Special Specification 6351
Signal Controller Activated In-Roadway Illuminated Marker Delineation System

1. DESCRIPTION

Furnish and install a signal controller activated in-roadway illuminated marker delineation system including all auxiliary components such as LED signs, beacons, and external activation equipment required to support the system.

2. MATERIALS

2.1 High Performance LED In-Roadway Marker

Should the installer wish to submit an alternate system for an approved equal, specifications of the proposed alternate that conform to the following specifications will be submitted to the Engineer with jurisdiction at least 3 months before the installation date or as determined by the Engineer. No proposed “equal” product proposed after this period will be accepted.

2.2 In-Roadway Lights

2.2.1 Mechanical Characteristics – Upper Housing

Upper housing must be heat treated, cast 304 stainless steel or equal, in a directional configuration with nominal diameter of 150 mm and height of 30.5 mm. The in-roadway profile must not exceed 0.125 in. above the pavement surface. The housing will have 2 prismatic lenses per marker. Ensure no plastic lens or plastic body components are exposed to traffic.

All electrical terminations must occur within the marker housing; under no circumstances should any electrical connection be made in the pavement outside the marker housing. Connection housing should accommodate further encapsulation of the wiring connectors, and all connectors should be encapsulated.

The upper housing ingress protection rating must be IP68 (NEMA 6P). Removal/replacement of the upper housing must be capable of being accomplished in 5 min. or less and should be fully resealable and water tight once re-assembly is done.

2.2.2 Mechanical Characteristics – Lower Housing

Lower housing must be corrosion-resistant aluminum alloy, or a manufacturer approved equal with a nominal diameter of 7 in., and a nominal height of 2.5 in. The installation depth including the wiring sub base should not exceed 2.75 in.

Attach the LED Module to the base with two stainless steel M8x20 DIN912 bolts, ASTM F593 and ASTM F594. Tighten the stainless steel bolts to 32 ft-lb of torque without being subject to loosening.

The lower housing must include an EPDM gasket, 0.125 in. nominal thickness, for dirt and ingress protection of the electrical splices housed in the sub base.

2.2.3 Optical Characteristics

Provide markers that include a total of 16 LED's (8 per lens). Ensure the LED colors (amber, white, green, blue, or red) comply with MUTCD spectral specifications. Ensure the amber markers meet ITE VTCSH chromaticity standards.

The daytime visibility must exceed 3,000 ft. regardless of ambient light conditions. The light intensity rating must exceed 3,500,000 cd/m2. The in-roadway illuminated markers lenses must provide a unidirectional narrow beam (not wider than 10 degree vertical or 30 degree horizontal) exit trajectory for proper aiming and visibility.
2.2.4 **Electrical Characteristics**

Provide in-roadway illuminated markers that operate between 9 and 48 VAC or DC. Nominal power consumption for daytime must not exceed 2.5 W and operate in ambient temperature range of -10ºF to 150ºF.

Provide in-roadway illuminated markers that are dimmable and that read back its status using 2-way communication with the system controller.

Provide in-roadway illuminated markers that do not house any batteries or antennas. Provide in-roadway illuminated marker that do not have any solar cells. Provide in-roadway illuminated markers that do not have more than two wires.

The in-roadway illuminated marker connecting wires must be AWG18 and be certified DIN EN 13602, DIN 72551 part 5 (1993), and LV 112. The splice connectors must be hydrophobic crimp connectors and be UL Listed, CSA Certified and RoHS 2011/65/EU Compliant.

2.2.5 **Mechanical Characteristics**

Provide an assembly (upper housing and lower housing embedded in epoxy) with a minimum compressive load rating of 11,000 lb.

2.3 **Peripheral Control Equipment**

Provide a 19 in. rack cabinet with appropriate surge and lightning protection for all inputs and outputs according to IEEE Std 1100 - 2005 ("Emerald Book").

2.3.1 **Signal Interface Controller**

Provide a Process Control Unit (PCU) Signal Interface in 19 in. (2U) rack-mountable enclosure designed for connection with output of intersection signal controller with the following specifications:

- Day/night mode control: Dynamic photo-sensor activated and night brightness adjustable 15%-100%,
- Up to 8 control inputs: 120V AC or DC from load switch outputs of intersection controller,
- Flash pattern and rate: Selectable "pulsed" flash rate or steady on, both selectable in either (color) signal controller output activated, or signal controller (color) signal output activated phases,
- Must be capable to reading the status of each in-roadway illuminated marker,
- Programming: Local via USB port or remotely (connection to Internet required),
- Connectivity: USB 2.0, Ethernet 10/100/1000 (RJ-45), wireless (optional) LTE, GSM, Wi-Fi,
- Remote firmware upgrade capable,
- Log files logging major systemic events for historical data retrieval, and
- Cooling by internal fan

2.3.1.1 **Internal Power Supply**

The power supply must be integrated in controller unit with:

- Supply voltage: 85 to 264 VAC, 47-63 Hz, single phase,
- Output capacity: 350 W or 100 in-road illuminated markers, or unlimited capacity with additional repeater,
- Temperature range: -40ºF (start-up) to +160ºF,
- Transient/inrush current: 60 A max at 264 VAC,
- General protection: Internal, Auto-reset electronic circuit protection on outputs,
- Power factor: > 0.9,
- Overload protection: 110% – 140%,
- Short circuit protection: continuous protection, constant current characteristic,
- Galvanic isolation: 3000 VAC input to output, 1500 VAC input to ground, 500 VDC output to ground,
- Emissions: EN55022 class B conducted, EN55022 class A radiated,
- Harmonic Currents: EN61000-3-2 class A, 350 W: class C for loads ≥10%, and
- Safety Approvals: IEC60950-1 CB report, CSA 22.2 No. 60950-1, UL60950-1, TUV, EN60950-1, SEMI F47

2.3.2 **In-Road Wiring**

In-Road wiring must be direct-burial control cable −14/2 + drain wire 0.31 in. OD (nominal), with water block system and tinned conductors.

2.3.3 **Sub-Base Encapsulation**
Sub-Base encapsulation must be 3M Scotchcast 8882, or equal. Waterproof connectors must be Silicon filled w/cap; 3M 314, 316IR; or manufacturer approved equal.

2.4. Other Trigger Sources
System must be configurable for various input signals:
- Opto-coupler for 120 VAC input from load switches controlling traffic lights, and
- contact inputs (N.O./N.C. configurable)

3. CONSTRUCTION
Install in-roadway markers into the pavement in strict adherence to the manufacturer’s installation requirements. Cut a 3/8 in. slot at a depth of 2 1/2 in. depth, and 7 in. or 8 in. diameter round holes at a depth of 2 3/4 in. centered over the slot where markers are to be placed. To avoid risk of stress fractures being produced by ingress into the road surface, only round core holes are to be made in the pavement for installation of the road markers, without exception. In snow plow regions, the uppermost part of the LED module should be mounted flush with the pavement surface, to the rear of the opening in the pavement where the LED module is located. Without exception, deflectors or other protective apparatus must not be required to protect the LED modules from snow removal equipment. Mount and bed the in-road markers with factory approved resilient-setting Epoxy Resin or factory approved equal.

Tighten the in-road markers upper housing to the lower housing with stainless steel bolts (per section 2.2.2 paragraph 3), and to 32 ft-lb of torque. In-road markers’ anti-capillary wires (per section 2.2.4 paragraph 4), must be connected with hydrophobic crimp connectors and the connectors must be encapsulated with re-enterable gel. The wires must remain free and unconstrained by the markers weight or any other objects that could pinch or crush the wires.

Saw cuts and cores must be done per the manufacturer’s installation requirements, and all cables must include backer rod for protection. The cable should be protected from sharp corners, sharp objects, pinch points, or sharp bend radii. All splices must be done in approved junction boxes or in the control cabinet. No splices should be made in the road, pull box, or pole.

4. WARRANTY
Provide a signal controller activated in-roadway illuminated marker system that includes a minimum 5-yr. warranty against manufacturer defects under normal operating conditions that begins on the date the system is fully installed and in active service. Any equipment with less than 95% of its warranty remaining at final acceptance of this system will not be accepted by the Department.

5. MEASUREMENT
This Item will be measured by each signal controller activated in-roadway illuminated marker and control equipment.

6. PAYMENT
The work performed, and materials furnished in accordance with this item are measured as provided under “Measurement” will be paid for at the unit price bid for “Signal Controller Activated In-Roadway Illuminated Marker” and “Signal Controller Activated In-Roadway Illuminated Marker (SCAIRIM) Controller Equipment”.

This price is full compensation for furnishing and installing complete signal controller activated in-roadway illuminated marker system including the housing, LED face, LED bulbs, lens, wiring, signal interface controller, power supply, electrical, equipment, materials, labor, tools, and incidentals.

The price also includes full compensation for all associated interconnection work with the traffic signal and/or chevron signs (as applicable) to the satisfaction of the Engineer, as well as the testing of the signal controller activated in-roadway illuminated marker system and making adjustments as needed.