

## SECTION 427

### SIGNAL ASSEMBLIES

427.1 GENERAL: This work shall consist of furnishing and installing traffic and pedestrian signal assemblies on signal poles and attaching back plates and directional louvers to traffic signals in compliance with the specifications, details shown on the plans, and Standard Drawings at the locations shown on the plans, or as established by the ENGINEER.

#### 427.2 REFERENCES.

427.2.1 American National Standards Institute (ANSI) Standards, Latest Edition

427.2.2 American Society for Testing and Materials (ASTM) Standard Specifications, Latest Edition

B209 Aluminum and Aluminum-Alloy Sheet & Plate

427.2.3 Institute of Transportation Engineers (ITE) Publications, Latest Edition

Adjustable Face Vehicular Traffic Control Signal Heads

427.2.4 Manual on Uniform Traffic Control Devices (MUTCD), Latest Edition

427.2.5 National Electrical Code (NEC), Latest Edition

427.2.6 National Electrical Manufacturers Association (NEMA) Standards, Latest Edition

427.2.7 This Publication, Latest Edition

#### 427.3 MATERIALS.

##### 427.3.1 TRAFFIC SIGNAL ASSEMBLY

###### 427.3.1.1 GENERAL

427.3.1.1.1 The number of signal faces (sections) in each traffic signal assembly will be shown on the plans. Signal faces shall be standard 12-inch lens size.

427.3.1.1.2 Signal assemblies shall meet the requirements of the latest edition of ITE Publication "Adjustable Face Vehicular Traffic Control Signal Heads," in addition to the requirements contained herein.

427.3.1.1.3 Signal assemblies shall be the adjustable, colored flat black, vertical or horizontal type

with the number, color and type of lights (faces) shown on the plans and shall be adjustable through 360 degrees about the axis. Signal assemblies shall be mounted at the location and in the manner shown on the plans.

427.3.1.1.4 Signal assemblies shall be fabricated from polycarbonate resin material. The housing and door shall be fabricated from the same material. Polycarbonate resin material shall be flame resistant, ultra-violet stabilized, and shall withstand minimum of 70 foot-pounds of impact without fracture or permanent deformation.

427.3.1.1.5 All signal assemblies shall be designed so that back plates may be mounted.

###### 427.3.1.2 OPTICAL UNITS

427.3.1.2.1 An optical unit shall consist of a lens, a reflector, and a lamp holder with lamp. The optical units shall conform to ITE Standards and ANSI Standards.

427.3.1.2.2 Lenses shall be of the color shown on the plans, circular, with a visible diameter of 12 inches. The design shall produce outward and downward light distribution, with a minimum of light distributed above the horizontal. Lenses shall be true color, and constructed of polycarbonate resin material, free from imperfections, and of high illumination transmission. The lens shall be capable of withstanding the heat associated with continuous illumination of 150 watt traffic signal lamp.

427.3.1.2.3 A reflector shall be one-piece alzak aluminum. An opening shall be provided in the back of each reflector for the lamp holder. This opening shall be designed so that there will be no dark spots cast on the lens.

427.3.1.2.4 Reflectors, lenses, and hoods shall be designed to reduce sun phantom to a minimum.

427.3.1.2.5 Lamp holders shall have a heat-resistant molded phenolic housing and be designed to accommodate a 150-watt standard A-21 traffic signal lamp. The holder shall be capable of positioning the lamp at the exact focal point of the reflector. The lamp holder shall provide proper lamp filament orientation without affecting lamp focus.

###### 427.3.1.3 HOUSING

427.3.1.3.1 A signal housing shall consist of an assembly of separate sections without tie rods, substantially secured together in a watertight manner to form the number of units required and provide an acceptable appearance. Each section shall house an individual optical unit.

427.3.1.3.2 The housing of each section shall be a one-piece, polycarbonate resin material with sides, top, and bottom integrally molded. Polycarbonate housing shall be a minimum of 0.090 inch thick and ribbed to produce the strongest possible assembly consistent with light weight, and must pass ITE wind load testing.

427.3.1.3.3 Each section shall include a one-piece hinged door, with mounting for the lens, and other parts of the optical system, watertight gaskets, and a simple non-corrosive door locking device. The optical system shall be mounted so that the various parts may be readily accessible or removable. Sections shall be interchangeable and constructed so that they can be removed or added. A round opening shall be provided in the top and bottom of each head to receive a 1½-inch supporting pipe frame.

427.3.1.3.4 Each door shall be hinged and held securely to the body of the housing by two stainless steel hinge pins, eye bolt, washer and wing nut. Exposed screws and fasteners shall be non-corrosive. Interior screws and fasteners shall be fabricated from corrosion-resistant nonferrous materials.

427.3.1.3.5 A locking boss with 72 teeth shall be integrally cast or molded into the signal housing at both openings. The angle of the teeth shall be 90 degrees, and the depth of the teeth shall be 3/64 inch. The locking boss, when used with other locking fittings of the same mesh or with or without use of an adaptor, shall provide positive positioning of the entire signal head to eliminate rotation or misalignment.

427.3.1.3.6 The reflector and lamp holder shall be held in place by an aluminum reflector ring, pivoting so that it is independent of the door. The unit shall be designed so that the lamp may be replaced without the use of tools.

427.3.1.3.7 Weather-resistant neoprene gasketing shall be provided so that the inside of the lens and reflector are sealed from dust and moisture.

427.3.1.3.8 A terminal block shall be mounted in the back of the middle section of the signal assembly. The terminal block for all signal assemblies shall be a 4-position, 8-terminal, barrier-type strip at a minimum. The signal section leads shall be attached to the left of each terminal block. The opposite terminals shall be for the field wires.

427.3.1.3.9 Wiring from each lamp holder shall be provided by two-coded leads with NEMA quick disconnect tabs. A white wire shall be connected to the shell of the lamp holder. A black or colored wire shall be connected to the bottom or end terminal of the lamp holder. For identification, color coded leads shall be colored the appropriate red, yellow, or green, (yellow or green tracer for arrow indications), or, if black wires are used, the terminals to which the leads are attached shall be permanently marked as to the indication. Leads shall be No. 18 AWG size, Type TFF.

427.3.1.4 VISORS: A 12-inch nominal long tunnel visor shall be provided for each signal section. Visors shall be fabricated from polycarbonate resin material. Tunnel visors shall encircle the lens for 300 degrees with a four (4) inch open slot on the bottom. The visor shall have four (4) twist-on attaching ears for installation to the signal door by four (4) non-corrosive screws. The vertical outer face of the door shall have four threaded holes equally spaced about the circumference of the lens opening and 45 degrees from the horizontal or vertical axes so as to permit a vertical or horizontal installation of the signal assembly.

#### 427.3.1.5 FRAMEWORK OR MOUNTING BRACKETS

427.3.1.5.1 Mounting brackets shall consist of assemblies of 1½-inch nominal size standard steel pipe and malleable iron, ductile iron, or brass pipe fittings. Securely assembled members shall provide plumb or level support.

427.3.1.5.2 Conductors shall be concealed within framework, poles, and signal assemblies. Conductors entering assemblies from poles shall be supported and protected by cable guides. Threads shall be coated with grease during field assembly.

427.3.1.6 FINISH: The finish color for all signal assembly components shall be flat black. The flat black color shall be completely impregnated in the resin material, and scratches shall not expose uncolored material.

#### 427.3.2 OPTICALLY PROGRAMMED SIGNAL ASSEMBLY

427.3.2.1 Optically programmed traffic signal assemblies will be used instead of standard traffic signal assemblies at locations shown on the plans where it is necessary to limit the visibility zone of the indication. Optically programmed assemblies shall have the same general appearance and shall be mounted in the same manner as the standard assemblies shown on the plans and specified in this Section 427 except that lens faces shall appear square

when not illuminated. The object lens shall provide a round signal indication when illuminated. Sufficient optical masking tape shall be supplied with each assembly to allow proper aiming of each section. Aiming of signal sections shall be done under the Traffic Engineer's supervision.

427.3.2.2 Optically programmed signal assemblies shall conform to the requirements for traffic signal assemblies, except as follows:

427.3.2.2.1 Optically programmed assemblies shall permit the visibility zone of the indication to be determined optically and shall require no hoods or louvers. The projected signal may be visible or selectively veiled anywhere within 15 degrees of the optical axis. No indication shall result from external illumination nor shall one indication illuminate a second indication.

427.3.2.2.2 The components of the optical system shall consist of a lamp, a circulet reflector, an optical limiter-diffuser, and an objective lens. The lamp shall be mated to the diffusing element by a circulet reflector with a specular inner surface. The optical limiter-diffuser shall be composed of heat resistant glass. The limiter-diffuser shall provide an imaging surface, at focus on the optical axis for objects 900 feet to 1200 feet distance, and shall permit an effective veiling system to be variously applied as determined by the desired visibility zone. The limiter-diffuser shall have a positive means of indexing.

427.3.2.2.3 The objective lens shall be a high resolution planar incremental lens hermetically sealed with a flat laminate of weather resistant acrylic.

427.3.2.2.4 Visors shall be 9½ inch-long cutaway type, finished in flat black.

427.3.2.2.5 The lens shall be symmetrical in outline and shall be capable of being rotated to any 0-degree orientation about the optical axis.

427.3.2.2.6 Exteriors of the signal case, lamp housing, and mounting flanges shall be finished in accordance to this Section 427.

427.3.2.2.7 Lamp fixtures shall consist of a separately accessible housing and integral lamp support, a ceramic socket, and self-aligning, quick-release lamp retainer. The electrical connection between case and lamp holder shall be an interlock assembly which disconnects the lamp holder when open. Coded No. 16 AWG size lead wires of a length sufficient to permit solderless connection to line wires external to the signal shall be used.

427.3.2.2.8 The assembly shall mount to standard

1½-inch fittings as a signal section or a multiple section face or in combination with other signals. A rigid connection shall be provided that will permit the signal section to tilt from at least 9 degrees above to 9 degrees below the horizontal while maintaining a common vertical line through couplers and conduit. The assembly shall be mountable with ordinary tools and shall be serviceable without tools.

### 427.3.3 PEDESTRIAN SIGNAL

427.3.3.1 GENERAL: Pedestrian signals shall be one-way signals in weatherproof vandal resistant and dust-tight housing, designed to display the alternating symbol messages "HAND" in Portland Orange or "WALKING PERSON" in Lunar White. The assemblies shall be neon.

#### 427.3.3.2 PEDESTRIAN SIGNAL - NEON

##### 427.3.3.2.1 GENERAL

427.3.3.2.1.1 The signal shall be a one section signal assembly with symbols "HAND" and "WALKING PERSON," capable of displaying the alternate messages and conforming to the details in the plans and to the MUTCD.

427.3.3.2.1.2 The signal shall be internally illuminated. The message shall be formed by painting (blankout) the message plate except for the area occupied by the 11-inch high and 6-inch minimum wide symbols.

427.3.3.2.1.3 The messages shall blank out when not energized.

##### 427.3.3.2.2 HOUSING

427.3.3.2.2.1 The housing shall be a one-piece corrosion-resistant aluminum alloy casting with integrally cast top, bottom, sides, and back. An opening shall be provided in the top and bottom of the housing to accommodate standard 1 ½-inch pipe brackets. A shurlock boss shall be integrally cast into the housing at the bottom opening. Four integrally cast hinge lug pairs, top and bottom, shall be provided for the door mounting.

427.3.3.2.2.2 The housing door shall be a one-piece corrosion-resistant aluminum alloy casting with integrally cast hinges. The door shall be attached to the housing by stainless steel spring pins. The door shall pivot or swing downward when opened. A gasket shall be provided between the door and the housing. Latching shall be by two noncorrosive hinged bolts with captive wing nuts and washers.

427.3.3.2.2.3 The complete housing (assembly) shall be 18 to 19 inches wide, 18 to 19 inches high and 9 to 10 inches deep with the visor.

#### 427.3.3.2.3 MESSAGE MODULE

427.3.3.2.3.1 A message module shall consist of neon tubes, a molded, white, acrylonitrile butadiene styrene or polycarbonate plastic tubing housing, and a screened message lens. The message lens shall be an integral assembly with the tubing housing, fitted with a neoprene gasket around its perimeter.

427.3.3.2.3.2 Two compartments shall be formed in the front of the module, enclosing and protecting the two neon tube light sources. The material may be white or the inside of the tubing compartments shall be painted with white acrylic paint to provide a protective background.

427.3.3.2.3.3 The tubing for the "HAND" symbol shall be a minimum of 10 mm diameter and shall be coated on the inside with fluorescent material producing the desired Portland Orange output. Tubing for the "WALKING PERSON" symbol shall be a minimum of 9 mm and coated on the inside for the desired Lunar White output.

427.3.3.2.3.4 The tubing housing shall hold neon tubing in a positive location relative to the message plate so that a clearly readable message is provided. The tubing housing shall require no tools for removal or replacement.

427.3.3.2.3.5 The tubing housing shall be provided with electrical contacts which will plug directly into recessed contacts or connect to flexible high tension leads by snap-on connectors. To reduce corona effects, flexible leads shall be of the minimum length necessary to allow the door to swing open.

#### 427.3.3.2.4 MESSAGE LENS

427.3.3.2.4.1 The message lens shall be one of the following:

427.3.3.2.4.1.1 Ultraviolet stabilized polycarbonate plastic with external prismatic pattern, 1/8-inch minimum thickness.

427.3.3.2.4.1.2 Ultraviolet stabilized acrylic plastic with prismatic pattern, 3/16-inch minimum thickness.

427.3.3.2.4.2 For both types, the first coating of blankout paint shall be black and the second coating shall be white to reflect internal light.

#### 427.3.3.2.5 TRANSFORMERS

427.3.3.2.5.1 Solid state circuitry shall be

assembled on one or two printed circuit boards, energizing two high voltage flyback transformers for the respective neon tubes. The transformers and circuitry shall be in an enclosure behind the tube compartments providing protection from water penetration and physical damage.

427.3.3.2.5.2 The "Hand" and "Walking Person" circuits shall require approximately 30 watts with a voltage range of 105 to 130 V.A.C. Each circuit shall be internally fused. Quick disconnect lugs shall be provided inside the housing for easy removal. A three-terminal pair (6-position) screw type terminal block shall be provided for termination of field wires.

#### 427.3.3.2.6 SCREENS

427.3.3.2.6.1 One of the following types of screens (visor) shall be provided for each signal:

427.3.3.2.6.1.1 Z crate type screen shall consist of a minimum of 20 straight horizontal louvers and 21 horizontal louvers formed in a zig zag pattern. Every other formed louver shall be reversed so as to form cells 1 inch square, rotated 45 degrees from the horizontal (diamond shaped cells). Each diamond shall then be bisected by insertion of a straight louver interspersed between each pair of formed zig zag louvers. Where each apex of each formed louver contacts a straight louver, the entire length of the joint shall be chemically welded.

427.3.3.2.6.1.2 The material shall be nominally 0.030 inch thick, black polycarbonate plastic with a flat finish on both sides. The screen shall be enclosed in a 0.040 inch minimum thickness aluminum or polycarbonate plastic frame. The frame shall be 1½ inches deep and contain mounting holes for insertion in the door frame.

427.3.3.2.6.1.2.1 Eggcrate type screen, 1½ inch deep, of 0.020 inch minimum thickness aluminum of 3003 H14 alloy conforming to the requirements of ASTM B 209 or polycarbonate of 0.036-inch nominal thickness. The assembly shall be mounted on an aluminum alloy or polycarbonate frame of 0.040-inch minimum thickness.

427.3.3.2.6.1.2.2 The spacing between horizontal members shall be ½ inch (beginning near the top of the symbol) and supported by a minimum of 15 vertical members.

427.3.3.2.7 FINISH: The inside and outside surfaces of the housing, doors, and visor screens shall be finished in a factory applied, environmentally safe, electrostatically applied, ultra violet resistant powder coating of the color flat black, which will then be oven-cured. Pretreatment of all exposed metal parts

excluding stainless steel attachment hardware shall utilize current industry standards of multi-stage pretreatment.

427.3.3.2.8 All exposed screws and fasteners shall be of ANSI Type 304 stainless steel. Interior screws shall be made of noncorrosive materials or be cadmium plated.

427.3.4 BACKPLATES: Backplates shall be provided for signal faces with vehicular signal indications when shown on the plans. Backplates shall be one (1) piece polycarbonate and shall be of a size to provide a 5-inch border around the perimeter of the signal. Backplates shall be finished in accordance with the requirements of this Section 427.

427.3.5 DIRECTIONAL LOUVERS: Directional louvers shall be installed in signal visors at locations shown on the plans. Louvers shall be sheet aluminum and shall be made to fit snugly in the signal visors. Louvers shall be 11 3/8 inches in diameter and 8 1/2 inches long and shall have a degree of cutoff from either side of the center axis of the light beam of 10 1/2 degrees. Louvers shall be finished in accordance with the requirements of this Section 427.

#### 427.3.6 TRAFFIC SIGNAL LAMPS

427.3.6.1 All incandescent lamps for signal assemblies shall be clear, ANSI designation A21, horizontal with medium base, 8000-hour rated life traffic signal lamps. All 12-inch signal assemblies shall be furnished 150-watt, 1770 average minimum initial lumens lamps.

427.3.6.2 Each lamp socket and lamp furnished shall be designed to position the lamp filament accurately within the reflector. (Light center length: 150-watt--3 inches.)

#### 427.4 CONSTRUCTION METHODS.

427.4.1 Vehicular signal assembly faces shall be covered after installation until the controller and intersection signals are placed into operation. The covering shall be such so as not to permit any misunderstanding by the general public that the signal may be in operation.

427.4.2 Signal faces shall be plumb and adjusted to proper direction. Faces and frameworks shall be plumb and level, symmetrically arranged, and secure after alignment. Mounting shall conform to details in the plans.

427.4.3 Overhead mast arm mounted traffic signal assemblies will normally be mounted horizontally. When the plans call for an overhead signal assembly to

be mounted vertically to a mast arm or span wire, the mounting bracket shall be as detailed in the plans.

427.4.4 Backplates and directional louvers shall be installed on signal assemblies according to the recommendation of the manufacturer.

#### 427.5 MEASUREMENT AND PAYMENT.

427.5.1 Traffic signal assemblies, optically programmed traffic signal assemblies, backplates, and directional louvers will be measured by the unit complete in place.

427.5.2 The accepted quantities of traffic signal assemblies, optically programmed traffic signal assemblies, backplates, and directional louvers will be paid for at the contract unit price per unit of measurement for each of the pay items listed as shown on the bid proposal.