

FURNISH LIGHT EMITTING DIODE (LED) ELECTRONIC SIGN:

After receiving the Engineer's approval of catalog cuts, the contractor shall procure signs conforming to the technical specifications contained in the Appendix. The following LED signs are used in the District of Columbia.

- 18" x 24" ONE WAY RIGHT ARROW
- 18" x 24" ONE WAY LEFT ARROW
- 30" x 30" NO LEFT TURN
- 30" X 30" DO NOT ENTER
- 30" X 30" WRONG WAY

The contractor shall be responsible for the safekeeping and storage of each sign at the Contractor's facility following receipt of the materials from the vendor. Payment to the contractor by the city may be authorized only after the sign has been delivered to and remains within the District of Columbia.

MEASURE AND PAYMENT: Each individual sign will be measured and paid at the Contract unit price.

INSTALL LIGHT EMITTING DIODE (LED) ELECTRONIC SIGN ON ANY POLE:

After receiving the Engineer's approval of catalog cuts, the contractor shall procure Light Emitting Diode (LED) Electronic signs conforming to the technical specifications contained in the Appendix, and upper and lower mounting brackets and hardware, as described herein. The work described herein is closely associated with that described in Special Provision No. 52 FURNISH AND INSTALL ELECTRICAL CABLE FOR TRAFFIC SIGNALS. The work is to be performed as follows:

- The contractor shall procure materials described above.
- The contractor shall drill a hole in the pole at the point where the upper sign mounting bracket is to be installed. The hole shall be approximately one inch in diameter, and edges shall be machined to remove burrs, which may snag cable.
- The contractors shall prepare the sign for attachment to the pole prior to arriving in the field at the intersection. Tunnel visors may be attached at this time or after the sign is erected.
- Pole mounted signs shall be outfitted with upper and lower mounting brackets. This assembly shall feature serrated locking washers at the sign to prevent misalignment. This assembly shall be attached to the sign and to the pole such that a watertight barrier results. This shall be accomplished through the use of washers and/or sealing compound at the pole. The assembly shall consist of 1 ½ inch diameter steel tubes (nipples) threaded to fit into the pole plate and into the 90 degree ell leading to the sign. The other end of the assembly shall be affixed to a universal pole plate into which the 1 ½ inch diameter steel nipple can be screwed. The universal pole plate may be constructed from cast aluminum and shall be structured to accept 1 inch wide stainless steel banding strapping above and below the nipple where the plate sits next to the pole. The 1 ½ inch steel nipple shall be of sufficient length and configuration to match the hardware arrangement of the sign being replaced and to situate the sign equidistant from the pole as the sign being replaced.
- The field cable protruding through the hole in the pole is to be carefully routed through the mounting hardware into the sign and connected routed through the mounting hardware into the sign and connected to the proper terminals in the terminal block of the sign. The contractor shall make the proper electrical connections of the field cable to the terminal block and ascertain that the connections are secure and consistent with the

approved traffic signal sequence of operation. The field cable shall be fitted with terminal lugs for attachment to the terminal block.

- The contractor shall mount the signs to the pole after carefully aligning the universal pole plate to the pole without damaging or crimping field cable. Each new sign will be mounted so that the bottom of the sign is at a height about grade equal to the sign being replaced. The universal pole plate shall be affixed to the pole utilizing 1 inch wide stainless steel banding trapping to points on each pole plate, one above and one below where the nipple screws into the pole plate. The mounting shall be accomplished with banding tools specifically intended for securing banding strapping and with standard tools.
- The contractors shall ensure a secure fit of the assembly and confirm that the sign operates in compliance with the approved traffic signal sequence of operation.

MEASURE AND PAYMENT: Each individual Light Emitting Diode Electronic Sign installed will be paid at the contract unit price. The price will include the upper and lower mounting brackets, universal pole plate, all miscellaneous hardware including terminal lugs, tunnel visors, stainless steel banding materials, and all labor, equipment and materials.

**TECHNICAL SPECIFICATION
LIGHT EMITTING DIODE (LED) ELECTRONIC SIGN**

1. PURPOSE

The purpose of this specification is to describe the minimum acceptable design and operating requirements for Light Emitting Diode (LED) Electronic Signs to display the specified messages, as required in contract documents and plans by the District of Columbia.

2. GENERAL REQUIREMENTS

- 2.1 All sign messages shall meet the standards contained in the most current edition of the Manual on Uniform Traffic Control Devices, and Standard Highway Signs, unless otherwise indicated.
- 2.2 All sign messages shall be at least standard size, as described in the Standard Highway Signs.
- 2.3 Signs shall have message display capabilities on both sides of the sign.
- 2.4 Signs shall be capable of displaying one or multiple messages on each side of the sign.
- 2.5 Sign messages shall be formed by rows of Light Emitting Diodes (LED's).
- 2.6 ~~Sign messages shall be clear and legible under any ambient lighting condition.~~ When not illuminated, the sign message shall not be visible regardless of outside ambient lighting conditions.
- 2.7 Signs shall be provided in three (3) sizes; 18"x24", 30"x30", and 36"x36"
 - 2.7.1 18"x24" Signs shall be clear and legible at distances up to 200 feet.
 - 2.7.2 30"x30" and 36"x36" signs shall be clear and legible at distances up to 500 feet.
 - 2.7.3 All sign messages shall be displayed at full intensity within a 15 degree cone of vision centered about the optical axis.
 - 2.7.4 Signs shall be no more than 8 inches deep, excluding the visor.
- 2.8 The sign assembly shall be designed to ensure that all internal components are adequately supported to withstand mechanical shock and vibration from wind ratings meeting AASHTO's requirements for a sustained 80 MPH wind with a 30% gust factor.
- 2.9 Unless otherwise specified, only red and lunar white LED shall be used to portray messages. Red shall be used for symbols consistent with MUTCD color requirements. Lunar white shall be used to form all letters, one way arrows, and the left turn arrow in the symbolic NO LEFT TURN sign.
- 2.10 Each sign delivered to the District of Columbia must include a full complement of six (6) drive modules in the driver rack. Drive modules not used for the sign application shall be retained by the District of Columbia for maintenance.
- 2.11 Each sign delivered to the District of Columbia must include two (2) visors; one to be mounted on the sign during field installation, and another to be used for future maintenance.

3. **SIGN HOUSING CONSTRUCTION**

- 3.1 The sign housing shall be fabricated from extruded aluminum with a minimum thickness of 0.125 inches.
- 3.2 Signs featuring messages on one side of the sign only shall feature a flat aluminum panel welded onto the back of the housing.
- 3.2 All housing corners and seams are to be heli-arc welded to provide and ensure a weatherproof seal around the entire housing.
- 3.3 The housing shall meet the requirements of NEMA Type 4 enclosures.
- 3.4 The housing shall be reinforced, as necessary, at proper locations to provide structural integrity.
- 3.5 Each sign housing shall feature four (4) screened drain holes at the bottom of the housing. Each drain hole is to be a minimum 3/16 inch diameter.
- 3.6 Each sign housing shall feature an extruded aluminum door with a minimum thickness of 0.125 inches.
 - 3.6.1 Each door shall be appropriately welded and reinforced for structural integrity and to prevent excessive door flexure when open.
 - 3.6.2 Each door shall feature a drip edge around the mating flange.
 - 3.6.3 The extruded aluminum sign door shall be hinged on the left side using a continuous, full length stainless steel hinge.
 - 3.6.4 Each door shall be locked on the right side of the sign using a minimum of two (2) Number 3 stainless steel ¼ turn link-locks to provide tool free access to the interior of the sign.
 - 3.6.5 Door gaskets shall be 3/16"x1" neoprene to provide a continuous weatherproof seal between the door and the housing.
 - 3.6.6 One side of the door shall be removable to gain access to the sign face.
 - 3.6.7 A retaining rod shall be provided to hold the front door in the open position.
- 3.7 Each sign housing shall feature mounting hubs on the top and the bottom of the sign for cable access and to facilitate mounting and affixing to poles.
 - 3.7.1 Mounting hubs shall be cast aluminum alloy with 1 ½" standard pipe threads.
 - 3.7.2 Hubs are to be mounted on a gasket to the sign housing by three 5/16"x1" stainless steel hex head bolts and nuts.
 - 3.7.3 Gaskets shall be serrated and shall lock into the housing to prevent sign misalignment.
 - 3.7.4 The connection between the sign housing and the mounting hubs shall be waterproof.
 - 3.7.5 The holes in the sign housing at the mounting hubs shall be 1 ½ inches in diameter and machined to eliminate burrs which may snag electrical cables.
- 3.8 The entire housing assembly shall feature a visor extending over the top and both sides of the sign.

- 3.8.1 ~~Each visor shall be 0.063 thick aluminum.~~
- 3.8.2 Each visor shall be 6" in Length and shall extend off the housing door.
- 3.8.3 Each visor shall be affixed to the sign housing using stainless steel screws.
- 3.9 The face lens shall fit into the door. The entire sign face shall be protected by a ¼ inch clear polycarbonate lens in the door frame.
- 3.9.1 The lens shall be non glare matte-finish polycarbonate with a UV resistant surface treatment and light transmission properties of at least 82%.
- 3.9.2 The lens shall minimize any unwanted reflections.
- 3.9.3 The entire display face, which includes the face lens and the LED Message Display Board, shall be assembled as a one-price self contained module that can easily be removed from the sign housing without the need of any tools.
- 3.10 The entire sign housing assembly shall be acid etched and painted with two (2) coats of zinc-chromate primer.
- 3.10.1 The interior of the sign housing and the inside of the visor shall be painted with 2 coats of high quality flat black enamel.
- 3.10.2 ~~The exterior of the sign housing, the sign door frame and the~~ outside of the visor is to be painted with 2 coated of high quality enamel colored battleship gray (MVC 1417, GE LEXAN No. 7040Z, Federal Color No. 16099). In certain specified applications, Federal Black Color No. 27038, may be substituted for battleship gray.
- 3.11 Two air vents shall be installed on the sides of the housing; one at the lower left hand side and one at the upper right hand side of the sign. Vents shall be designed to prevent moisture or rainfall from penetrating the housing and both shall have replaceable air filters to keep the enclosure dust free.
- 3.12 The sign construction shall be a modular concept consisting of hand removable, self-contained modules, message display, rack mounted individual message drivers, the driver rack assembly, and the housing shell.
- 3.13 All mechanical fasteners and hardware shall be corrosion resistant stainless steel.

4. ENVIRONMENTAL REQUIREMENTS

- 4.1 The sign shall be rated for use in ambient operating temperatures in the range of ~~-40°C (-40°F) to +74°C (+165°F).~~
- 4.2 The LED display module shall be completely sealed against dust and moisture intrusion in conformance with NEMA Moisture Resistant Standard 250-1991, Sections 4.7.2.1 and 4.7.3.2 for Type 4 enclosures to protect all internal components.

5. CHROMATICITY

- 5.1 The measured chromaticity coordinates for red, yellow, green, lunar white and portland orange shall conform to the chromaticity requirements of Section 8.04 and Figure 1 of the VTCSH Standard.
- 5.2 Chromaticity requirements shall remain unchanged over the input line voltage of 95 VAC to 135 VAC.
- 5.3 The measured chromaticity coordinates of LED's shall conform to the following chromaticity requirements:
 - RED: Y: not greater than 0.308 or less than 0.998-x.
 - YELLOW: Y: not less than 0.411, not less than 0.995-x, not less than 0.452.
 - GREEN: Y: not less than 0.506-0.519 x, nor less than 0.150+1.068x, not more than 0.730-x.
 - PORTLAND ORANGE:
 - Y: not greater than 0.390, not less than 0.331, nor less than 0.997-x.
 - LUNAR WHITE:
 - X: not less than 0.290 nor greater than 0.330.
 - Y: not less than 1.5x-0.175, or greater than 1.5x-0.130.

6. LED MESSAGE DISPLAY BOARD

- 6.1 The message display shall consist of LED's mounted on a PCB matrix with a mat black solder mask.
- 6.2 The universal PCB matrix shall have the capabilities to display sign messages conforming to MUTCD requirements. LED's shall be arrayed on the mat to depict the required message.
- 6.3 The LED's shall be arranged in a manner to form an outline of the symbols and shall be distributed evenly along the message outline.
- 6.4 The maximum distance between consecutive LED's shall be .550 inches and shall not vary more than 10%.
- 6.5 The PCB matrix shall have a minimum thickness of .093 inches;
- 6.6 The PCB shall have a component identifier silk screen.
- 6.7 The red LED's shall be of the latest AlIn GaP Technology, the lunar white LED's shall be of the latest In GaN Technology.
- 6.8 The minimum nominal luminous intensity of the LED's shall be 6,000 mcd at 20mA.
- 6.10 The individual LED light sources shall be interconnected so that a catastrophic failure of a single LED will result in a total loss of not more than 5% of the signal light output.
- 6.11 There shall be no electronic components visible on the front of the display. The display face shall consist solely of LED's mounted on a mat black PCB.
- 6.12 The rear side of the PCB shall be protected by a molded polymeric back cover to seal and protect it from any possible damages.
- 6.13 The display PCB with back cover shall fit into front door which consist of an aluminum frame and face lens.

- 6.14 The display module shall have a multi conductor cable with an individual 2 pin connector for each message.

7. **DRIVE CIRCUITRY**

- 7.1 The sign shall feature one individual LED drive module for each message. A drive module shall be provided for each individual symbol, for each message line and for each overlapped message on any given line.
- 7.2 The drive modules shall be designed to be "rack mounted" as per standard industry dimensions of 6.5"x4.5".
- 7.3 The drive modules shall consist of a PCB (0.62" thick) with an aluminum front plate and handle as commonly used for inductive loop detectors.
- 7.4 The drive modules shall drive the LED's at a DC current not exceeding the maximum rating recommended by the LED manufacturer (20mA).
- 7.5 The drive modules shall regulate the LED drive current to compensate for line voltage fluctuations over the range of 95VAC to 135 VAC. The luminous output of the display shall not vary more than 10% over the voltage range and shall not be perceptible to the human eye.
- 7.6 The drive modules shall be fused and include voltage surge protection to ~~withstand high-repetition noise transients and low-repetition high-energy transients~~ as stated in section 2.1.6, NEMA Standard TS-2, 1992.
- 7.7 The on-board circuitry shall meet FCC title 47, sub-part B, section 15 regulations concerning the emission of electronic noise.
- 7.8 The circuitry shall ensure compatibility and proper triggering and operation of load switches and conflict monitors in signal controllers currently in use by the District of Columbia.
- 7.9 The drive modules shall have a capacity of 25 watts.
- 7.10 The drive modules shall be designed to maintain a constant LED drive current regardless of outside temperature (-30°C to +40°C).
- 7.11 The drive modules shall be designed to dim automatically based on the ambient light level.
- 7.12 In order to reduce long term degradation of LED's, the automatic dimming circuit shall be tuned to reduce the light intensity of the display by 35%.
- 7.13 The dimming circuit shall have a 30 sec. Delay to prevent interference caused by shadows or headlights.
- 7.14 LED drive current shall be regulated just as effectively when in the "dimmed state".
- 7.15 The drive modules shall be designed to monitor the proper operation of the message display and to provide an alarm signal if the display is not operational.
- 7.16 The drive modules shall be capable of providing a "confirmation" or "alarm" signal, the signal can be configured for 120Vac or 24Vdc PLC application (sinking or sourcing type).

- 7.17 In the event of a malfunction in one sign drive module rendering that part of the message blank, the monitoring circuit shall detect the malfunction and disable all other drive circuits displaying a blank sign message to prevent any possible conflicts.
- 7.18 Drive modules shall include a green LED for power status and a red LED for alarm status.
- 7.19 All electronic components shall be standard industry type, available from wholesale electronics distributors.

8. DRIVER RACK ASSEMBLY

- 8.1 The driver rack assembly shall be a single part self contained module consisting of an interconnect PCB and an anodized aluminum frame.
- 8.2 The driver rack shall have the capabilities to house up to 6 drive modules.
- 8.3 The aluminum rack shall be vented from top to bottom and shall include latches to lock the modules in place.
- 8.4 The driver rack assembly shall be secured in the sign enclosure by four (4) captive type spring-loaded thumbscrews. The entire assembly shall be removable in less than one minute without the need of any tools.
- 8.5 The interconnect PCB shall include connectors for 6 drive modules and 6 display messages.
- 8.6 The interconnect PCB shall include terminals for all field wiring: 120VAC controls, external photocell, and alarm signals.
- 8.7 The field wiring and display terminals shall be spring loaded "anti-vibration" type.
- 8.8 All interconnections within the sign shall be accomplished through this PCB, no internal wiring shall be permitted with the exception of a single cable for the message display.
- 8.9 The interconnect PCB shall be equipped with a 10 position binary switch for each message to allow the drive current to be calibrated for each individual message and to increase drive current in case of long-term degradation to LED's. Each step shall provide a 1mA increment up to a maximum of 25mA.
- 8.10 All connectors and terminals shall be identified via the silk screen identifier on the surface of the PCB.
- 8.11 The driver rack assembly shall be mounted on the left side of the sign enclosure.
- 8.12 All PCB's shall be mounted vertically to facilitate air-cooling and prevent collection of dust and moisture.

9. ELECTRICAL REQUIREMENTS

- 9.1 The sign power rating shall not exceed 15 watts per message.
- 9.2 Each sign shall operate from a 60HZ \pm 3HZ AC line over a voltage ranging from 95 volts to 135 volts. Fluctuations in line voltage shall have no visible effect upon the luminous intensity of the sign message.
- 9.2.1 The operating voltage of the LED's shall be 120 volts AC. All operating parameters shall be measured at this voltage.

- ~~9.2.2~~ Sign circuitry shall prevent perceptible flicker to the unaided eye over the 95 volt to 135 volt range.
- 9.3 The sign's on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients as stated in Section 2.1.6 of the NEMA Standard TS-2 dated 1992.
- 9.4 Each sign and associated on-board circuitry shall be in compliance with Federal Communications Commission (FCC) noise regulations and must meet FCC Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
- 9.5 Each sign shall be operationally compatible with controller assemblies and peripheral equipment including solid state load switches, flashers, and conflict monitors currently used in the District of Columbia. Current controller specifications are available for review at the specific request of the contractor or vendor.
- 9.6 Each sign shall feature control circuitry to prevent current flow through the LED module in the off state to avoid any false indication as may be perceived by the human eye during daylight and evening hours.
- 9.7 All LED's will have an expected lifetime of 100,000 hours.

10. **WARRANTY**

- 10.1 All warranties shall pass from the contractor to the District of Columbia following final acceptance of the sign after it is placed into service.
- 10.2 Individual LED's shall be warranted against defects in materials and workmanship for a period of 60 months.
- 10.3 The sign assembly shall be warranted against defects in materials and workmanship for a period of 24 months.
- 10.4 The warranty period for all products shall begin on the date the sign is placed into operational service in the District of Columbia or ninety (90) days after the sign is delivered to the District of Columbia, whichever occurs first.
- 10.5 Replacement signs, LED's or component part shall be provided on a one for one basis after receipt by the manufacturer of the failed unit. Replacement of signs, LED's or component parts which failed while under warranty shall occur at no cost to the District of Columbia.