

## SECTION 6 TRAFFIC CONTROL

### TABLE OF CONTENTS

PARA	DESCRIPTION	PAGE
	Construction Requirements	
	Actuated Signal Controller	
	Cabinet and Accessories	
	Solid State Digital Inductive Loop Vehicle Detector	
	Traffic Signal Conduit	
	Electrical Conductors	
	Polycarbonate 12-Inch Traffic Signal Head	
	Modular Pedestrian Signal Head	
	Traffic Signal Backplate	
	Signal Mounting Bracket	
	Geometrically Programmed Louver	
	Pedestrian Push Button and Station	
	Poles and Mast Arms	
	Traffic Signal Pole Concrete Footings	
	Pull Boxes	
	Roadway Luminaires	
	School Flashers	
	Signs	
	Aluminum Sign Blanks	
	Reflective Sheeting	
	Galvanized Steel Sign Posts	
	Square Steel Sign Posts	
	Traffic Stripe (Paint)	
	Traffic Stripe (Thermoplastic)	
	Traffic Stripe (Plastic Tape)	
	Glass Beads for Pavement Marking Material	
	Pavement Markers	
	Traffic Standard Bid Items	

## **SECTION 7 TRAFFIC CONTROL**

### **1.0 CONSTRUCTION REQUIREMENTS**

1.1 DESCRIPTION. This section covers general construction requirements for traffic control systems, devices and appurtenances.

1.2 PREQUALIFICATION. In the event that Prequalification Standards are required, the bidder of work performed under this specification shall be pre-qualified as Class "A" or "B" to perform such work. The Contractor must obtain all permits required by the City of Ardmore, State and federal regulations and laws.

1.3 CONSTRUCTION OUTSIDE CITY LIMITS. The Contractor performing work outside the corporate limits of Ardmore shall comply with all ordinances, regulations, and policies of the county and city wherein the work is located. He shall obtain any permits, provide barricades and lights, and make repairs as required by the responsible authorities.

1.4 TEST HOLES. Test hole information, when shown on the plans or included in the specifications, shall only represent subsurface characteristics to the extent indicated, and only for the point location of the test hole. Each bidder shall make his own interpretation of the character and condition of the materials that will be encountered between test hole locations. Each prospective Bidder may, at his own expense, make additional surveys and investigations as he may deem necessary to determine conditions which will affect performance of the work.

1.5 MATERIALS. All materials and certifications shall conform to the Oklahoma Department of Transportation Standard Specifications for Highway Construction 1999 or latest revision thereof; or to the City of Ardmore Materials Specifications, latest edition. Certifications will be checked for conformance with the applicable Specifications and an approved copy will be returned to the Contractor. All materials furnished under certification shall be tagged, stenciled, stamped, or otherwise marked by lot number, order number or other appropriate identification which can be readily recognized and checked against the certification. Materials accepted on certification shall not be incorporated in the work until the certificates have been approved by the Engineer.

1.6 DELIVERY OF MATERIALS. Construction materials shall not be delivered to the site of the work more than 3 days in advance of their anticipated use nor shall the quantity of materials on hand at the site of the work at any time be in excess of the amount required to complete work contemplated within the following 7 calendar days. Pilferable and high-value items such as signal heads shall not be stored on site.

1.7 SURFACE DRAINAGE STRUCTURES. When not called for on the plans or specified as a separate bid item, all surface structures and appurtenances which may interfere with the placement of signal poles, curbs, sidewalks and handicap ramps, shall be removed and replaced in a condition equal to or better than the original installation when required. No additional compensation shall be made for this work and the cost of same shall be included in right of way clearing and restoration pay item.

1.8 CONCRETE AND STEEL REINFORCEMENT. Unless otherwise specified, all concrete used in construction of signals and appurtenances shall be Type I Concrete, have a minimum 28-day compressive strength of 4,000 psi and shall conform with the applicable requirements of the Materials Section. All steel reinforcement used shall be Grade 60 with a minimum yield strength of

60,000 psi. Where required on the project, steel reinforcement shall be coated with epoxy coatings and conform to ASTM A775 standards.

## 1.9 CONSTRUCTION METHODS

1.9.1 Signal Replacement. Where existing signals are in operation, they shall remain in operation until the new signals are substantially complete and capable of operating in either pre-timed, recall or fully actuated modes. Exceptions may be made with permission of the Engineer.

1.9.2 Traffic Signal Start-up. The Contractor shall notify the City Inspector a minimum of 2 working days prior to the start of operation of all new, upgraded or modified traffic signals.

## 2.0 ACTUATED SIGNAL CONTROLLER

2.1 DESCRIPTION. This section covers the minimum design and operation requirements for 2 through 16 phase solid state vehicle actuated traffic signal controllers, cabinets and accessory equipment. All traffic signal controllers, cabinets, and accessory equipment shall meet the requirements of NEMA Publication No. TS2-1992 or its latest revision in addition to the requirements of this specification. Catalog sheets shall be provided to the Engineer on items bid after award of the Contract.

## 2.2 MATERIALS

2.2.1 Controller Unit. Interface, physical, functional and environmental standards shall meet the requirements specified by NEMA Publication No. TS2-1992 or its latest revision for Type 2 controller units. The controller unit shall be modular in design. Modules shall be easily removable without the use of special tools. The controller shall be capable of storing all timing in RAM with the power off and without the use of batteries. It shall be possible to upload or download all data through a standard RS232 port to a laptop computer. All controller features shall be in accordance with NEMA Publication TS2-1992 including:

- All standard timings
- Overlaps
- Preemption operation
- Diamond phasing
- Sequential phase operation
- Split dual ring operation
- Converting all phases to overlaps

2.2.2 Controller Display. The controller display shall provide simultaneous (i.e., concurrent) presentation, where concurrent states exist, of all of the following states/functions:

- Phase Information
  - Phase or phases in service (one per phase)
  - Phase or phases next to be serviced (one per phase)
  - Presence of vehicle call (one per phase)
  - Presence of pedestrian call (one per phase)

- Status of Active Phase in the Ring:
  - Initial
  - Extension
  - Yellow change H) Red clearance
  - Walk
  - Pedestrian clearance
  - Reason for Green termination
  - Gap-out
  - Force-off
  - Maximum time-out
  - Rest state (dwell)
  - Processor Monitor Indicator (one per controller)

2.2.3 Timing Display. The timing display shall use an LCD and shall indicate the current vehicle phase and active interval with a countdown in whole seconds of the time remaining on the active interval. If maximum recall is "on" for the current phase, maximum timing countdown shall be displayed. All displays shall be viewable in direct sunlight.

2.2.4 Programming. The controller shall provide for all control decisions to be performed by a microprocessor. All control functions shall be menu selectable by keyboard entry.

2.2.5 Interval Keyboard Advance. When reading the stored timing for any interval, it shall be possible to read the timing on the next interval in sequence on the same phase with a maximum of one keystroke.

2.2.6 Timing Interval. The timing for all phases of each interval shall be displayed at the same time on one screen. Timing entry shall be maintained for a minimum of 30 days with the removal of power from the controller without the use of a discrete battery.

2.2.7 Programmable Functions. All programmable functions and variables shall be accessible through an integral keypad on the face of the unit, and via Port 2 RS-232C interface and a personal computer.

2.2.8 Conditional Service. The controller shall provide conditional service operation. This function, when enabled, causes the controller to monitor the time remaining on any even numbered phase which is opposed by an even numbered phase that has gapped-out. If the time remaining is sufficient to allow at least a minimum service of its associated odd numbered phase, the controller shall cause the gapped-out phase to terminate and shall re-service the odd numbered phase. The opposing odd numbered phase shall not be serviced at this time. It shall be possible to select each barrier separately.

2.2.9 Overlaps. All overlaps shall be generated internally and meet the specifications of NEMA publication No. TS2-1992 or its latest revision. Overlaps shall be keyboard programmable.

2.2.10 Diamond Operation. It shall be possible to set up the controller to operate the intersection as a diamond intersection through the keyboard alone utilizing any of the following phasing schemes. This shall be a standard built in function of the controller unit.

- Lead-Lead
- Lag-Lead

- Lead-Lag
- Lag-Lag
- TTI-Lead

The phasing schemes listed are identical to those developed by the Texas Transportation Institute, (TTI) and utilized in TTI's PASSER-III software.

2.2.11 Time Base Control. The controller unit shall include provisions for internal Time Base Control meeting the requirements of NEMA Publication TS2-1992 Section 3.8, or its latest revision.

2.2.12 Actuated Coordination. The controller unit shall include an internal coordinator. The coordinator shall accept Timing Plan (Dial/Split) and Offset commands from traditional (pre-timed) interconnect systems, from a companion Time Base program, and/or an Internal System Interface.

2.2.13 Preemption Operation. The controller shall provide for preemption operation for emergency vehicles and railroads. A minimum of 6 separate preempts shall be provided. When both emergency vehicle and railroad preemption are utilized in the same system, railroad preemption shall take priority over emergency vehicle preemption. Preemption shall be a standard built in function of the controller unit.

2.2.14 Processor Monitor. The controller shall have a Processor Monitor to monitor micro-processor operation in accordance with NEMA Publication TS2-1992 Section 3.9.3.1.2 or its latest revision. If failure occurs in the microprocessor, the processor monitor shall initiate flashing operation and the processor monitor indicator on the face of the controller unit shall illuminate.

2.2.15 Diagnostic Tester. The controller unit shall have, as optional equipment, a diagnostic tester for performing comprehensive troubleshooting tests. Displays on the tester or on the controller unit shall indicate a valid completion of the test or an error code that can be translated to locate a component failure.

### 3.0 CABINET AND ACCESSORIES

3.1 DESCRIPTION. The cabinet and all accessories equipment shall meet the requirements of NEMA Publication TS2-1992 or its latest revision in addition to the requirements of this specification. All auxiliary equipment shall be furnished in the price bid for controllers.

#### 3.2 MATERIALS

3.2.1 Cabinet Materials. Cabinets shall be fabricated of either sheet aluminum or cast aluminum. Sheet aluminum cabinets shall meet the requirements of NEMA Publication TS2-1992 Sec 7.2.2.1, or its latest revision. Cast aluminum cabinets shall meet the requirements of NEMA Publication TS2-1992 Sec 7.2.2.2. Cabinet finish and surface preparation shall meet the requirements of NEMA Publication TS2-1992 Sec 7.7.3.

3.2.2 Minimum Cabinet Dimensions. The controller cabinet shall conform to the dimensions listed in Table 7.3-1 of NEMA Publication TS2-1992 Sec 7.3 or its latest revision.

3.2.3 Cabinet Shelves. The cabinet shall be provided with a sufficient number and sizes of substantial metal shelves or brackets to support the controller unit and auxiliary equipment. The equipment and shelves shall be arranged so that it is possible to remove any piece of auxiliary equipment from the cabinet without removing any other piece of auxiliary equipment.

3.2.4 Cabinet Mounting. Cabinets shall be either base-mounted or pedestal mounted as shown on the Plans. Pedestal-mounted cabinets shall meet the requirements of NEMA Publication TS2-1992 Sec 7.8.2.; base-mounted cabinets shall meet the requirements of NEMA Publication TS2-1992 Sec 7.8.3.

3.2.5 Ventilation System. The controller cabinet shall be equipped with a ventilation system which meets the requirements of NEMA Publication TS2-1992 Sec 9. All air intakes into the cabinet shall be equipped with filters per Sec 7.9.2.3 of NEMA TS2-1992.

3.2.6 Main Door. Cabinets shall be provided with a full front door that provides complete access to the interior of the cabinet. The cabinet door shall meet all the requirements of NEMA Publication TS2-1992 Sections 7.5.1 through 7.5.6.

3.2.7 Maintenance and Police Panels. The cabinet shall be provided with a maintenance panel inside the main door and a police panel accessible from a separate door attached to the main door. Maintenance and Police Panels are described in the sections below.

3.2.8 Maintenance Panel. The Maintenance Panel shall be located on the inside of the cabinet door and shall contain the following switches:

- Auto/Flash Switch
- Controller Power Switch
- Stop Timing Switch
- Detector Test Switches (push button type, one for each vehicle and pedestrian phase)

3.2.9 Police Panel. The Police Panel shall be located in the Police Compartment which shall be accessible from a door located on the outside of the main door. The Police Compartment and Door shall meet the requirements of NEMA Publication TS2-1992 Sec 7.5.7. The Police Panel shall contain one Auto/Flash switch.

3.2.10 Print Holder. A heavy-duty clear plastic print holder shall be securely attached to the inside door of the cabinet to provide storage for the cabinet wiring diagrams. The print holder shall be 9-inches by 12-inches minimum.

3.2.11 Cabinet Electrical Design. Cabinet wiring shall be in accordance with these Specifications and NEMA Publication TS2-1992 Section 5 or its latest revision.

3.2.12 Power Requirements. The controller and all auxiliary equipment housed within the cabinet assembly shall be designed to operate from 89-135 VAC 60 Hertz single-phase alternating current. Distribution of the AC Power throughout the cabinet shall not occur until the AC+ has first passed through all of the power protection devices or as explicitly permitted by this Specification or by NEMA Publication TS2-1992 or its latest revision.

3.2.13 AC+ Power Protection Devices. The power protection devices shall include a minimum 30 amp main AC+ power circuit breaker, a 15 amp auxiliary AC+ power circuit breaker, radio interference suppressor, and lightning and surge protectors. These devices shall be in addition to any protection devices furnished with the controllers and auxiliary equipment housed within the cabinet.

3.2.14 Terminals and Facilities Interface. The Terminals and Facilities Interface shall be designed to meet the requirements of NEMA Publication TS2-1992 Section 5.3.2 or its latest revision.

3.2.15 Grounding System. The grounding system shall meet the requirements of NEMA Publication TS2-1992 Section 5.4.2.1, or its latest revision.

3.2.16 Circuit Breakers. The AC+ field service shall be connected to circuit breakers as shown in Figure 5.4.2-1 of NEMA Publication TS2-1992 Section 5.4.2.1. Circuit breakers shall meet the requirements Section 5.4.2.2. The circuit breakers shall be capable of manual operation and clearly marked to indicate the ON and OFF positions. The circuit breaker shall have an adequate rating (amps) to handle the present and future cabinet and signal load.

3.2.17 Radio Interference Suppression. The cabinet shall be equipped with a Radio Interference Suppressor meeting the requirements of NEMA Publication TS2-1992 Section 5.4.2.5.

3.2.18 Surge Protection. An Innovative Technology Model #HS-P-SP-120A-60A-RH Protector transient voltage surge suppressor or equivalent shall be installed between the AC power and cabinet mounted on the side of the cabinet immediately adjacent to the AC terminal block.

3.2.19 Wiring and Insulation. The cabinet load bay shall be hard wired. Printed circuit runs will not be accepted. All terminals shall be permanently identified in accordance with the cabinet wiring diagram. Wiring of the cabinet load bay shall meet the requirements of NEMA Publication TS2-1992 Sec 5.2.

3.2.20 AC+ Convenience Outlet. A convenience receptacle shall be provided.

3.2.21 Illumination. The cabinet shall be furnished with a fluorescent lamp or equivalent LED light. The "On-Off" switch for the lighting fixture shall be a door actuated switch that turns the light on when the door is open and off when the door is closed.

3.2.22 Detector Rack. Inductive loop vehicle detectors shall be rack mounted. The detector rack shall meet the requirements of NEMA Publication TS2-1992 Sections 5.3.4 through 5.3.4.5, in addition to the following:

- The detector rack chassis shall be hinged on one side allowing the unit to swing out a minimum of 90 degrees for access to the units edge connector wiring.
- The remote reset circuits shall be fully operational.
- All delay inhibits shall be wired to the associated phase green.

3.2.23 Solid State Load Switches. Load switches shall meet the requirements of NEMA Publication TS2-1992 Section 6.2 through 6.2.4. Load switch sockets shall meet the requirements of Section 5.3.2.1.

3.2.24 Solid State Flasher. The flasher shall be solid state and have 2 output circuits. It shall be rated at 15 amps per circuit per NEMA Publication No. TS2-1992 Section 6.3.

3.2.25 Flash Transfer Relays. The flash transfer relay shall meet the requirements of NEMA Publication TS2-1992 Section 6.4.

3.2.26 Not Used.

3.2.27 Malfunction Management Unit (Conflict Monitor). The Malfunction Management Unit (MMU) shall meet the requirements of NEMA Publication No. TS2-1992 Section 4 or its latest revision. In the event of conflicting signals, it shall place the intersection in flash and the controller in stop timing. The monitor shall have conflict memory indicators to aid in tracing the cause of a conflicting signal indication or loss of signal condition.

3.2.28 Bus Interface Unit. The Bus Interface Unit shall meet the requirements of NEMA Publication TS2-1992 Section 8.

3.3 TESTING. The cabinet assembly shall be inspected and tested by the City Inspector and or Maintenance Superintendent during the project acceptance and handover phase. The cabinet shall be supplied with 3 copies of the cabinet wiring and schematic diagrams. Each termination point shall indicate all connections to and from that point.

3.4 BASIS OF PAYMENT. Vehicle actuated traffic signal controller units, complete with the cabinet and all auxiliary equipment described in this section, shall be measured by the unit complete and in place. Vehicle actuated traffic signal controllers shall be paid for at the contract unit price for:

VEHICLE ACTUATED TRAFFIC SIGNAL CONTROLLER EA

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals, including concrete foundation and/or pedestal, necessary to complete the work as specified.

#### 4.0 SOLID STATE DIGITAL INDUCTIVE LOOP VEHICLE DETECTOR

4.1 DESCRIPTION. This section covers the minimum performance and design requirements of a card rack mounted digital inductive loop vehicle detector. Catalog sheets shall be provided to the Engineer on items bid after award of the Contract.

#### 4.2 MATERIALS

4.2.1 General Requirements. Physical and functional standards shall conform to this Specification and to NEMA Publication No. TS2-1992 Section 6.5. The detector shall be completely self tuning with automatic tracking. The loop inductance range shall be 30 to 2000 microhenries. The loop input terminals shall be buffered by an isolation transformer. The detector shall have internal lightning protection devices to provide total circuit protection. There shall be three selectable frequencies to provide frequency separation to eliminate crosstalk. Three sensitivity selections shall be provided, with a high sensitivity of 0.02 percent change in loop inductance. There shall be a presence time control to select the rate at which detector tracking circuits cause the unit to tune out a stationary vehicle over the loop. The output indicator shall be a high intensity light emitting diode. The detector shall provide a continuous call output whenever power is removed. The operating temperature range shall be -30°F to +180°F. The operating power range shall be 95 - 135 VAC 60 Hz.

4.2.2 Delay and Extension Timing. When specified on the plans, the detector shall be supplied with programmable delay and extension timing features. The call delay time shall be adjustable from 0 to 31 seconds in one second steps. The call extension time shall be adjustable from 0 to 15 seconds in 0.25-second steps. Activation of the Delay/Extension Feature shall meet the requirements of NEMA Publication TS2-1992 Section 6.5.2.9.7.



4.3 BASIS OF PAYMENT. Solid state digital inductive loop vehicle detectors installed shall be measured by the unit complete and in place, wired and connected to the controller. Solid state digital inductive loop vehicle detectors shall be paid for at the contract unit price for :

SOLID STATE DIGITAL INDUCTIVE LOOP VEHICLE DETECTOR EA

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

## 5.0 TRAFFIC SIGNAL CONDUIT

5.1 DESCRIPTION. This section covers the minimum construction and materials requirements for conduit used to enclose traffic signal conductors. All traffic signal conduit shall conform to Section 739 of the Oklahoma Department of Transportation Standard Specifications for Highway Construction 1999 or latest revision thereof unless otherwise noted in these Specifications.

## 5.2 MATERIALS

5.2.1 General. Traffic signal conduit shall be of the types given below. All fittings, entrance caps, and cements used shall be compatible with the conduit material for which they are used and comply with current traffic signal industry standards.

- Galvanized Steel - Rigid galvanized steel conduit shall comply with the requirements AASHTO M 272.
- Rigid Plastic - Rigid plastic conduit shall comply with the requirements of AASHTO M 272. Rigid plastic conduit shall be Schedule 40 PVC plastic conduit, unless otherwise specified.
- Flexible Plastic - Flexible plastic conduit shall comply with the requirements of NEMA TC7 and shall be smooth wall coilable duct of high density polyethylene (HDPE) meeting the requirements of ASTM D 1248, Type III Class C, Grade P33, Category 5, Schedule 40.
- Cable-in-Duct - Cable-in-duct conduit shall be factory assembled. The duct shall be HDPE and be the size shown on the Plans. The conductors shall be the type, size, and number shown on the Plans. Identification of the conductors shall be accomplished by color coding the insulation by means of a continuous longitudinal colored stripe or various solid colors of insulation, in addition to the standard color markings.

5.2.2 Materials Certification. Traffic signal conduit shall be accepted if all pieces are clearly marked with the UL label and a type D certification is provided by the manufacturer.

5.3 BASIS OF PAYMENT. Traffic signal conduit of the size, type and method of installation specified shall be measured by the linear foot and shall include all fittings, outlets, entrance caps, pull wires, expansion devices and any other hardware necessary to complete the conduit system. Accepted traffic signal conduit will be paid for at the contract unit price for :

(SIZE) GALVANIZED STEEL CONDUIT (INSTALLATION METHOD)	LF
(SIZE) RIGID PLASTIC CONDUIT (INSTALLATION METHOD)	LF
(SIZE) FLEXIBLE PLASTIC CONDUIT (INSTALLATION METHOD)	LF
(SIZE) CABLE-IN-DUCT	LF

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

## 6.0 ELECTRICAL CONDUCTORS

6.1 DESCRIPTION. This section covers the materials and installation requirements for electrical conductors used for traffic lighting and signal electric cable, shielded loop detector lead-in cable, loop detector wire and communications cable.

6.2 MATERIALS. Conductors shall meet the requirements listed below:

- Traffic and Signal Electrical Cable. Traffic and signal electrical cable shall be straight conductor 600 volt cable with a polyethylene outer jacket for aerial and duct installation, and shall meet International Municipal Signal Association (IMSA) Specification No. 20-1. The conductors shall be solid copper No. 14 AWG. Electrical conductors for lighting shall be of the type shown on the Plans.
- Shielded Loop Detector Lead-In Cable. Shielded loop detector lead-in cable shall comply with the requirements of IMSA No. 50-2. The conductors shall be stranded copper No. 14 AWG with a polyethylene outer jacket.
- Standard Loop Detector Wire. Loop detector wire shall comply with requirements of IMSA No. 51-3. The conductors shall be No. 14 AWG stranded copper wire in a polyethylene outer jacket.
- Loop-In-Duct Detector Wire. When Loop-In-Duct detector wire is specified on the Plans, it shall comply with the requirements of IMSA No. 51-5. The conductors shall be ducted No. 14 AWG stranded copper wire.
- Signal and Control Cable. Control cable for communications shall comply with the requirements of IMSA specification 20/6.

## 6.3 CONSTRUCTION METHODS

6.3.1 Traffic and Signal Electrical Cable. Traffic and signal electrical cable shall be installed from the heads and luminaries on each traffic signal pole to the traffic signal controller or power source. The electrical cable from the traffic signal pole to the controller shall be in conduit. The electrical cable to be furnished shall have a sufficient number of conductors and at least one spare conductor as shown on the Plans.

6.3.2 Shielded Loop Detector Lead-In Cables and signal and control cable. Shielded loop detector lead-in cables shall be placed in conduit from each loop detector pull box location to the traffic signal controller. At each of the loop detector pull box locations, the loop wire or the sensing element lead shall be spliced to the loop detector lead-in cable as shown on the Plans. Signal and control cable shall be placed in conduit between traffic signal controllers as shown on the plans.

6.3.3 Loop Detector Wire. Loop detectors shall be located as shown on the Plans, the exact location being marked by chalk, spray paint or some other suitable marking device for inspection by the Engineer prior to being cut. The loop slots, including corner cuts, shall be cut in the pavement a minimum of 2-inches deep and 1/4-inch wide unless otherwise specified on the Plans. The slot shall be cleaned and dried with compressed air to remove all water and debris. All loop wires in any given slot shall be wound in the same direction a minimum of 2 turns and a maximum of 3 turns per loop. All loop wire shall be one continuous length to the pull box where it shall be

connected to the lead-in cable. The run of loop wire between the loop and the pull box shall be twisted a minimum of 5 turns per foot. A blunt instrument shall be used for placing the wire into the slot to prevent damage to the wires insulation. All loops connected to the same detector channel shall have their polarity reversed with respect to their adjacent loop. Loop wires shall be identified in the pull box as to loop number and the direction the loop is wound (i.e. clockwise, counter-clockwise). All connections that are made from loop wire to the lead-in cable shall be made only in the pull box. The connection shall be soldered with a 60/40 alloy, rosin core solder. A grease-filled connector sealing pack shall be placed over the connection after soldering is completed. After the loop wire has been carefully placed in the slot and the circuitry checked by the Contractor, the slot shall be sealed with a sealer. A minimum of 1-inch of sealer shall be over the top-most wire in the slot. Loop sealant shall encapsulate loop wires in the saw cut. The process of cleaning the slot, installing the loop wire, checking the circuit, and sealing the slot shall be completed within the same working day to prevent the buildup of foreign matter in the slot after cleaning and prior to sealing.

6.4 BASIS OF PAYMENT. Electrical conductor shall be measured by the linear foot for the various types specified and installed including all connectors, splices and incidentals necessary to complete the traffic signal and lighting system as provided on the Plans. Accepted electrical conductors will be paid for at the contract unit price for :

(No. of Conductors) CONDUCTOR TRAFFIC SIGNAL ELECTRICAL CABLE	LF
TWO-CONDUCTOR SHIELDED LOOP DETECTOR LEAD-IN CABLE	LF
LOOP DETECTOR WIRE (AWG No.)(Wire Type)	LF
(No. of Conductors)(AWG No.) ELECTRICAL CONDUCTOR	LF

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

## 7.0 POLYCARBONATE 12-INCH TRAFFIC SIGNAL HEAD

7.1 DESCRIPTION. This section covers the minimum design and operating requirements for adjustable face polycarbonate traffic signal heads that can be arranged in different combinations to provide vehicle signal displays in accordance with the Manual On Uniform Traffic Control Devices (MUTCD). Catalog sheets shall be provided on items specified and bid.

7.2 MATERIALS. Traffic signal heads shall conform to the ITE standard for Adjustable Face Vehicular Traffic Control Signal Heads. All traffic signal heads shall be mounted vertically, rigid, and not free swinging. Traffic signal placement shall be as shown on the plans and conform to the requirements of the MUTCD.

7.2.1 Physical and Mechanical Requirements. The housing of each signal section shall be one piece polycarbonate resin of the specified color, especially stabilized for atmospheric ultra-violet exposure, injection molded complete with integral top, bottom, and sides, having a minimum thickness of 0.1 inches.

- One (1) section of each signal head shall be equipped with a five 5-position terminal block for termination of field wiring.
- The top and bottom of each housing shall have an opening to accommodate standard 1-1/2-inch pipe fittings and brackets. Signal sections shall be joined together in a manner that provides both mechanical integrity and prevents intrusion of dust and weather.

- Each signal section shall be capable of being rotated 360 degrees about its axis and shall be capable of being locked at 5-degree intervals. Serrations shall be integral with the signal section and designed to permit interlocking of adjacent sections.

7.2.2 Housing, Door, and Visor. Each signal section shall be constructed to accommodate a 12-inch nominal dimension optical unit. The door of each signal section shall be hinged to the housing to permit access to the section for relamping. Each signal section shall be provided with a tunnel visor. The visor shall be a minimum of 9-inches in length with a minimum downward tilt of 3°. Each visor shall be secured to its door in a manner that will prevent its removal by wind. All exterior metal fasteners, including hinge pins, shall be made from stainless steel. Gasket material for the optical unit shall withstand temperatures up to 250°F without permanent deformation and discoloration, without adversely affecting the lens, reflector or lamp.

7.2.3 Color. Nonmetallic materials shall have the color completely impregnated in the material. The exterior color of the entire signal head, including the outside of visors, shall be yellow. The inside of visors shall be flat black in color.

7.2.4 Light-Emitting Diode (LED) Traffic Signal Lenses. Light emitting diode (LED) lamp modules with spade tab connections shall meet the requirements in the Institute of Traffic Engineers (ITE) standard entitled "Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Circular Signal Supplement" (VTCSH-LED). LED lenses shall be Dialight, GelCore, Duralight or an approved equal. Incandescent bulb type traffic signals are not acceptable.

7.2.5 Signal Head Warranty. The warranty from defective workmanship and materials shall be 5 years from the date of the project's final acceptance. During the project's maintenance bond period, the contractor shall remove and replace defective LED modules within 3 working days of receiving notice from the City. For reasons of immediate public safety, the City may remove and replace the module(s) and the contractor will be notified to furnish the city with replacement unit(s) meeting current ITE requirements. After the end of the maintenance bond period, all failed modules will be removed and replaced by the City and the contractor will be required to furnish the City with direct replacement unit(s) meeting current ITE requirements.

7.3 BASIS OF PAYMENT. Polycarbonate 12-inch traffic signal heads shall be measured by the unit complete and in place including wiring. The contract unit price includes backplates, signal mounting brackets, geometrically programmed louvers (if specified), as hereinafter described. Traffic signal heads shall be paid for at the contract unit price for:

ONE (1) SECTION TRAFFIC SIGNAL HEAD	EA
THREE (3) SECTION TRAFFIC SIGNAL HEAD	EA
FOUR (4) SECTION TRAFFIC SIGNAL HEAD	EA
FIVE (5) SECTION TRAFFIC SIGNAL HEAD	EA

which will be full compensation for furnishing materials, labor, equipment, and incidentals necessary to complete the work as specified.

## 8.0 PEDESTRIAN SIGNAL HEAD

8.1 DESCRIPTION. This section covers the minimum design and materials requirements for an adjustable face pedestrian signal head. The pedestrian signal head shall conform to the latest Institute of Transportation Engineers (ITE) Standard.

## 8.2 MATERIALS

8.2.1 Physical and Mechanical Requirements. Signal sections shall be joined together in a manner that provides both mechanical integrity and maximum protection against intrusion of dust and weather. Each signal face shall be capable of being rotated 360 degrees about its axis and shall be capable of being locked at 5-degree intervals. Serrations shall be integral with the signal section and designed to permit interlocking of adjacent sections.

8.2.2 Housing, Door and Visor. Each signal section shall be constructed to accommodate a 12-inch nominal dimension optical unit. The door of each signal section shall be hinged to the housing to permit access to the section for relamping. Each signal section shall be provided with a tunnel visor. Each housing and door shall be made of polycarbonate resin and shall be ultraviolet and heat stabilized. The housing and door shall conform to ASTM Specifications. All exterior metal fasteners, including hinge pins, shall be made from stainless steel. Gasketing material for the optical unit shall withstand temperatures up to 250°F without permanent deformation and discoloration, and without adversely affecting the lens, reflector or lamp.

8.2.3 Color. All nonmetallic materials shall have the color completely impregnated in the material. The exterior color of the entire signal head, including the outside of visors, shall be yellow. The inside of visors shall be a flat black in color.

8.2.4 Lenses and Reflectors. Lenses shall be made of glass and shall conform to the latest ITE specifications. The "Upraised Hand" lens shall be Portland Orange and the "Walking Person" lens shall be lunar white. The letter height shall be 4-1/2-inches and the stroke width shall be a minimum of 7/16-inches. Reflectors shall be specular aluminum with a protective anodic coating.

8.2.5 Electrical. Traffic signal lamps shall be 65 watt, 120 volt lamps, and have a minimum rated life of 8000 hours. The lamp receptacles shall be of heat resisting material designed to properly position a traffic signal lamp with means for correct filament positioning. The receptacle shall be provided with a lamp grip to prevent the lamp from working loose due to vibration. Provision shall be made on either the lamp receptacle or the reflector holder to permit rotation of the lamp so that the opening between filament ends is up. Each lamp receptacle shall be provided with 2 each color-coded No. 18 or larger lead wires with sufficient length to reach the terminal block with the reflector fully open. Each lead shall have a terminal attached to its end. Connection of the lead to the terminal block in the signal shall not require any tools other than a screwdriver. A suitable terminal block for connection of the wires from the signal circuits shall be provided in the signal housing.

8.3 CONSTRUCTION METHODS. Pedestrian signal heads shall be installed at a height of 8 feet measured from the pole base plate to the bottom of the lower pedestrian signal section, or as directed by the Engineer. Pedestrian signal heads shall be installed on the corner of the pole that most nearly aligns them with the crosswalk or as specified on the Plans.

8.4 BASIS OF PAYMENT. Pedestrian signal heads shall be measured by the unit, complete and in place including wiring and all mounting hardware. The number of ways (separate signal displays within a single unit) and mounting configuration for all signal heads shall be as shown on the Plan. Pedestrian signal heads shall be paid for at the contract unit price for:

PEDESTRIAN SIGNAL HEAD

EA

which will be full compensation for furnishing materials, labor, equipment, and incidentals necessary to complete the work as specified.

## 9.0 MODULAR PEDESTRIAN SIGNAL HEAD

9.1 DESCRIPTION. This section covers the minimum design and materials requirements for an adjustable face modular (i.e. clamshell) pedestrian signal head. The pedestrian signal head shall conform to the latest Institute of Transportation Engineers Standard.

## 9.2 MATERIALS

9.2.1 General Physical Requirements. The modular pedestrian signal shall be manufactured from a one piece die cast housing with a single face. It shall display the "Upraised Hand" message in the top portion of its face and the "Walking Person" message in the bottom portion. Its visor shall be a flat grid type. The assembled unit shall provide a completely dust tight and weather tight unit when installed.

9.2.2 Housing, Door, and Visor. The housing of the unit shall be a one piece corrosion resistant aluminum alloy die casting. It shall have an integrally cast top, bottom, sides, and back. It shall provide 4 integrally cast hinge lug pairs, 2 at the top and 2 at the bottom. These shall be provided for operation of the swing door unit. The door frame shall be a one piece corrosion resistant aluminum alloy die casting. It shall have two hinge lugs cast at the bottom and two latch slots cast at the top of the door frame. The door shall be attached to the case with two stainless steel spring pins. Two stainless steel hinged bolts with captive stainless steel wingnuts and washers shall be attached to the case by stainless steel spring pins to complete the latching system. The visor for the unit shall be a flat grid type designed to eliminate glare from ambient light. The visor grid shall be installed parallel to the face of the "DONT WALK - WALK" message. The visor shall be attached by means of stainless steel screws. The visor shall be made of black polycarbonate with a flat finish on both sides.

9.2.3 Color. The exterior color of the entire signal head except for the visor shall be Federal yellow. The entire visors including the outside shall be flat black.

9.2.4 Lenses. Light emitting diode (LED) lamp modules with spade tab connections shall meet the requirements in the ITE standard entitled "Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Circular Signal Supplement" (VTCSH-LED). LED lenses shall be Dialight, GelCore, Duralight or an approved equal. The "Upraised Hand" lens shall be Portland Orange and the "Walking Person" lens shall be Lunar White. The letter height shall be 4-1/2-inches and the stroke width shall be a minimum of 7/16 inches.

9.3 CONSTRUCTION METHODS. Pedestrian signal heads shall be installed at a height of 8 feet measured from the pole base plate to the bottom of the lower pedestrian signal section. Pedestrian signal heads shall be installed on the corner of the pole that most nearly aligns them with the crosswalk or as specified on the Plans.

9.4 BASIS OF PAYMENT. Modular pedestrian signal heads shall be measured by the unit, complete and in place including wiring and all mounting hardware. The number of ways (separate signal displays within a single unit) and mounting configuration for all signal heads shall be as shown on the Plan. Modular pedestrian signal heads shall be paid for at the contract unit price for:

MODULAR PEDESTRIAN SIGNAL HEAD

EA

which will be full compensation for furnishing materials, labor, equipment, and incidentals necessary to complete the work as specified.

## 10.0 TRAFFIC SIGNAL BACKPLATE

10.1 DESCRIPTION. This section covers the material requirements for Type I and Type II traffic signal backplates.

10.2 MATERIALS. Traffic signal backplates shall be premanufactured, one piece construction units specifically profiled to fit the signal head(s) furnished under this contract. Backplates shall extend outward from all parts of the signal face assembly a minimum distance of 5-inches. All corners shall be rounded to have a 1-1/2-inch radius. Backplates shall be secured to the traffic signal heads with stainless steel machine screws and lock nuts. Type I backplates shall be constructed from polycarbonate sheet material and shall conform to the requirements of ASTM D 638, D 695, D 790, and D1822. Type II backplates shall be vacuum formed from acrylonitrile-butadiene-styrene (ABS) material conforming to ASTM D 1788. Backplates shall be black in color with a haircell finish on the front side and smooth finish on the back side. The backplate shall be treated for ultra-violet retardation.

10.3 BASIS OF PAYMENT. Payment for backplates shall be included in the contract price for traffic signal heads.

## 11.0 SIGNAL MOUNTING BRACKET

11.1 DESCRIPTION. This section covers the minimum design and material requirements for traffic and pedestrian signal mounting brackets. Signal brackets shall be designed to hold signal heads in a vertical arrangement.

11.2 MATERIALS. Traffic signal mounting brackets shall be of the type and construction as listed below.

11.2.1 Mast Arm Mounting Brackets. Mast arm mounting brackets shall attach to both the top and bottom of the signal head. The bracket shall be capable of adjusting the signal head in both the horizontal and vertical planes relative to the bracket. The bracket shall be adjustable about the mast arm. The mounting bracket shall be constructed with aluminum pipe and fittings (plastic fittings are not acceptable).

11.2.2 Side Pole Mounting Bracket. The side pole mounting bracket shall consist of an upper and lower arm assembly with standard band-on mounting hub plates for banding on a tubular pole. The upper arm assembly shall include 1-1/2 by 10-inch nipple, serrated ell, neoprene gasket, and cast nipple. The lower arm assembly shall include 1-1/2 by 10-inch nipple, serrated tee and cast nipple. The mounting bracket shall be constructed with aluminum pipe and fittings (plastic fittings are not acceptable) and shall have a spun aluminum alodine finish.

11.2.3 Post Top Mounting Brackets. One-way post top mounting brackets shall consist of a vertical terminal compartment, upper and lower arm assemblies, and a 1-1/2 by 37-inch center support tube for mounting 3-section 12-inch traffic signal heads on a 4-1/2-inch outside diameter pedestal pole. The upper arm assembly shall include a standard upper arm which will slide over the support tube and a tri-bolt arrangement for attaching to the signal housing. The lower arm assembly shall include a 1-1/2-inch by 5-inch nipple, serrated tee and cast nipple. The mounting

bracket shall be constructed entirely of aluminum (plastic fittings are not acceptable) and shall be painted Federal yellow.

11.3 METHOD OF MEASUREMENT. Payment for signal brackets shall be included in the contract price for traffic signal heads and pedestrian signal heads.

## 12.0 GEOMETRICALLY PROGRAMMED LOUVER

12.1 DESCRIPTION. This section covers the minimum design and materials requirements for a twelve (12) inch louver assembly designed to direct the light beam from a traffic signal section to a predetermined viewing range. The physical and functional standards of the louver shall conform to the latest Institute of Transportation Engineers Standards.

## 12.2 MATERIALS

12.2.1 General. The louver shall be designed to fit into a twelve (12) inch nominal dimension signal. The louver shall provide an absolute exact visual cut-off, and a full round ball display with minimum sat effect throughout the selected view range. In addition, the louver shall have a minimum glow outside the view range. The louver shall allow the view angle within each signal section to be adjusted to a designated area. The louver shall allow for controlling either the horizontal or vertical view range within the signal visor. The louver shall be of lightweight material, easily installed with minimum labor, and maintenance free.

12.2.2 Housing. The housing shall be consist of a two-piece assembly injection molded from black UV inhibited ABS plastic. Two brass inserts shall be molded into the bottom half allowing the assembly to be fastened together with two stainless steel screws. The housing shall have spherical contour which allows the light beam from the signal section to be directed up in all directions from the centerline of the visor/lens system. The inside surface shall have a multiplicity of grooves for positioning light directing baffles. The remaining inside surface shall be grooved to prevent surface reflections of light.

12.2.3 Baffles. Baffles shall be injected molded from flat black UV-inhibited virgin polycarbonate. Each baffle shall be a thin opaque disc with a multiple of parallel evenly spaced apertures .Each structural member forming the aperture shall have a cross section which allows for good stiffness and structural integrity but shall have a thin edge to prevent reflection outside the desired viewing range. All baffles shall be identical in design and interchangeable within the housing. The plane of each baffle shall be 90 degrees to the centerline axis of the housing.

12.3 METHOD OF MEASUREMENT. Payment for geometrically programmed louvers shall be included in the contract price for traffic signal heads.

## 13.0 PEDESTRIAN PUSH BUTTON

13.1 DESCRIPTION. This section covers the material and installation requirements for pedestrian push buttons.

13.2 MATERIALS. The pedestrian push button housing shall be cast aluminum and shall be suitable for mounting on a rounded surface. The body shall have a wire entrance hole at the back. A neoprene gasket shall provide a weather tight fit between the cover and body. The push button switch shall be waterproof. The cover shall be attached with recess hex head stainless steel screws. The push button housing shall be painted Federal yellow. The pedestrian push button



shall be constructed to be tamper proof. It shall be designed such that it will be virtually impossible to receive any electrical shock under any weather condition.

13.3 CONSTRUCTION METHODS. The pedestrian push button and sign shall be attached to the traffic signal pole or pipe in the location shown on the Plans and at a height of 40-inches measured from the bottom of the unit to the pole base plate. It shall be attached to the pole or pipe in a rigid and secure manner. Holes which are drilled in the field during installation shall be regalvanized, metalized, or painted with an approved zinc dust-oxide paint.

13.4 BASIS OF PAYMENT. Pedestrian push buttons shall be measured by the unit complete and in place, including an MUTCD designation R10-4 or R10-4b sign and all hardware. Accepted pedestrian push buttons will be paid for at the contract unit price for:

PEDESTRIAN PUSH BUTTON AND SIGN                      EA

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

#### 14.0 ACCESSIBLE PEDESTRIAN PUSH BUTTON STATION

14.1 DESCRIPTION. This section covers the material and installation requirements for accessible pedestrian push button stations. Push button stations shall consist of a modular unit containing both the push button and an MUTCD designation R10-3b sign. Accessible pedestrian push button stations shall provide users with visual, tactile and audible information at the intersection crossing where installed. Each station shall include the following features:

- Audible locating tone to guide pedestrians to accessible pedestrian push button stations. Automatically adjusting audible output to compensate for ambient sound levels.
- Light emitting diode (LED) visual indicator showing the user that the service call from the push button station has been sent to the traffic signal controller. Audible and vibrotactile confirmation to the user that the service call from the push button station has been sent to the traffic signal controller.
- The push button station shall vibrate at the start of the walk interval. Audible message played for the user indicating the direction of travel. Audible voice message indicating when a street can be crossed and identifying the street by name. The message shall play at the start of the walk interval and countdown the number of seconds remaining to cross the street during the pedestrian clearance phase.

14.2 MATERIALS. The accessible pedestrian push button station housing shall be cast aluminum and shall be suitable for mounting on a rounded surface. The body shall have a wire entrance hole at the back. A neoprene gasket shall provide a weather tight fit between the cover and body. The push button switch shall be waterproof. The cover shall be attached with recess hex head stainless steel screws. The push button station housing shall be painted Federal yellow. The pedestrian push button and sign shall be constructed to be tamper proof. It shall be designed such that it will be virtually impossible to receive any electrical shock under any weather condition.

14.3 CONSTRUCTION METHODS. Accessible pedestrian push button stations and sign shall be attached to the traffic signal pole or pipe in the location shown on the Plans. Push buttons

attached to the signal pole at points no lower than 15 inches nor higher than 40 inches as measured from the center of the push button to the grade adjacent to the pole where the user activating the push button would be positioned. It shall be attached to the pole or pipe in a rigid and secure manner. Holes which are drilled in the field during installation shall be regalvanized, metalized, or painted with approved zinc dust-oxide paint.

14.4 BASIS OF PAYMENT. Accessible pedestrian push button stations shall be measured by the unit complete in place, connected, including signs and all hardware. Accepted accessible pedestrian push button stations will be paid for at the contract unit price for:

ACCESSIBLE PEDESTRIAN PUSH BUTTON STATION                      EA

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

16.0 POLES AND MAST ARMS

16.1 DESCRIPTION. This section covers the minimum requirements for traffic signal poles, mast arms and pedestal poles. The structural design of traffic signal poles and mast arms shall be the responsibility of the manufacturer. Poles and mast arms shall be designed for a minimum of 90 mile per hour winds with a gust factor of 1.2 and shall meet all other design requirements of AASHTO Standard Specifications for Structural Supports of Highway Sign, Luminaires, and Traffic Signal Poles.

16.2 MATERIALS. Materials used shall meet the requirements specified in AASHTO Standard Specifications for Structural Supports of Highway Signs, Luminaires, and Traffic Signals.

16.2.1 Pole Materials. Pedestal poles shall meet the following requirements:

Aluminum Alloy	6063-T6
Tensile Strength, ksi	30
Yield Strength, ksi	25
Elongation	10%
Minimum Wall Thickness, Inches	0.237 min
Outside Diameter, inches	4.05

16.2.2 Pole Installation. Traffic signal pole and mast arm sizes and locations shall be as shown on the Plans. Mast arms and poles shall be selected from preapproved shop drawings of poles and mast arms which have been standardized for maximum loading. All mast arms shall provide for 17 foot clearance measured from the bottom of the traffic signals heads.

16.2.3 Pole Base. The threaded pedestal flange base shall be heavy-duty galvanized iron with a 7-1/4-inch bolt circle. Anchor bolts shall be provided with 2 nuts and 2 washers per bolt for double nut leveling of the pole. Anchor base poles shall be leveled with nuts or shims. If double nut leveling is used, the space between the concrete foundation and the pole base shall be filled with a nonshrink grout.

16.2.4 Pole Handholes. Each pole shall be furnished with a reinforced handhole and weatherproof cover, unless otherwise specified on the Plans. Handholds shall be oval in shape, 4-inches wide, at least 6-inches long, with the bottom of the hole 8-inches from the pole base, unless otherwise specified on the Plans.

- Handhole covers shall be one piece formed from ABS plastic, shall be a pearl gray color, and shall be suitable for exposure to harsh sunlight and extreme weather. Cover shall latch with two screw thaches and shall fit tightly to the enclosure ring to create a rainproof seal. Latch screws shall be 1/4-20 stainless flat socket head screws with tamper proof fetures. A removable pole cap shall be installed on each shaft.
- Threading and deburring of the pedestal pole shall be in accordance with the basic dimensions of the American National Standard Taper Pipe Threads, NPT(ANSI B2.1). All holes made in poles or mast arms after galvanizing shall be regalvanized, metalized, or painted with an approved zinc dust-oxide paint.

16.2.5 Grounding. All metal poles shall be provided with a grounding connection inside the base of the shaft and shall be grounded as shown on the Plans.

16.3 BASIS OF PAYMENT. Traffic signal poles, mast arms, luminaire arms and pedestal poles, of various types, sizes, and lengths shall be measured by each unit installed. The accepted poles, mast arms, luminaire arms and pedestal poles shall be paid for at the contract unit price for :

POLE AND SPECIFIED NO. OF MAST ARM(S)	EA
POLE AND SPECIFIED NO. OF MAST ARM (S) AND LUMINAIRE ARM	EA
PEDESTAL POLE WITH SPECIFIED MOUNTING HEIGHT	EA

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified, excluding reinforced concrete footings, which are classified separately for payment.

## 17.0 TRAFFIC SIGNAL POLE CONCRETE FOOTINGS

17.1 DESCRIPTION. This section covers the construction material and installation requirements for reinforced concrete traffic signal pole footings. Footings shall be of the type(s) shown on the Plans. The footing dimensions and steel reinforcement requirements shall conform to the latest revision of the Oklahoma Department of Transportation Traffic Standard detail sheet CDF-1-05, "Typical Conduit and Signal Pole Footing Details".

17.2 MATERIALS. Concrete footings shall be placed in reasonably close conformity to the dimensions shown on the Plans and shall conform to the following material requirements:

17.2.1 Portland cement shall conform to the requirements of AASHTO M85 and AASHTO M240. Aggregate shall conform to the requirements of ASTM C330. Reinforcement shall conform to the requirements of AASHTO M55 or AASHTO M221. Portland cement Concrete shall comply with the requirements of AASHTO T23 and AASHTO T22. Concrete shall have a minimum compressive strength of 4,000 psi at 28 days.

17.2.2 Anchor bolts and nuts shall conform to AASHTO M 183. Galvanizing (bolts, nuts and washers) shall conform to AASHTO M 233.

17.3 CONSTRUCTION METHODS. Concrete footings shall constructed in accordance with the most current revision of ODOT standard specifications section 509 – Structural Concrete, and shall be of the size(s) indicated and in the locations shown on the Plans. When an obstruction prevents the construction of a footing at the planned location, the Contractor shall construct the footing at

the location established by the Engineer. The design, number and layout of anchor bolts required shall be the responsibility of the manufacturer. Materials used shall meet the requirements specified in AASHTO Standard Specifications for Structural Supports of Highway Signs, Luminaires, and Traffic Signals. Anchor bolts and nuts shall be in accordance with the requirements of the preapproved shop drawings for poles and mast arms, which are standardized for maximum loading.

17.4 BASIS OF PAYMENT. Concrete footings of the type(s) shown on the Plans shall be measured by the cubic yards of structural concrete and pounds of reinforcing steel required. The contract price for concrete footings includes anchor bolts, nuts, washers, ground rod, conduit, excavation and backfilling, necessary to construct the footings as shown on the Plans or as directed by the Engineer. Accepted footings shall be paid for at the contract unit price for:

STRUCTURAL CONCRETE	CY
REINFORCING STEEL	LBS

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

#### 18.0 PULL BOXES

18.1 DESCRIPTION. This section covers the material and installation requirements for pull boxes. Pull boxes shall be size I or II as shown on the Plans. The dimensions of size I and II pull boxes shall conform to those given in the latest revision of the Oklahoma Department of Transportation Traffic Standards.

18.2 MATERIALS. Portland Cement Concrete and polymer concrete pull boxes shall be placed in reasonably close conformity to the dimensions shown on the Plans and shall conform to the following material requirements:

18.2.1 Normal Concrete Pull Boxes. Portland Cement shall conform to the requirements of AASHTO M85 and AASHTO M240. Aggregate shall conform to the requirements of ASTM C330. Reinforcement shall conform to the requirements of AASHTO M55 or AASHTO M221. Concrete shall comply with the requirements of AASHTO T 23 and AASHTO T22. Concrete shall have a minimum compressive strength of 4,000 pounds per square inch. Gray Iron Casting Covers shall conform to AASHTO M105.

18.2.2 Polymer Concrete Pull Boxes. Polymer concrete pull boxes have a polymer concrete cover, frame and body and a minimum load rating of 20,000 pounds. Polymer concrete pull boxes shall be Armorcast, Quazite or an approved equal. Fiberglass and/or plastic pull boxes or composites of same will not be accepted.

18.4 CONSTRUCTION METHODS. Pull boxes shall be the sizes shown on the Plans. The general location of pull boxes shall be shown on the Plans. Field adjustment of pull box locations to fit existing conditions shall be permitted with approval of the Engineer.

18.4.1 Location. The tops of pull boxes installed in sidewalks or other surfaced areas shall be flush with the finished surface. Pull boxes in unsurfaced areas shall be flush with the top of the ground or no more than one (1) inch above the top of the ground. Pull boxes not installed in a surfaced area shall be installed with a concrete apron. The dimensions of the apron shall conform to those given in the latest revision of the Oklahoma Department of Transportation Traffic Standards.

18.4.2 Installation. Pull boxes shall be installed on a bed of crushed rock or as shown on the Plans. Rock depth and size shall conform to the latest revision of the Oklahoma Department of Transportation Traffic Standards. Care shall be taken to thoroughly compact or hand-tamp the disturbed soil and backfill. When called for on the Plans, pull box extensions shall be provided. The extensions shall be made of the same materials as the pull box and shall be attached to the pull box in a manner that will maintain the required depth without separation of the assembly.

18.4.3 Pull box covers shall be marked with the legend "Highway Lighting" or "Street Lighting" when used for lighting conductors and "Traffic Signal" when used for traffic signal conductors with or without lighting conductors. The legend shall be cast into the cover face. The words "High Voltage" shall be added when the conductor voltage is greater than 600 volts. The cover shall be equipped with a recessed molded lifting eye and recessed hold down bolts. The cover shall have a nonskid surface. If called for on the Plans, a copperweld ground rod shall be installed as shown on the Plans.

18.5 BASIS OF PAYMENT. Concrete pull boxes of the size and type shown on the Plans shall be measured by each unit installed and shall include cover, extension, ground rod, concrete apron, crushed rock, excavation, and backfilling, necessary to construct and install the pull boxes as shown on the Plans or as directed by the Engineer. Accepted pull boxes will be paid for at the contract unit price for:

PULL BOX TYPE I	EA
PULL BOX TYPE II	EA

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

## 19.0 ROADWAY LUMINARIE

19.1 DESCRIPTION. This section covers the minimum design and material requirements for luminaires to provide roadway lighting. The luminaire shall be either

19.1.1 HPS, a horizontal or vertical burning, high pressure sodium (HPS), outdoor luminaire complete with housing, appropriate mounting, built in ballast, adjustable mogul socket, lamp, gasketed reflector, and glass refractor; or

19.1.2 LED, a light-emitting diode light fixture, with lamp, housing, etc.

## 19.2 HPS.

19.2.1 Structure. The luminaire housing shall be precision die-cast aluminum and be of adequate size to contain the ballast components, reflector, lamp and socket, terminal board, and slip fitter allowing all the electrical components to operate within their designed temperature range. The refractor shall be manufactured of pressed, heat resistant, crystal clear borosilicate glass, annealed, homogenous and free from imperfections and striations. Refracting prisms shall be incorporated in the refractor to assure maximum utilization of the light generated and provide the required photometric distribution. The refractor door shall be precision die-cast aluminum with clips for proper positioning of the refractor. The door shall be easily detached from the housing by operating the spring loaded latch or latches and separating the hinges while wearing linemen's gloves. Luminaires for mast arm mounting shall be equipped with a slipfitter design to accept 1-

1/4-inch to 2-inch schedule 40 pipe and provide a method of leveling the luminaire and vertical adjustment  $\pm 5$  degrees using externally accessible bolts. The slipfitter shall be equipped with a pipe stop. Luminaires for post top mounting shall be equipped with a slipfitter designed to accept a 2-3/8-inch to 3-inch O.D. pole or tenon. The reflector shall be of specular finished, hydro-formed, anodic coated aluminum to provide a minimum reflecting of 80%. The reflector shall have a reverse flange mounted within the housing to assure a firm surface for proper gasket sealing when the refractor door is closed. The lamp socket shall be a completely porcelain enclosed, mogul type with internal lamp grips to assure electrical contact under conditions of normal vibration. The socket shall have welded internal connections and be in compliance with the latest revisions of Edison Electric Institute (EEI) Publication No. TDJ-147. The socket support shall contain identifying marks so the socket may be easily adjusted, both horizontally and vertically to provide the specified IES light distribution.

19.2.2 Electrical. The ballast shall be a high power factor bobbin wound, ISO-regulator constant wattage type, capable of operating the high intensity discharge lamp specified from a single phase, grounded, 120/240 Volt nominal, multiple system. The ballast shall regulate lamp watts within plus or minus 10%. The ballast, capacitor, and starting aid module, if required, shall be prewired to the lamp socket and terminal board and be designed for easy removal and installation by using quick disconnect features. The ballast shall be designed to start the lamp at minus 20°F. The terminal board shall be of phenolic molded plastic or porcelain with protective barriers between terminals. The screw terminals shall be captive type, compatible with aluminum or copper conductors and capable of accepting up to a No. 6 AWG conductor. All electrical components shall be insulated to a minimum of 10 KV BIL. All wire shall be UL approved and the insulation capable of withstanding the designed operating temperatures of the luminaire. The photoelectric control shall be a detachable type cadmium sulfide photocell of 105-285 Volt, 50/60 Hertz AC, outdoor control complete, in accordance with EEI-NEMA Standard TDJ-146. It shall have a built in time delay of 5 seconds, relay load contacts rated 1000 Watts or 1800 Volt-Ampere reactive, a single-pole, single-throw, contact normally closed for "Fail Safe" operation, positive lightning and surge protection enclosed in a high impact acrylic housing which has a neoprene base plate gasket and 3-pole polarized twist-lock plug. Turn-on shall occur at approximately 2 footcandles and turn-off at approximately 4 footcandles. Turn-on and turn-off shall be adjustable.

19.2.3 Miscellany. Each luminaire shall be supplied with a permanently attached name plate inside the housing and/or on the ballast. This label shall indicate the manufacturer, Catalog No., Lamp type, wattage, line voltage rating and connection diagram. Each luminaire shall be marked in accordance with EEI-NEMA standards for "Field Identification of High-Intensity Discharge Lamps in Luminaries used in Roadway Lighting Equipment", EEI Publication No. TDJ-150 and NEMA Publication No. OD150.

### 19.3 LED

19.4 BASIS OF PAYMENT. Luminaires will be measured by the unit, complete in place including wiring and all hardware. The accepted luminaires will be paid for at the contract unit price for:

ROADWAY LUMINAIRE (250 WATT HPS)	EA
or	
ROADWAY LUMINAIRE (LED)	EA

which will be full compensation for furnishing materials, labor, equipment, and incidentals necessary to complete the work as specified.

## 20.0 SCHOOL FLASHERS

20.1 DESCRIPTION. This section covers the material and construction requirements for school flashers used to supplement school speed limit signs.

20.2 MATERIALS. School flashers shall be as described following.

20.2.1 Signs. Signs used with school flashers shall be a MUTCD designation S5-1, 24 inches by 48 inches

20.2.2 Flasher Assembly. Conform to relevant paragraphs of these specifications. The flasher beacons shall utilize a yellow lens 12-inches in diameter fitted with a cut-away visor.

20.2.3 Programmable Time Clock. The programmable time clock shall be a Paragon EC72D, or approved equal. It shall be completely solid state. Programming of time of day, day of week, date, and year, shall be accomplished through an integral keypad. The functions of the keypad keys shall be clearly marked. Change over between daylight time and standard time shall be made automatically at the appropriate times as defined by United States Law. Timing shall be synchronous with the power line. In the absence of power, a backup power source shall be used to maintain timing accuracy within  $\pm 3$  seconds per 24 hours.

20.2.4 Pedestal Pole. The pedestal pole shall meet the requirements listed below:

Aluminum Alloy	6063-T6
Tensile Strength, ksi	30
Yield Strength, ksi	25
Elongation	10%
Minimum Wall Thickness, Inches	0.237 min
Outside Diameter, inches	4.05
Total Height, feet	13

Threading and deburring of the pedestal pole shall be in accordance with the basic dimensions of the American National Standard Taper Pipe Threads, NPT(ANSI B2.1).

20.2.5 Flange Base. The threaded pedestal flange base shall be heavy-duty galvanized iron with a 7-1/4-inch bolt circle. Anchor bolts shall be provided with 2 nuts and 2 washers per bolt for double nut leveling of the pole.

20.2.6 Grounding. On all school flasher assemblies, the AC neutral wire shall be bonded to the equipment grounding conductor.

20.3 CONSTRUCTION METHODS. School flashers shall be located as shown on the Plans, however, the center of the flasher pole shall not be closer than 5 feet from the face of curb or edge of the roadway shoulder. The distance from the pole base to the top of the lower beacon shall be 7 feet. The distance from the pole base to the top of the upper flasher shall be 13 feet.

20.4 BASIS OF PAYMENT. School flashers shall be measured by the unit, complete in place, wired and connected to the power supply as shown on the Plans and in accordance with these Specifications. Accepted school flashers will be paid for at the contract unit price for:

SCHOOL FLASHERS EA

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

21.0 SIGNS

21.1 DESCRIPTION. This section covers the minimum requirements for furnishing and erecting signs complete in place in accordance with these Specifications and in reasonably close conformity with the dimensions and lines shown on the Plans or established by the Engineer. Included signs are sheet aluminum and extruded aluminum panels, all with a reflective or non-reflective sheeting background and with steel or aluminum sign bracket arms, bolts and fittings. All signs shall be fabricated and installed in conformance with the latest edition of the MUTCD.

21.2 MATERIALS. Materials used in the fabrication of signs shall meet the requirements of other relevant paragraphs of these specifications.

21.3 CONSTRUCTION METHODS. Sign blanks shall be thoroughly cleaned prior to application of sheeting material in accordance with the manufacturer's recommendations. Signs shall be installed such that the sign face is vertical and at a horizontal angle of approximately 87 degrees toward the direction of travel or as shown on the Plans. Signs shall be installed so that the bottom of the sign is 7 feet above the roadway surface. Signs shall be placed 5 feet behind curbed roadway sections or as shown on the Plans. Signs on roads with out curbs shall be placed 6 feet from the edge of pavement on residential streets and 8 to 15 feet from the edge of pavement on other streets or as shown on the Plans. Signs shall be installed so as to minimize specular reflection.

21.4 BASIS OF PAYMENT. Signs shall be measured by the square foot of area of the vertical front face with no deduction for rounding off sign corners. Accepted signs will be paid for at the contract unit price for:

SHEET ALUMINUM SIGNS	SF
EXTRUDED ALUMINUM PANEL SIGNS	SF
MAST ARM MOUNTED SIGNS	SF

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

22.0 ALUMINUM SIGN BLANKS

22.1 DESCRIPTION. This section covers the minimum requirements for aluminum sign blanks to be used for traffic control devices.

22.2 MATERIALS

22.2.1 All material furnished shall be guaranteed to be in accordance with the manufacturer's specifications and shall perform the function for which they were designed and manufactured. The Contractor shall obtain and assign to the City all manufacturer's warranties, guarantees, and/or exchange policies for defective items provided. All sign blanks shall be free of buckles, warps, dents, cockles, burrs, or other defects. All sign blanks shall be of stable flat sheet material, mill finished and furnished in domestic aluminum alloy 6061-T6, or 5052-H38, governed by ASTM



specification B209-61, or latest revision. Thickness, dimensions, hole sizes, and hole locations shall be shown on the Plans or specified during the submittal phase.

22.2.2 Metal Treatment. All blanks shall be thoroughly cleaned and etched by immersions in detergents, trichloroethylene or alkaline degreasers followed by phosphoric acid or alkaline etching. All metals shall be free of finger prints, grease, oils, or other contaminants.

## 23.0 REFLECTIVE SHEETING

23.1 DESCRIPTION. This section covers the minimum requirements for sheeting used in the fabrication of sign faces. Types of sheeting shall be as described below. Reflective sheeting shall meet the requirements of Federal Specification FP-92 or its latest revision and the requirements further noted in this Specification. All sheeting shall be type III unless otherwise specified on the Plans with the exception of sheeting used in construction traffic control. Sheeting used in construction traffic control shall be TYPE II-A.

23.2 MATERIALS. The reflective sheeting used in the fabrication of reflectorized sign faces shall be from the types listed in Federal Publication FP-85 and are described below:

- Type II - Type II is an enclosed lens type sheeting which consists of spherical lens elements embedded beneath the surface of a smooth, transparent, flexible plastic, resulting in a nonexposed lens, optical reflecting system.
- Type II-A - Type II-A is the same system as Type II with the exception of a higher quantity and quality of lens elements being employed.
- Type III - Type III is an encapsulated lens type sheeting which consists of spherical lens elements adhered to a synthetic resin and encapsulated by a flexible, transparent, water proof, plastic having a smooth surface.
- Type IV - Type IV is made of cubically shaped prismatic retroreflective elements integrally bonded to a transparent, flexible, smooth, tough, and weather resistant polymeric film.

## 24.0 GALVANIZED STEEL SIGN POSTS

24.1 DESCRIPTION. This section covers the minimum requirements for galvanized steel pipe sign posts. Sign posts shall be provided and constructed in accordance with these Specifications and in reasonably close conformity with the dimensions and locations shown on the plans or established by the Engineer.

24.2 MATERIALS. Sign posts shall be made from new galvanized steel pipe conforming to the size and dimensions shown on the Plans and shall meet the requirements of ASTM A53. All posts shall be standard weight schedule 40 steel pipe in 12 foot lengths unless otherwise designated. Galvanizing shall be done after fabrication and punching and drilling of holes unless approved by the Engineer. Holes made after galvanizing shall be regalvanized, metalized, or painted with an approved zinc dust-oxide paint. Sign posts shall be protected by a clear film, non-oil base chemical coating and shall provide conformity with ASTM Specifications D522, B117, and D1720.

24.3 CONSTRUCTION METHODS. In the event it is necessary to cut a post in the field, the cut end shall be placed in the concrete foundation. Any part of the sign posts from which the galvanized and/or clear film protective coating is knocked, chipped or scratched off exposing bare metal during transit, installation or alteration shall be regalvanized, metalized or painted with an approved zinc dust-oxide paint and clear film coated.

24.4 BASIS OF PAYMENT. Sign posts shall be measured by the linear foot for each size erected in place as shown on the Plans or as directed by the Engineer. Accepted sign posts will be paid for at the contract unit price for:

GALVANIZED STEEL SIGN POST                      LF

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals including concrete footings necessary to complete the work as specified.

## 25.0 SQUARE STEEL SIGN POSTS

25.1 DESCRIPTION. This section covers the minimum requirements for square steel sign posts. The sign posts shall be provided and constructed in accordance with these Specifications and in reasonably close conformity with the dimensions and locations shown on the Plans or established by the Engineer.

25.2 MATERIALS. Square steel sign posts shall be made from hot-rolled strip steel (structural quality) and shall conform to ASTM Specification A446, Grade A. The cross section of the post shall be square and formed into size required on the Plans. The finished posts shall be straight and have a smooth uniform finish. It shall be possible to telescope the post with each consecutive larger or smaller size of square tube, freely and for not less than ten feet of their length without the necessity of matching any particular face to any other face. All holes and ends shall be free from burrs and shall be cut square. Hole diameter shall be 7/16 inch plus or minus 1/64 inch on one (1) inch centers, running on all four sides for the entire length of the post. Holes shall be on the center line of each side in true alignment and opposite to each other. Holes shall be pre-punched or quick punched. All posts shall be weather-protected by galvanizing conforming to ASTM A525. Galvanizing shall be done after fabrication and punching of holes unless approved by the Engineer. Holes made after galvanizing shall be regalvanized, metalized, or painted with an approved zinc dust-oxide paint.

25.3 CONSTRUCTION METHODS. Any parts of the square steel sign posts from which the galvanizing is knocked, chipped, or scratched off exposing bare metal in transit, installation, or alteration shall be regalvanized, metalized or painted with an approved zinc dust-oxide paint. Place in ground according to commonsense and pertinent standard details.

25.4 BASIS OF PAYMENT. Square steel sign posts shall be measured by the linear foot for each size erected in place as shown on the Plans or as directed by the Engineer. Accepted sign posts will be paid for at the contract unit price for:

SQUARE STEEL SIGN POST                      LF

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

## 26.0 TRAFFIC STRIPE (PAINT)

26.1 DESCRIPTION. This section covers the material and application requirements for placing white and yellow painted traffic stripes containing glass beads.

26.2 MATERIALS. Painted traffic stripes shall be applied by the drop method and shall conform to these Specifications, The Uniform Manual on Traffic Control Devices for Streets and Highways, and be in reasonably close conformity with the locations, lines and dimensions shown on the Plans

or established by the Engineer. The white and yellow paint shall be formulated and manufactured from first-grade raw materials, and shall be free from defects and imperfections that might adversely affect the serviceability of the finished product. The paint shall be suitable for spray application and use as a reflecting traffic guide on concrete and bituminous roadway surfaces. Glass beads used to produce retroreflection shall conform to the relevant paragraphs of these specifications.

26.3 EQUIPMENT. The paint machine shall be capable of applying an even clean-cut line without excessive drifting of paint and without dripping or stringing fine lines of paint on end sections. The paint machine shall have the automatic cutoff controls for the bead dispenser and the paint dispenser synchronized.

26.4 CONSTRUCTION METHODS. The contractor shall be required to clean all dirt, grease, and other foreign materials off the road surface prior to application of traffic stripes to ensure maximum adhesion. The paint shall be applied to the pavement surface at a wet film thickness of approximately 0.015 inch. The glass beads shall be uniformly distributed over the wet paint at a reasonably accurate rate of not less than 6 pounds per gallon of paint, unless a different rate is specified by the Engineer. The glass beads shall be dispensed immediately upon the completed line by means of an automatic bead dispenser working in synchronization with the paint dispenser. The completed line shall be of a uniform cross section. The completed lines shall be of the dimensions and spacing as shown on the Plans or as specified by the Engineer. The paint traffic stripe shall not be applied when there is moisture on the pavement that would cause a poor bond between the paint and the pavement. Paint traffic stripe shall not be applied when the atmospheric temperature is at or below 45°F.

26.5 BASIS OF PAYMENT. Traffic stripe (paint) shall be measured by the linear foot of 4-inch wide traffic stripe placed or the equivalent 4-inch stripe necessary when a wider or narrower stripe is specified of the Plans or approved by the Engineer. Accepted traffic stripe (paint) will be paid for at the contract unit price for:

TRAFFIC STRIPE (PAINT)	LF
------------------------	----

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

## 27.0 TRAFFIC STRIPE (THERMOPLASTIC)

27.1 DESCRIPTION. This section covers the materials and application requirements for placing white and yellow reflectorized thermoplastic compound on roadway surfaces. Thermoplastic traffic stripe shall be applied by extrusion die method and shall conform to these Specifications, The Uniform Manual on Traffic Control Devices for Streets and Highways, and be in reasonably close conformity with the locations, lines, and dimensions shown on the Plans or established by the Engineer.

27.2 MATERIALS. The white and yellow thermoplastic traffic stripe shall be formulated and manufactured from first-grade raw materials, and shall be free from defects and imperfections that might adversely affect the serviceability of the finished product. The thermoplastic traffic stripe shall provide a durable, reflectorized, traffic guide on concrete and bituminous roadway surfaces. Glass beads used to produce retroreflection shall conform to SECTION 737 of these Specifications. The hot applied thermoplastic compound shall meet the requirements of AASHTO M249.

27.3 EQUIPMENT. The thermoplastic material shall be applied to the pavement surface by the extrusion die method where the pavement surface forms one side of the die. Extrusion of material above the pavement surface shall not be permitted. All parts of the application equipment which mix, convey, or shape the thermoplastic material shall maintain the material at the plastic temperature, and assure the continuous uniformity in the dimensions of the stripe providing clean and sharp dimensions. The equipment shall be capable of applying a uniform film thickness between 3/32-inch and 3/16-inch. The equipment shall apply the glass beads to the surface of the stripe at a rate of approximately 1 pound per 100 feet of 4-inch wide stripe. The beads shall be applied in such a manner that at least half the diameter of the larger gradations sizes are firmly embedded into the thermoplastic material.

27.4 CONSTRUCTION METHODS. The contractor shall be required to clean all dirt, grease, curing compound, or other foreign materials from the pavement surface prior to application of thermoplastic materials. On all asphalt surfaces in place over 6 months and all Portland cement concrete surfaces of any age, a liquid seal coat shall be applied to the area that is to be striped. The seal coat shall be compatible with the thermoplastic material used and the pavement surface to which it is applied. Thermoplastic shall not be applied over longitudinal joints unless approved by the Engineer. Thermoplastic material shall be applied by the extrusion die method at a temperature between 400 and 450°F measured at the pavement surface and in accordance with manufacturer's recommendations. The application shall only take place on clean, dry pavement having a minimum surface temperature of 55°F. The drying time shall be defined as the minimum elapsed time after application when the stripe shall have and retain the characteristics required and after which time normal traffic will leave no impression or imprint on the new stripe. The drying time shall be a maximum of 2 minutes at 50°F and 70% relative humidity when applied at a thickness of 3/16-inch. Thermoplastic material used in accordance with these Specifications shall be compounded and applied such that the good reflectance, adhesion, durability, impact resistance, weather resistance, and discoloration resistance is retained for the life of the stripe.

27.5 BASIS OF PAYMENT. Traffic stripe (thermoplastic) shall be measured by the linear foot of 4-inch wide traffic stripe placed or the equivalent 4-inch stripe necessary when a wider or narrower stripe is specified on the Plans or approved by the Engineer. Words, symbols, and arrows shall be measured by the unit. Accepted traffic stripe (thermoplastic) will be paid for at the contract unit price for:

TRAFFIC STRIPE (PLASTIC)(4-INCH WIDE)	LF
TRAFFIC STRIPE (PLASTIC)(ARROWS)(SINGLE)	EA
TRAFFIC STRIPE(PLASTIC)(ARROW)(DOUBLE)	EA
TRAFFIC STRIPE (PLASTIC)(WORDS)	EA
TRAFFIC STRIPE (PLASTIC) (SYMBOLS)	EA

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

## 28.0 TRAFFIC STRIPE (PLASTIC TAPE)

28.1 DESCRIPTION. This section covers the material and application requirements for placing white and yellow preformed plastic traffic striping tape. Preformed plastic traffic stripes shall conform to these Specifications, The Uniform Manual on Traffic Control Devices for Streets and Highways, and be in reasonably close conformity with the locations, lines and dimensions shown on the Plans or established by the Engineer.

28.2 MATERIALS. The preformed plastic pavement marking material shall consist of white or yellow films with pigments, selected and blended to conform to standard highway colors through the expected life of the film. Glass beads shall be incorporated to provide immediate and continuing retroreflection. The material shall also conform to the items listed below.

28.2.1 Material. General purpose high durability retroreflective pliant polymer film for preformed longitudinal, transverse and words/symbol markings subjected to high traffic volumes and severe wear conditions such as repeated shear action from crossover or encroachment on edge and channelization lines, and stop, start, or turn movements. The preformed plastic shall be capable of being adhered to asphalt concrete or Portland cement concrete by a precoated pressure sensitive adhesive providing an initial minimum skid resistance value of 45 BPN when tested according to ASTM E303.74. The film shall have a minimum tensile strength of 150 pounds per square inch of cross-section when tested according to ASTM D638-76. The film without adhesive shall have a minimum thickness of 60 mils.

28.2.2 Performance. The marking shall be capable of being adhered to asphalt concrete or Portland cement concrete by a precoated pressure sensitive adhesive. The preformed marking film shall mold itself to pavement contours by the action of traffic. The film shall have resealing characteristics such that it is capable of fusing with itself and previously applied marking material of the same composition. The material, when properly applied, shall provide a neat, durable marking that will not flow or distort due to temperature provided the pavement surface remains stable. The material shall provide a cushioned resilient substrate that reduces bead crushing and loss. The material shall be weather resistant and, through normal traffic wear, shall show no appreciable fading, lifting, or shrinkage throughout the life of the markings, and shall show no significant tearing, roll back, or other signs of poor adhesion. The white or yellow sheeting shall be precoated on the reverse side with a pressure sensitive adhesive and be protected by an easily removable plastic liner to facilitate processing. The sheeting is intended for hand positioning of irregular shaped markings such as pre-cut symbols, arrows, and legends, etc.

28.3 CONSTRUCTION METHODS. The contractor shall clean all dirt, grease, curing compound, or other foreign materials from the pavement surface prior to application of preformed plastic pavement marking materials. Preformed plastic pavement marking material shall be applied in accordance with the manufacturer's recommendations and procedures. Application shall be during weather conditions allowed by the manufacturer and not when the surface temperature of the roadway is below 50°F.

28.4 BASIS OF PAYMENT. Traffic stripe (plastic tape) shall be measured by the linear foot of 4-inch wide traffic stripe placed or the equivalent 4-inch stripe necessary when a wider or narrower stripe is specified on the Plans or approved by the Engineer. Words, symbols, and arrows shall be measured by the unit. Accepted traffic stripe (plastic tape) will be paid for at the contract unit price for:

TRAFFIC STRIPE (PLASTIC TAPE) (4 INCH WIDE)	LF
TRAFFIC STRIPE (PLASTIC TAPE) (ARROW)(SINGLE)	EA
TRAFFIC STRIPE (PLASTIC TAPE) (ARROWS)(DOUBLE)	EA
TRAFFIC STRIPE (PLASTIC TAPE) (WORDS)	EA
TRAFFIC STRIPE (PLASTIC TAPE) (SYMBOLS)	EA

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

## 29.0 GLASS BEADS USED IN TRAFFIC PAVEMENT MARKING MATERIAL

29.1 DESCRIPTION. This section covers transparent glass spheres (glass beads) applied to traffic paint, thermoplastic compound, and plastic pavement marking tape for the production of a reflective surface creating improved night visibility of the markings.

29.2 MATERIALS. Glass beads used in traffic paint and thermoplastic compound shall be transparent, clean, colorless glass, smooth and spherically shaped, free from milkiness, pits, or excessive air bubbles. The glass beads shall conform to the requirements of AASHTO M 274, Type I unless specified differently below. The glass beads shall have a minimum of 70% true spheres with a minimum refractive index of 1.50.

## 30.0 PAVEMENT MARKERS

30.1 REQUIREMENTS. Pavement markers shall meet the requirements of the Oklahoma Department of Transportation Standard Specifications for Highway Construction Sections 736 and 857, 1999 Edition or its latest revision. Pavement markers shall be installed in the locations shown on the Plans.

30.2 BASIS OF PAYMENT. Pavement markers shall be measured by the unit complete in place. Accepted pavement markers will be paid for at the contract unit price for:

PAVEMENT MARKERS, CLASS A TYPE 1	EA
PAVEMENT MARKERS, CLASS A TYPE 2	EA
PAVEMENT MARKERS, CLASS B (YELLOW)	EA
PAVEMENT MARKERS, CLASS B (WHITE)	EA
PAVEMENT MARKERS, CLASS C TYPE 1	EA
PAVEMENT MARKERS, CLASS C TYPE 2	EA

which shall be full compensation for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

31.0 TRAFFIC CONSTRUCTION STANDARD BID ITEMS. This section covers Standard Bid Items used in the contract documents for construction. Additional bid items may be called out in the Special Provisions, other sections of the Standard Specifications, or as directed by the Engineer for additional work covered and change orders.

SECTION	DESCRIPTION	UNIT
	VEHICLE ACTUATED TRAFFIC SIGNAL CONTROLLER	EA
	SOLID STATE DIGITAL INDUCTIVE LOOP VEHICLE DETECTOR	EA
	GALVANIZED STEEL CONDUIT	LF
	RIGID PLASTIC CONDUIT	LF
	FLEXIBLE PLASTIC CONDUIT	LF
	CABLE-IN-DUCT	LF
	CONDUCTOR TRAFFIC SIGNAL ELECTRICAL CABLE	LF
	2-CONDUCTOR SHIELDED LOOP DETECTOR LEAD-IN CABLE	LF
	LOOP DETECTOR WIRE	LF
	ELECTRICAL CONDUCTOR	LF
	SIGNAL AND CONTROL CABLE	LF
	TRAFFIC SIGNAL HEAD 1-HEAD	EA
	TRAFFIC SIGNAL HEAD 3-HEAD	EA
	TRAFFIC SIGNAL HEAD 5-HEAD	EA
	PEDESTRIAN SIGNAL HEAD	
	MODULAR PEDESTRIAN SIGNAL HEAD	
	PEDESTRIAN PUSH BUTTON AND SIGN	
	PEDESTRIAN PUSH BUTTON STATION	
	POLE AND SPECIFIED NO. OF MAST ARM(S)	
	POLE AND SPECIFIED NO. OF MAST ARM (S) AND LUMINAIRE ARM	
	PEDESTAL POLE WITH SPECIFIED MOUNTING HEIGHT	
	STRUCTURAL CONCRETE	
	REINFORCING STEEL	
	PULL BOX TYPE I	
	PULL BOX TYPE II	
	ROADWAY LUMINAIRE (250 WATT HPS)	
	SCHOOL FLASHERS	
	SHEET ALUMINUM SIGNS	
	EXTRUDED ALUMINUM PANEL SIGNS	
	MAST ARM MOUNTED SIGNS	
	GALVANIZED STEEL SIGN POST	
	SQUARE STEEL SIGN POST	
	TRAFFIC STRIPE (PAINT)	
	TRAFFIC STRIPE (PLASTIC) (4 INCH WIDE)	
	TRAFFIC STRIPE (PLASTIC TAPE) (4 INCH WIDE)	
	TRAFFIC STRIPE (PLASTIC TAPE) (ARROW)(SINGLE)	
	TRAFFIC STRIPE (PLASTIC TAPE) (ARROWS)(DOUBLE)	
	TRAFFIC STRIPE (PLASTIC TAPE) (WORDS)	
	TRAFFIC STRIPE (PLASTIC TAPE) (SYMBOLS)	

	PAVEMENT MARKERS, CLASS A TYPE 1	
	PAVEMENT MARKERS, CLASS A TYPE 2	
	PAVEMENT MARKERS, CLASS B (YELLOW)	
	PAVEMENT MARKERS, CLASS B (WHITE)	
	PAVEMENT MARKERS, CLASS C TYPE 1	