuit that serves an inductive device, such as a fan motor, cabinet light, or a mechanical relay, shall have a suppressor to protect the controller's solid state devices from excessive voltage surges. Such suppressors shall be in addition to the surge protector at the main input power point.

f) Cabinet Wiring Standards.

(1) Conductors. All conductors used in controller cabinet wiring shall be No. 22 or larger, with a minimum 19 copper strands. Conductors shall conform to Military Specification MIL-W-16878D, Type B or better. The

insulation shall have a minimum thickness of 10 mils and shall be nylon jacketed polyvinyl chloride or irradiated cross-link polyvinyl chloride, polyhalocarbon, or polychlor-alkene.

(2) Lead-in Wires and Cable. Lead-in wires, from the loop detector field terminals in the cabinet to the amplifier unit inside the cabinet, shall conform to one of the following:

-A twisted pair of No. 22, or larger conductors.

-A cable containing two No. 22, or larger conductors with each conductor insulated with either (1) a minimum of 10 mils of polyvinyl chloride and 2 mils of nylon, or (2) a minimum of 14 mils of polyethylene or polypropylene. The conductors shall be twisted pairs with 3 to 6 turns per foot. The cable shall be provided with a polyethylene or polyvinyl chloride outer jacket with a minimum thickness of 20 mils, or with a chrome vinyl outer jacket with a minimum thickness of 25 mils. All conductors used in controller cabinet wiring shall conform to the following color code requirements:

-The AC common conductors shall be identified by a continuous white or natural gray.

-The chassis ground conductors shall be identified by a continuous green color.

-The non-ground conductors shall be identified by any color not specified above.

(3) Load Switch and Flasher Wiring. Each of the load switch outputs (120 VAC) and the flash transfer relay load base terminals shall be hard-wired with a minimum No. 14 copper conductor with a 90° C rated jacket, or No.16 copper conductor with a 105° C rated jacket. The 120 VAC load switch and flash relay terminals shall be soldered to each base terminal.

(4) Signal Load Switch Bus. The AC+ signal load switch buss shall be controlled by a signal pole 120 VAC mercury contactor or an auxiliary control relay. The minimum contactor size per switch buss shall be 50 ampere.

(5) Signal Load Panels. All load switches, flashers, and flash transfer relays shall be mounted on a load bay panel or back panel assembly of the appropriate size.

Detector amplifier modules shall be mounted in a detector rack.

The signal load panel or back panel shall be easily removable from the cabinet for repair in the field.

The load bay or back panel in a "P" type cabinet shall be wired to include all future signal phases and operations for an eight-phase with full pedestrian installation.

The load bay or back panel in an "M" type cabinet shall be wired to include all future signal phases and operations for a four phase with full pedestrian installation.

The load bay or back panel in a "B" type cabinet shall be wired to include all future signal phases and operations for a two phase with full pedestrian installation.

(6) Preemption. The type "P" and type "M" controller cabinet shall include the cabinet wiring provisions for a 2 position card rack capable of supporting four preemption channels.

g) Cabinet Foundations. Concrete for cabinet foundations shall be 3,000 psi Portland cement concrete.

4) Auxiliary Control Equipment. The auxiliary equipment described in this section shall be supplied and installed as required inside the controller cabinet.

All auxiliary equipment shall conform to current published NEMA Standards pertaining to that device.

a) Flasher Control Assembly. The Flasher control equipment shall consist of a complete electrical assembly which shall provide flashing traffic signals by enabling flash relays when the auto/flash switch or conflict monitor is activated. The relays shall be the flash load relay type as specified herein.

b) Solid State Flashers. The flasher unit shall be a solid state NEMA type flasher. All flashers for signalized intersections shall be the dual circuit type. All the flashers shall be constructed of replaceable, molded relay modules. Each relay module shall have the specified current capacity and shall operate with zero point switching.

Solid state Flashers shall be 20 amperes per circuit, dual circuit.

c) Solid State Load Switches. Load switches shall meet the requirements of NEMA for three circuit load switches.

Each load switch shall contain three individually replaceable, solid state relay modules. Each relay module shall utilize optical isolation between the input and the output.

The load switch unit shall have three indicators to designate when the AC output circuits are activated. Each indicator shall monitor the outputs and shall be labeled top to bottom "R" Red, "Y" Yellow, and "G" Green, on the front panel of the load switch.

d) Flash Load Relays. Flash load relays shall be for the purpose of providing special circuitry or operational requirements. The relays shall be the double pole, double throw type.

Flash relays shall interconnect with a Cinch-Jones 8 pin socket or an approved equal. The relay shall be covered with a clear dust cover which shall be secured to the relay base with a fastening device.

The relay contact points shall be of fine silver or silver alloy, or a superior alternate material, and shall be capable of carrying a load of 20 amperes per contact at 120 Volts AC.

The relay shall show no failure while making, carrying and breaking a 10 ampere, 120 volt, traffic signal lamp load through 10,000 cycles at the rate of 10 cycles per minute and a 50 percent duty cycle. Each relay shall be capable of making, breaking and carrying all the current for a 1,000 watt tungsten lamp load without burning, pitting, or otherwise failing for at least one million operations.

The relay shall withstand 1,500 volts at 60 Hz between insulated parts and between current carrying parts and grounded or non-current carrying parts.

e) Conflict Monitors. The conflict monitor shall conform to the current NEMA specifications.

Fully programmable monitors shall be programmed with soldered wire jumpers on a NEMA interchangeable programming card. Jumpered channels shall represent nonconflicting phases. Non-jumpered channels shall be in conflict with any other channel.

When a malfunctioning monitor is replaced in the field, the replacement monitor shall be field programmable without the use of tools.

The jumper numerical sequence shall be standard NEMA matrix. The monitor shall have an active indicator for each channel.

f) Detector Amplifiers.

(1) General. The correct type and quantity of detector amplifiers shall be furnished as specified herein. All detector amplifiers shall be rack mounted.

Each detector card shall be edge connected type. The detector edge connector shall be a 44 pin double read-out contact. The connector shall have 0.128 inch diameter mounting holes on each end, MIL-M-14 insulation material, and MIL-C-21097 contacts. The edge connector terminals shall be wired as specified herein.

All of the detector channel inputs and outputs, including those channels specified for future use, shall be wired from the mounting rack to the tie points and the field terminals of the controller cabinet.

Each amplifier rack assembly shall include power supplies capable of operating 12 dual channel detector cards in an 8 phase back panel or 4 dual channel detector cards in a 4 phase back panel.

The quantity of 12 amplifier units shall be furnished with each Type "P" control cabinet assembly. The quantity of 4 amplifier units shall be furnished with each Type "M" control cabinet assembly.

The amplifier rack positions shall be mechanically and electrically interchangeable such that amplifier modules of different manufacturers can be installed into any amplifier module position. The rack spacing shall be for NEMA 2.31 inch-wide front panels on all card rack units. A separate 2-slot card rack unit for emergency vehicle (EV) detector units shall be provided and wired for 4 EV inputs.

(2) Detector Amplifier Power Supply. A shelf mounted power supply with MS connector with a 5 AMP output shall be furnished with each type "P" control cabinet assembly. A rack mounted power supply shall be furnished with each type "M" control cabinet assembly.

(3) Loop Detector Amplifiers.

(a) General Requirements. The loop detector amplifiers shall detect all licensed motor vehicles when using the existing loop configurations.

(b) Loop Detector. The loop detector amplifier unit shall contain two channels per unit and shall have timing functions. No single channel amplifier shall be utilized. All loop detector card units shall be mechanically and electrically interchangeable with other card units of the same type and function from different manufacturers.

The amplifier unit shall utilize digital solid state circuitry. The detection, frequency counting and inductance measuring circuitry shall utilize crystal controlled MOS-LSI electronic circuits.

(c) Amplifier Requirements. Each amplifier channel shall have a front panel mounted indicator to provide a visual indication of each vehicle detection. The indicator shall be visible in bright sunlight from three feet directly in front of the unit. The amplifier shall operate in compliance with all the requirements herein specified when connected to an inductance loop plus lead-in of 50 to 500 microhenries with a loop Q parameter as low as 5.0 at the amplifier's operating frequency.

Each channel's call output shall be an optically isolated solid state type. Each amplifier channel shall conform to the following requirements:

(1) Amplifier Tuning. Each channel shall be self-tuning and shall be fully operational within three minutes after power up. After a power interruption, the channel shall automatically return to normal operation.

(2) Tracking. Each channel's circuits shall be designed so that changes due to environmental drift and applied power fluctuations shall not cause an actuation. It shall be capable of compensating for environmental changes of up to 0.001 percent per second. The requirement must be met within two hours after initial power up. The channel shall be capable of normal operation as the input inductance is changed +/-5.0 percent from the quiescent turning point regardless of initial circuit drift.

(3) Detection Modes. Each channel shall have a mode selection switch on the front panel which shall permit the selection of either the presence mode or the pulse mode of operation. In the pulse mode, the pulse width shall be 100 milliseconds unless otherwise specified. Each module shall have an off switch position for disabling unused channels.

(d) Special Timing Functions. The following special timing functions shall be furnished for each channel of the amplifier module.

-Delay Timing Function. This timing function shall delay the call output up to 15 seconds after the vehicle enters the loop sensor. The timer shall be adjustable, from 0 to 15 seconds, in no greater than 1.0 second increments.

-Extension Timing Function. This timing function shall extend the call output up to 7 seconds after the vehicle leaves the loop sensor. The timer shall be adjustable, from 0 to 7 seconds, in no greater than 0.5 second increments.

(e) Amplifier Sensitivity. Each of the amplifier channels shall have a minimum of three sensitivity settings per detection mode. The settings shall be selectable from the front panel by means of a thumb wheel type switch. The highest sensitivity setting shall consistently respond to a loop inductance change of 0.02 percent. The lowest sensitivity setting shall respond to nominal loop inductance changes of from 0.15 to 0.4 percent. All modules must have sensitivities which differ by not more than +/- 0.05 percent change in inductance from the nominal value chosen. A channel shall not respond to loop inductance changes less than 0.1 percent in the lowest sensitivity setting.

(f) Amplifier Response Time. The Amplifier channel response time in the lowest sensitivity setting shall be less than 20 milliseconds. For any negative inductive change which exceeds the sensitivity threshold, the channel shall output a ground true logic level within 20 milliseconds. When such inductance change is removed, the output shall become an open circuit within 20 milliseconds.

For test purposes, a negative change of inductance shall be maintained for a minimum of 100 milliseconds and a maximum of 600 milliseconds after it is applied. When the response time differences are averaged over ten trials, the value of that average difference shall not exceed 10 milliseconds.

The response time of the detector channel for the highest sensitivity setting shall be less than 250 milliseconds for a 1.0 percent inductance change.

(g) Operating Frequency. Each channel shall have a minimum of three operating frequencies. The frequency switch may be either on the front panel or on the circuit board. Frequency selection shall be possible without the use of tools.

(h) Detection Holding Time. The detector channel, in the least sensitive position, shall maintain the presence detection of a vehicle for a minimum of four minutes while the vehicle is over the loop sensor and is causing an inductance change of 1.0 percent or greater.

The channel, in the highest sensitivity position, shall maintain the presence detection of a vehicle for a minimum of three minutes while the vehicle is over the loop sensor and is causing an inductance changed of 0.02 percent or greater.

(i) Temperature Changes. The operation of the amplifier shall not be affected by environmental temperature changes at the rate of 1.5° F per three minutes.

(j) Interference. Each channel shall not cause crosstalk with any other channel within any other amplifier that is mounted in the same cabinet assembly. An amplifier channel shall not detect vehicles, moving or stopped, at distances of 3 feet or more from the loop perimeter to which it is connected.

(k) Lightning Protection. Each amplifier shall have lightning protection as an integral part of its own circuitry.

(l) Failsafe Operation. Each channel shall have a failsafe design such that if the loop sensor circuit is open, the channel shall output a continuous vehicle call.

(m) Isolation Transformers. Each loop sensor shall be coupled to the channel input by isolated transformers. The isolated input shall provide continued operation of the channel if the loop sensor in the street becomes grounded or has resistive leakage to ground.

g) Emergency Vehicle Preemption Equipment. Shall be per Section 2525 of the Standard Specifications.

h) Uninterrupted Power Supply System. The UPS system shall be cabinet installed and sized to meet the load requirements to keep the signal running for a minimum of three (3) hours. This item shall be installed in the existing cabinet at Kimberly and Pine.

C. Construction Requirements.

1) General Requirements. All traffic controller assembly equipment shall be furnished in accordance with these specifications. Cabinet wiring, connecting cables, support bases, and shelves shall be provided to allow for future installation and use.

2) Test Requirements. All specified traffic controller assembly items shall meet the applicable environmental and testing standards of NEMA Publication TS-1.

3) Wiring and Grounding Requirements.

a) Cabinet Wiring. All cabinet wiring shall be neatly arranged and made tight by the use of wiring harnesses, cable sheaths, cable wraps, or raceways. All wires in a harness shall be laced or bound together. Harnesses shall be routed to minimize crosstalk and electrical interference.

Cabling shall be routed to prevent conductors from being in contact with metal edges. Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.

All pin assignments shall be wired to the controller cabinet terminal for future use.

b) Conflict Monitor Wiring. The conflict monitor unit cable shall be wired to perform the following functions:

(1) To monitor conflicts of green, yellow, and walk signal for each applicable phase.

(2) To monitor absence of red voltage. Any phase specified for future use shall have a removable jumper so as to permit future implementation of that phase without rewiring the controller cabinet.

(3) To monitor +24VDC source of the controller unit.

(4) To start-delay the controller unit per NEMA Standards.

c) Cabinet Grounding. All controller cabinets shall have the AC common, the logic ground, and the chassis ground isolated from each other as detailed in the current NEMA Standards.

d) Field and Tiepoint Terminal/Wiring.

(1) Controller Cabinet. All field terminals shall be installed on a terminal support which shall be located at the rear of the lower portion of the controller cabinet and not less than ten inches from the base of the cabinet.

4) Cabinet Wiring Diagrams. Each controller cabinet assembly shall have a complete set of wiring diagrams which shall show the intersection plan, signal phasing layout, and all control device connections. Two sets of the final wiring diagrams shall be required with delivery of each control cabinet assembly.

11. DETECTORS.

A. Description. The work under this section shall consist of furnishing and installing vehicular and pedestrian detectors at the locations as shown on the project plans and in accordance with the details shown on the plans and the requirements of these specifications.

B. Materials.

1) Vehicle Detectors.

a) General. Detectors shall conform to the minimum acceptable design and operating requirements of these specifications for detecting the presence and passage of vehicles.

b) Loop Detectors. The detector loop dimensions shall be as specified on the plans. The conductors for the inductive loop detector and the loop detector lead-in cable shall be as specified previously.

c) Saw Cut Sealant. Saw cut sealants shall be a flexible encapsulant intended for sealing and protecting vehicle detector loop wires installed in saw cuts.

(1) Emulsified crack filler sealant for asphaltic concrete may be used to seal saw cuts in asphaltic concrete.

(2) One part elastomeric sealant may be used to seal saw cuts in Portland cement concrete pavement.

The sealant shall provide compressive yield strength to withstand normal vehicular traffic as well as sufficient flexibility to withstand normal movement in concrete pavements, while protecting the loop wire from moisture penetration.

The encapsulant shall be a one-part elastomeric compound requiring no mixing, measuring or application of heat prior to or during its installation. The encapsulant shall be designed for roadway installation when the surface temperature is between 40° F and 140° F.

2) Pedestrian Detectors.

a) General. Pedestrian Detectors shall conform to the minimum acceptable design and operating requirements of these specifications for detecting the presence of pedestrians.

b) Pedestrian Push Button Detectors. The pedestrian detector shall be a push button switch mounted inside an approved push button housing. The switch shall be the phenolic enclosed SPST type with momentary contacts. The contacts shall be rated at 15 amps and 125 VAC. The switch shall have screw type terminals and have a rated life of not less than one million operations. The switch shall operate in the normally open position.

The housing of the push button station shall be of substantial tamper proof construction and made of cast aluminum. The assembly shall be weather proof and so constructed that it will be impossible to receive any electrical shock under any weather conditions. The housing shall be shaped to fit the curvature of the pole to which it is attached and shall provide a rigid installation. The housing shall contain the instruction sign as described below.

c) Pedestrian Instruction Signs. Pedestrian instruction signs shall be made of 0.125 inch thick aluminum sheet, 9 inch by 12 inch in size. The corners of the sign shall be rounded for safety and a neat appearance. Instructions on the sign shall be black applied or silk screened symbols on a white Engineering Grade reflective background. The signs shall be left or right as required.

3) Video Detection System

The Video Detection System shall be an electronic logic unit installed in the controller cabinet that connects to the traffic controller unit via the NEMA TS-2 communication SDLC port for all vehicle detection inputs. The Logic Unit shall accept video (NTSC) input from 1 to 6 camera units. One NTSC video output shall be provided to view or export raw video to a phone connection system or to a fiber optic video line driver to be installed at a later date by the City. This raw video output shall be utilized to program the Logic Unit when connected to a local video monitor device. Programming of the video placement of the detector areas (Zones) shall be accomplished by the use of the video monitor and a mouse. No other equipment shall be required to program loop placements, for example, the requirement of a computer with video import shall not be acceptable for this Project. One video monitor, portable, with battery and AC adapter shall be provided complete with local mouse. Detection zones shall be accomplished by imposing squares or rectangles overlaid on the image on the screen. Detection zones shall be linkable or be capable of

individual output. A minimum of eight (8) detector outputs per camera shall be provided and a minimum of thirty-two (32) total detector outputs shall be provided per Logic Unit. Each detector output shall allow as few as one detector zone to as many as four zones to be linked for input to the traffic controller.

Each approach to the intersection shown on the plans shall be provided with a video camera of the same manufacturer as the Logic Unit. Each camera shall be field programmable for correct focus and lens view of the intersection; thereby, no lens changes shall be required to obtain the correct view of the detection zones. Adjustment of the lens viewing area shall be by a two pair cable installed at the camera and the cabling shall be returned to the controller cabinet for field adjustment without the requirement for going to the camera via a bucket truck. Each camera shall be adjustable from the cabinet via the two pair communication cable and the programming device used to set the lens angle. Cameras shall be provided with a mount as required to view the intersection approach, mast arm mount direct connect, mast arm pole at luminaire, mast arm with riser, or as specified by the manufacturer to obtain the height of the camera view to the area on street necessary to setup detection zones as shown on the plans. Each video camera shall define detection zones for vehicle detection and be assignable via the traffic controller for presence, passage, system and vehicle counts.

Unless otherwise specified, all Logic Units shall be provided with four (4) video inputs. The Logic Unit shall be provided with a communications port for connection of a portable computer for uploading from the Logic Unit or downloading to the Logic Unit. Software shall be provided to upload or download stored settings eliminating the requirement to reprogram a Logic Unit after installation for purposes of maintenance. This communications software shall be acceptable for use as a dial up, direct connect or for a remote fiber optic communications link, Central Office to Logic Unit. Remote fiber optic link shall allow multiple camera sites to share the data link via a single two-fiber communications channel. Up to a minimum of 32 unique Logic Units shall be addressable on a single fiber channel connection.

The Video Detection System shall be installed and setup under input by City for all zones of detection by the Manufacturer or their trained and certified representative. A copy of their certification by the manufacturer shall be provided up on request. The Manufacturer or certified representative shall provide a minimum of 20 hours training on the operation and maintenance of the Video Detection System. This training shall be provided at a site in the City of Davenport in a classroom setting and manuals shall be provided for each attendee. The class shall accommodate up to six City technicians.

4) Microwave Motion and Presence Sensor System

The microwave-based motion and presence sensor used for intersection control shall interface with the traffic-control cabinet and output signals when vehicles are present in user-defined zones. Zones are created using an X-Y coordinate system with operation verified and optimized using a laptop as part of the installation process.

This system shall allow the user to create up to 8 detection zones and assign vehicle presence in these zones to up to 4 outputs (such as left turn, right turn, straight through) to the controller. These microwave units must track the presence of a vehicle in a detection zone for a predetermined time.

The unit must be compatible with NEMA cabinets. For each sensor, one interface board is required in order to communicate with the controller. These cards are installed in the detection rack of the controller. This type of detection must be unaffected by weather, immune to sunrise and sunset glare, must have advance and stop bar detection in a single unit, detect bicycles and motorcycles, track multiple moving and stationary vehicles, update at least 10 times per second and have adjustable hold times from 0 to at least 600 seconds. The unit must also automatically recover from a power failure, be able to have user-defined delay and extension times for each zone and be FCC approved. The units are powered by CAT-5 outdoor-rated Ethernet cable. The contact cards, cable and detector units are all listed separately in the summary of quantities. Everything else needed for installation, such as brackets, are considered incidental to this item.

The minimum warranty covering defects shall be at least one year.

C. Construction Requirements.

1) Detector Installation.

a) General. Detectors shall be installed as shown on the project plans, and as directed by the Engineer. The installation of the detectors shall be such that the operation shall not be affected by temperature changes, water, ice, rain, snow, chemicals, or electromagnetic noise.

b) Hold Down Tabs. Hold down tabs shall be installed in the saw cut on top of the wire every two feet. The tabs shall be installed after loop wire installation and prior to the sealant installation. The tabs shall be individual sections of PVC tubing one inch in length which shall be bent and wedged tightly into the saw cut channel.

c) Saw Cut Sealants. Saw cuts shall be sealed with an approved sealant. All slots cut in the pavement shall be blown out and dried before installing conductors. After the conductors are installed in the slots, the slots shall be filled to within 1/8 inch of the pavement surface with sealant. Before the sealant sets up, the surplus sealant shall be removed from the road surface without the use of solvents. The handling of the sealant and the filling of the saw cut shall be in accordance with the directions of the manufacturer. Sand blotter shall be applied as directed by the Engineer.

d) Splices. The detector sensor conductors shall be spliced to the detector lead-in cable in the adjacent pull box. Detector lead-in cables shall run continuous and unspliced to the controller cabinet. All detector wire splices shall be soldered using resin core solder with 60 percent tin and 40 percent lead.

e) Detector Loop Installation Field Tests. Before and after the saw cut sealant has been installed, the contractor shall perform an insulation resistance-to-ground test. The insulation resistance-to-ground shall be at least 50 megohms when measured at a voltage between 400 volts and 600 volts D.C.

Any loop detector that does not meet the above requirement or cannot be tuned to the Engineer's satisfaction shall be replaced by the contractor at no cost to the City.

12. SIGNAL SUPPORTS.

A. Single Tubular Mast Arms and Poles.

1) The mast arms and support poles shall be continuous tapered, round steel poles of anchor base type as shown on the plans. The poles and mast arms shall be fabricated from one length of steel sheet with one continuous arc welded vertical seam, unless otherwise approved by the Engineer. The poles and mast arms shall be fabricated from low carbon steel (maximum carbon, 0.30) of U.S. Standard gauge, and the base and flange plates shall be of structural steel conforming to AASHTO M 183 (ASTM A 36) and cast steel conforming to ASTM A 27, Grade 70-36 or better. After manufacture, poles and mast arms shall have a minimum yield strength of 48,000 p.s.i.

It may be permissible to fabricate poles and mast arms by welding two sections together. The method used for connecting the sections shall result in a smooth joint and shall be factory welded as follows:

a) All longitudinal butt welds, except within one foot of a transverse butt-welded joint, shall have a minimum 60 percent penetration for plates 3/8 inch in thickness.

b) All longitudinal butt welds on poles and arms within one foot of a transverse butt-welded joint shall have 100 percent penetration.

c) All transverse butt welds for connecting sections shall have 100 percent penetration achieved by back-up ring or bar.

d) All transverse butt welds and all specified 100 percent penetration longitudinal butt welds on poles and mast arms shall be examined 100 percent by ultrasonic inspection.

Welding, fabrication, and inspection shall conform to the Iowa Department of Transportation Supplemental Specification for Structural Steel, a separate specification.

Personnel performing nondestructive testing shall be qualified in accordance with the American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A and applicable Supplements B (Magnetic Particle) and C (Ultrasonic). Evidence shall be presented for approval of the Engineer, concerning their qualifications. A report shall be required showing that welds have been inspected and either found satisfactory or found unsatisfactory be repaired and reinspected and found satisfactory. The cost of all nondestructive testing shall be paid by the contractor and will be considered incidental to the contract.

2) Pole manufacturers shall certify that only welding operators certified in accordance with Iowa Department of Transportation Supplemental Specification for Structural Steel were used. The welding consumables used shall be in accordance with the approved list furnished by the Iowa Department of Transportation.

B. Mast Arms. The mast arms shall be designed to support traffic signals and/or signs as shown on the plans. They shall be certified by the fabricator that the mast arms are capable of withstanding winds up to 100 MPH without failure. The length of the mast arms shall be as specified on the plans. The mast arm shall be galvanized, meeting the requirements of ASTM A 123.

C. Poles. The poles shall be designed to support the traffic signals and/or signs, and where called for on the plans shall be designed to assume high-rise design luminaire arms for street lights. The pole shall be equipped with a minimum 4 inch by 6 inch handhole and cover located approximately 12 inches up from the base. Securing of the cover to the pole shall be done with the use of simple tools. All poles shall have a galvanized finish meeting the requirements of ASTM A 123 Combination traffic signal and luminaire mast arm poles shall provide a nominal 35 foot mounting height for luminaires. The luminaire arm shall be provided with a plate type connection.

All poles shall meet the requirements of Section 2408 of the Iowa Department of Transportation Standard Specifications.

D. Hardware.

1) The mast arms and poles shall be equipped with all necessary hardware, shims, and anchor bolts to provide for a complete installation without additional parts.

2) The anchor bolts shall meet requirements of ASTM A 36.

3) The anchor bolts shall be hot-dip galvanized for a minimum of 12 inches on the threaded end. The anchor bolts shall be threaded a minimum of 6 inches at one end and have a 4-inch long, 90-degree bend at the other end. The fabricator shall submit drawings for anchor bolts and base design. All hardware shall be steel, hot-dipped galvanized according to ASTM A 153, Class D, or shall have an electro-deposited coating of the same coating thickness and so designed for this purpose.

E. Design Drawings and Calculations. The Contractor shall submit to the Engineer with the submittal data the design drawings showing design details and copies of the design strength and deflection calculations for each completed pole/arm/street light extension structure for review and acceptance prior to fabrication. The ASTM specification numbers for the materials to be used shall be included as part of the design strength calculations. All design drawings and calculations shall be signed, dated and sealed by the responsible Registered Professional Engineer. Such Registered Professional Engineer shall be registered in the State of Iowa. Said Registered Professional Engineer shall immediately bring to the attention of the Engineer any structural deficiency which becomes apparent in any structure or member of any structure as a result of the design requirements imposed by these Specifications, the plans or the typical drawings. Said Registered Professional Engineer shall be wholly responsible for the design of all poles, arms and street light extensions and review and acceptance of these designs by the Engineer shall not relieve said Registered Professional Engineer of this responsibility.

13. STREET LIGHT LUMINAIRES. The luminaire shall be a "cobra head" style high pressure sodium type wired for 120 VAC operation and sized per project plans. The optical unit of the luminaire shall be set for a type III medium semi-cutoff operation. The fixtures shall be equipped with a twist lock photo electric cell. Each circuit shall be equipped with a Buss HEB type fuse holder and a KTK 10 type fuse accessible at the pole handhole. The contractor shall install the luminaires as shown on the plans. The luminaire item also includes the high pressure sodium lamp. The cost of the street light luminaire includes all materials, equipment and labor required to install a street light luminaire.

14. SIGNS. The signs as shown on the Plans shall be provided and installed by the Contractor. This work shall include the necessary signs, sign brackets, equipment, and labor to install the signs as shown on the Plans.

All mast arm mounted signs shall utilize sign bracket assemblies.

The Contractor shall submit for approval all sign layout drawings detailing size of panel and all dimensions for lettering, borders prior to sign fabrication.

Regulatory signs shall have black legends and borders with silver/white high intensity background.

Street name signs shall have silver/white high intensity letters and borders with green high intensity background.

The signs shall be fabricated on 0.125 inch thick sheet aluminum and shall be of the height as shown on the plans. The sign length shall allow the letters and border to be spaced as required in standard spacing techniques outlined in the MUTCD and as recommended by the sheeting manufacturer. Maximum length of sign shall be 10 feet. If this maximum length is exceeded using "D" series lettering, "C" series lettering may be used. If the maximum length is exceeded using "C" series lettering, "B" series lettering may be used.

15. REMOVAL OF EXISTING EQUIPMENT. Existing traffic signals, pedestrian signals, mounting assemblies, cabinets, poles, fixtures, arms, signs, luminaires and other equipment shall be removed and stockpiled on site by the Contractor for subsequent removal by City forces. Existing foundations and pull boxes shall be removed by the Contractor. Existing wire and cable to be removed as part of this project shall become the property of the Contractor for disposal. Complete sidewalk and surface restoration will be required to remove all evidence of removed facilities.

The Contractor shall carefully handle all such equipment and provide the City with a listing of the salvage equipment for the project. Salvaged equipment shall be stockpiled neatly in an accessible area for the City forces to remove from the project site.

16. METHOD OF MEASUREMENT. Plan quantities listed in the following exhibits are for estimating purposes only, and these quantities will not be measured for payment separately.

17. BASIS OF PAYMENT. Payment will be made on a lump sum basis. No direct payment will be made for any incidental materials or work required to complete the traffic signal installation unless specifically provided for in the contract documents. Any other incidental work or materials for which no basis of payment is specifically provided will be considered incidental to the cost of the traffic signal system.

18. END OF THIS SPECIAL PROVISION

EXHIBIT A

SPECIAL PROVISIONS FOR
CITY OF DAVENPORT
TRAFFIC ENGINEERING DIVISION

TRAFFIC SIGNAL INSTALLATION

Pine Street – Kimberly Rd to 49th St
Project No. STP-U-1827 (662)—70-82
Estimate of Materials and Equipment

1.	Precast Reinforced Concrete Pull Box-24 inch	2	each
2.	Overhead Mounted 3-Section Vehicular Signal with Backplate (R,Y,G)	2	each
3.	Overhead Mounted 5-Section Vehicular Signal with Backplate (R,Y, G, YA, GA)	2	each
4.	Side of Pole Mounted 5-Section Vehicular Signal with Backplate (R,Y,G,YA,GA)	5	each
5.	Side of Pole Mounted Pedestrian Signal Countdown Style	2	each
6.	400 Watt High Pressure Sodium Multivolt Luminaire	2	each
7.	4" HDPE Bored	233	lft
8.	Traffic Signal Cable (5c #14 IMSA 19-1)	158	lft
9.	Traffic Signal Cable (7c #14 IMSA 19-1)	243	lft
10.	Traffic Signal Cable (16c #14 IMSA 19-1)	453	lft
11.	Pedestrian Push Button Cable (2c #14 IMSA 50-2)	423	lft
12.	Preemption Cable Type B, shield jacket, three – insulated conductor cable, 20 AWAG, one – 20 AWG bare stranded ground, 600 Volts, orange-blue-yellow color coded and 5/16 inch diameter	504	lft
13.	Ethernet Cable (CAT-5, outdoor rated)	659	lft
14.	Luminaire Cable (2c #8 IMSA 19-1)	477	lft

15. Tracer Wire (#8 THHN-Orange)	249	lft
16. Microwave Motion & Presence Detector	4	each
17. Microwave Detection Cards	4	each
18. Optical Preemption Detector (3M 711)	2	each
19. Optical Preemption Card (3M 562)	2	each
20. Pedestrian Push Button and Sign assembly	2	each
21. 22. Combination Mast Arm Pole NE Cor 35’ Signal Arm	1	each
22. Combination Mast Arm Pole NW Cor 50’ Mast Arm	1	each
23. 36 inch x 12 foot reinforced concrete foundation for signal poles.	2	each
24. Uninterrupted Power Supply to be installed in Existing Controller	1	each
25. Signs	2	each