

**MISSOURI DEPARTMENT OF TRANSPORTATION (MoDOT)
TRAILER MOUNTED FLASHING ARROW PANEL SPECIFICATIONS
(DIESEL ENGINE POWERED, WITH SEALED BEAM LAMPS)**

Description

The trailer mounted flashing arrow panel shall consist of an arrow panel, mounting frame and rotating mechanism, control switches and circuitry, trailer, and self-contained power supply. Each unit shall be fully assembled when delivered.

Panel and Mounting Assembly

The arrow panel shall be aluminum and contain 15 lamps. Lamps shall be energized from control switches located in a lockable, weatherproof aluminum box located on the arrow panel support frame, power supply cover, or under the power supply cover.

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.

Lamps shall be 12-volt DC, 18-watt, PAR-46, (NO. 4412A), yellow, sealed-beam type and each lamp shall meet the existing MoDOT specifications for visibility and legibility performance standards as stated later in these specifications.

Overall size of the arrow panel shall be a nominal 4 feet by 8 feet.

Panel mounting height shall be 7 to 9 feet from the roadway surface to the lowest point on the panel. The bottom edge of the panel shall be relatively level when in use.

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 two or four vertical post framework consisting of 2-inch by 2-inch by 1/8 inch welded steel tubing. All tubing shall be capped and welded shut. Steel supports shall be welded to the deck plate and the deck plate welded to the frame and cross members. The panel shall be rotatable from a horizontal to a vertical position electrically, hydraulically, by winch and cable (minimum 1/4-inch diameter galvanized aircraft cable) with automatic brake, with a screw type mechanism, or by a self-locking, manually operated square stainless steel tube. 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. Manually operated winch mechanisms shall be located on the right, or passenger, side of the trailer.

The support frame shall be painted one coat of primer and one coat of Du pont 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 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. Left and right flashing arrows shall flash 10 lamps, 5 in the 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 control shall include an on/off switch, a dim/bright selector switch, an operation mode selector switch, a photoelectric cell, flasher and load relays. All electronic components, except flasher and load relays, shall be solid state and electrically protected by fuses or circuit breakers. All cables and control wiring shall enter the control cabinet from either the back or bottom through salt-resistant, weatherproof connectors. No external or spliced wire connections will be accepted outside of the control cabinet.

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 photoelectric control shall be mounted on the side or bottom of the arrow control cabinet.

A readily accessible cartridge fuse or circuit breaker shall be provided in the circuit between the power supply and arrow panel control. The fuse or breaker shall be rated to handle the maximum lamp load of 14 lamps. The fuse or breaker shall be located in the control cabinet.

The arrow panel control shall be housed in a removable, weather and splash proof cabinet. The cabinet shall be securely mounted to the arrow panel support frame, or on or under the power supply protective cover. Removal of the entire cabinet shall be accomplished by disconnecting two amphanol, or equivalent amp-type, cable connectors and removing no more than two cabinet attachment bolts. The cabinet door shall contain a gasket and a non-ferrous metal locking mechanism with provision for padlocking, if the control is not located under the power supply cover. 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 minimum of #16 AWG conductors.

The positive, or plus, 12-volt power shall be supplied to each lamp through a minimum #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. The manufacturer shall determine the length of the control cable. 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.

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, 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, 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.

Electrical conductors between the control 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.

Trailer

Dimensions: Minimum trailer dimensions shall be length 110" and width 76" (fender to fender).

Frame: Structural steel tubing or channel, minimum 3 cross braces, with tie-down loops on front corners.

Axle: Single, minimum 3,500-pound capacity, tubular, with 5-hole 4.5" B.C. circle pattern on idler hub.

Wheels: 15-inch steel, safety rim, 5 lug bolts.

Tires: 15-inch, tubeless, radial, highway tread. Size and rating to match axle capacity.

Springs: Minimum 4-leaf, double eye.

Tongue: 3-inch x 3-inch x 3/16 inch steel tubing Y-braced to trailer frame, removable for shipping and to prevent theft. Tongue weight approximately 10-15 percent of gross weight. Minimum 4-foot hitch-to-trailer clearance.

Deck: 32 sq. ft., 1/8 inch steel safety-tread plate.

Fuel Tank: Minimum 20-gallon with gauge. Mounted below deck with filler cap access through deck plate. Protective metal guard on front and bottom if tank is not metal.

Fuel Valve: In-line, lever operated, on-off.

Power Supply Cover: Hinged, 16 gauge steel, expanded metal sides or vents, lockable. Hinge bolted or riveted through deck plate.

Starting Battery Enclosure: 14-gauge steel, under deck, minimum 2 drain holes, lockable.

Fenders: 16-gauge steel, inside closed in above deck, round, full-wheel coverage.

Safety Chain: Two, 5/16 inch x 34-inch long, plated, steel chains connected to a loop that is welded to the tongue. Chain shall have yield strength equal to weight of trailer and payload or greater. Chain loop shall have yield strength equal to chain, or greater.

Screw Jack: Tongue mounted, 2,000-pound capacity, steel base 4" x 4" square foot, minimum size and capacity.

Leveling Legs: Adjustable, on 1" increments, with foot pads (4" x 4" minimum), mounted on

four corners of frame, perforated 1 3/4" square tube x 12 gauge wall, locked in place by 3/8" diameter snapper pins, secured to the trailer frame by a wire cable or chain..

Hitch: Easily removable combination 2" diameter ball coupler and a 3-inch inside diameter flat pintle ring, adjustable 24-inch to 36-inch, in 2-inch increments.

Paint: Entire trailer - one coat primer, one coat Du pont Automotive Deluxe Enamel Code 93-75306 (yellow) or Chrome Enamel 13432 (yellow) of Federal Standard 595, or equal, including all surfaces under deck and on underside of fenders. 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 the yellow paint.

Lights: (DOT Approved) 12-volt, two tail/stop/turn signal; side, rear and tongue reflectors. No electrical connector required. Wires shall be identified as to function.

Power Supply - Diesel Engine Driven Generator Unit

Engine: Diesel, Lombardini 6LD260, 4 HP at 2800 RPM, 262 cc, 3-quart deep-sump, oil capacity with spin-on filter, dry cartridge air filter, electric and manual starter, run/off switch, start switch and 20 gal. fuel tank.

Starting Battery: 12-volt D.C., wet cell BCI Group 24 Marine, minimum 420 amps cold cranking, 2-hour reserve capacity.

Alternator: Delco direct driven with flexible coupling, 12-volt, 51-amp, voltage regulator, ammeter, non-resettable hour meter. A weather-resistant, metal enclosure shall be provided to house the meters and switches.

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.

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.

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 power supply, 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.

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