

**MISSOURI DEPARTMENT OF TRANSPORTATION (MoDOT)
TRUCK MOUNTED FLASHING ARROW PANEL SPECIFICATIONS
(TRUCK-SYSTEM POWERED, WITH LED LAMPS)**

Description

The truck mounted flashing arrow panel shall consist of an arrow panel, mounting frame and rotating mechanism, remote control switches and circuitry, and a lockable control cabinet housing electronic components. Each unit shall be fully assembled when delivered.

Panel and Mounting Assembly

The arrow panel shall be aluminum and contain 15 LED lamps. Lamps shall be energized from remote control switches located inside the truck cab.

A nominal 5-inch, 360° tunnel visor with full attachment flange shall be provided for each lamp. Visors shall be attached to the panel with stainless steel machine screws and steel, blind-rivet nuts. Visors shall be removable without removing the screws. A nominal 1/2 inch, butyl rubber or neoprene gasket shall be provided between each lamp and the panel face to absorb vibration and prevent intrusion of moisture. The panel or lamp holder shall be notched to match a projection on the lamp to ensure proper lamp alignment. All lamps shall be replaceable from the front of the panel.

A lamp of the same type used on the panel face shall be provided on the back side of the panel and be continuously energized or flashed when the arrow panel is operating. A visor is not required on this lamp. It shall be located in the uppermost corner of the panel on the driver's side.

LED Lamps shall be 12-volt DC, PAR-46, yellow, LED type and each lamp shall meet the existing MoDOT specifications for visibility and legibility performance standards stated later in these specifications.

Overall size of the arrow panel shall be a nominal 3 feet by 6 feet.

Panel mounting height shall be a nominal 4 1/2 feet from the bottom of the support frame to the lowest point on the panel.

The arrow panel shall consist of a nominal 3-inch by 1-inch by 1/8 inch welded aluminum channel with a 1/16 inch thick aluminum sheet attached to the front and back. A nominal 6-inch square, removable panel shall be provided on the back panel to provide access to the control cable connector and ground wire bus. The access panel shall have a rubber or neoprene gasket. The interior of the panel shall be reinforced with aluminum spacers and nylon spacers. The front and back surfaces of the panel shall be painted non-reflective flat black. All wiring inside the arrow panel shall be corrosion resistant wiring and shall be attached to the panel approximately every 8-inches. Company names or logos shall not be placed on the arrow panel.

The arrow panel shall be supported on a four vertical post framework consisting of 2-inch by 2-inch by 1/8 inch welded steel tubing. All open ends of tubing shall be capped and welded shut. The panel shall be rotatable from a horizontal to a vertical position electrically, hydraulically, by winch and cable (minimum 1/4" diameter, galvanized, aircraft cable) with automatic brake, with a screw- type mechanism, or by a self-locking, manually operated square stainless steel tube. Manually operated winch mechanisms shall be located on the right, or passenger, side of the truck. (See the drawing on Attachment 2.). The supporting frame shall have a locking device to secure the panel in the horizontal and vertical positions. When in the horizontal position, the panel shall rest on a rigid frame support, relieving the load from the rotating device. Angle and cross bracing of the vertical supports shall be provided at the top and bottom of the supports to ensure a rigid frame.

The support frame shall be painted one coat of primer and one coat of Dupont Automotive Deluxe Enamel Code 93-75306 (yellow), or Chrome Enamel 13432 (yellow) of Federal Standard 595, or equal. A high-visibility, safety orange paint, such as Sherwin Williams Omaha Orange Paint, which is similar to Federal Standard 595B #12243, or equal, may be used in lieu of yellow paint.

Control and Wiring

The remote cab control switches shall provide left and right flashing arrows, a double flashing arrow, and caution modes of operation. The caution mode shall consist of flashing 4 lamps using the upper and lower lamps of the left and right arrowheads and may be energized when the cab control power switch is placed in the "on" position. Left and right flashing arrows shall flash 10 lamps, 5 in arrowhead and 5 in the horizontal shank, simultaneously. The double flashing arrow shall flash 13 lamps, 5 in each arrowhead and 3 in the horizontal shank, simultaneously.

The remote cab control shall include an on/off switch, a dim/bright selector switch, an operation mode selector switch, an LED "power -on" lamp, and be equipped for top of dash mounting. The control shall be provided with at least 30 feet of multi-conductor, salt-resistant, weatherproof cable. The remote cab control shall be assembled in a manner to allow easy access to internal circuitry and switches for service and repair, such as with machine screws. All electronic components shall be solid state and electrically protected by fuses or circuit breakers.

The flashing rate of the lamps shall not be less than 25 or greater than 40 flashes per minute. Lamp "on-time" shall be at least 50 percent.

Control circuitry shall provide a minimum 50 percent voltage reduction to all lamps during night operation. Dimming shall be by manual and automatic control. The photoelectric cell shall automatically reduce the flashing arrow light intensity as ambient light reduces by reducing the voltage to the lamps from 12-volts to 6 volts. When in the dimmed condition, voltage to any lamp shall be within 1.5 volts of the voltage to any other lamp. The weatherproof, photoelectric control shall be mounted on the bottom or side of the arrow panel with a watertight fitting.

A readily accessible cartridge fuse or circuit breaker shall be provided at the power supply end of the circuit between the power supply and cab power switch control. The fuse or breaker shall be rated to handle the maximum lamp load of 14 lamps. An additional fuse or breaker shall be located on the controller cabinet, protecting the circuit supplying the remote cab control.

The arrow panel electronic components shall be housed in a salt-resistant, weatherproof cabinet. The cabinet may be mounted to the arrow panel support frame or located in the truck cab behind the seat. The cabinet door shall contain a gasket and a non-ferrous metal locking mechanism with provision for padlocking if located on the support frame. A baffle shall be placed inside the cabinet to prevent water from reaching electrical components through ventilation louvers, if used. No openings will be permitted in the cabinet top. All wiring entrances to the cabinet shall be through salt-resistant, weatherproof connections. All electrical and electronic components in the cabinet shall be readily accessible, removable and serviceable. All electronic components shall be mounted on only one side of the circuit board. All components shall be labeled or coded and printed at their location on the circuit board. If condensation drains are provided in the bottom of the cabinet, they shall be protected from road splash. After assembly, all circuit boards and terminals shall be thoroughly cleaned and coated with clear acrylic or clear polyurethane.

All wiring and electrical and electronic equipment shall be capable of carrying an electrical load of 150 percent of maximum amperage rating of the unit. Solid-state devices containing non-accessible or non-replaceable components will not be permitted. Riveted load switches or heat sinks or solder connected integrated circuits will not be permitted or accepted.

Control circuitry shall provide a negative, 12-volt ground to each lamp at all times. Frame ground circuitry to the lamps will not be permitted. A ground circuit shall be supplied to a ground bus bar or terminal strip inside the arrow panel through a minimum of two # 12 AWG conductors. Individual ground circuits to each lamp shall be provided from the bus bar or terminal strip through a minimum of # 16 AWG conductors.

The positive, or plus, 12-volt power shall be supplied to each lamp through a minimum of # 16 AWG conductors from solid-state load switches in the control cabinet. A barrier terminal strip for the positive voltage conductors will not be required or permitted inside the arrow panel. Conductors shall connect from the lamps to the 14-pin, male connector on the bottom edge or front face of the panel. Continuous, plus, 12 volts to the lamps will not be permitted. The plus 12 volts to each lamp shall be reduced to zero voltage by the solid-state load switches.

The arrow panel and control cabinet shall be interconnected through a multi-conductor control cable or individual conductors in an electrical, flexible, salt-resistant, waterproof conduit. Length of the control cable shall be determined by the manufacturer, but not less than 30 feet if the control cabinet is located in the truck cab. Control cable length shall be sufficient to permit arrow panel rotation without binding or kinking the cable. A 14-pin, female connector shall be affixed to each end of the control cable. Caps or covers shall be provided for one end of the control cable and for the connector on the arrow panel to protect the connectors when disconnected, if the control is located in the truck cab.

A male, 14-pin connector shall be located on the bottom or side of the control cabinet. The connector shall be installed inside the control cabinet and retained by a clip or clips or stainless steel machine screws to permit removal from the cabinet without disconnecting wires from the control.

Control connectors shall be metal, salt-resistant, weatherproof, 14-contact Amphanol MS 3106 A 28-02 P plug, or equivalent amp-type connectors, with cable clamp and boot and MS 3102 A 28-

02 S socket. Power supply connectors shall be metal, salt-resistant weatherproof, 2-contact Amphanol MS 3106 A 22-01 P plug, or equivalent amp-type connectors, with cable clamp and boot and MS 3106 A 22-01 S socket.

Pin assignments shall be as shown in Attachment 1.

Electrical conductors between the cab control switches and control cabinet and between the control cabinet and arrow panel shall be Type THW UL approved, salt-resistant, weatherproof, multi-conductor cable or single conductors. Conductors shall be soft-drawn, Class B or C stranded copper wire meeting the requirements of IPCEA S-61-402, Part 2.

Electrical circuits between the control and power supply shall be UL approved single conductors in an electrical, flexible, salt-resistant, waterproof conduit or multiple conductor Type THW cable. Minimum conductor size shall be #10 AWG. Conductors shall be soft-drawn, Class B or C stranded copper wire meeting the requirements of IPCEA S-61-402, Part 2.

Crimp-on lugs, with amperage ratings equivalent to the conductor size, shall be used for all terminal connections of stranded copper conductors not connected to amphanol, or equivalent amp-type, connectors.

Performance

The flashing arrow must be visible on a sunny day for a distance of one mile. The arrow panel support frame shall contain a device to align the arrow panel to oncoming traffic and to adjust the arrow panel so its bottom edge is relatively level when in use. The panel lamp must be visible during the "on time" at an angle of 15° minimum to both the left and right of center and 4° minimum both up and down of center.

General

All units shall meet or exceed the specifications for advance warning arrow panels as listed in Part 6F.53 of the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD) Millennium Edition, December, 2000. Units shall be skid mounted to slip into the back of dump truck.

Owner's Manual

The successful bidder shall furnish two Owner's Manuals for each arrow panel. Each manual shall include the manufacturer's instructions for maintenance and operation of the arrow panel and control. Each manual shall also include a detailed, schematic, wiring diagram showing all circuits and components from the power supply through the control to the arrow panel. The schematic diagram shall list all transistors, resistors, triacs, diodes and other components with the manufacturer's name and part number.