To: SUPERSEDED BY EI 04-041 EFFECTIVE 05 /05 /05		New York State Department of Transportation ENGINEERING INSTRUCTION	EI 04-012

Title: **TRAFFIC SIGNAL AND PEDESTRIAN SIGNAL LIGHT- EMITTING DIODE (LED) MODULES**

Distribution:
- ☒ Manufacturers (18)
- ☐ Local Govt. (31)
- ☒ Agencies (32)
- ☐ Surveyors (33)
- ☐ Consultants (34)
- ☒ Contractors (39)
- ☐ _____( )

Approved:

P. J. Clark, P.E.
Deputy Chief Engineer, (Design)

03/02/04
Date

ADMINISTRATIVE INFORMATION:

- This Engineering Instruction (EI) is effective with projects submitted for the letting of 09/09/04.
- This EI supersedes EI 02-017 and replaces the shelf note "Traffic Signal Heads" with the attached shelf note.
- The revisions issued with this EI will be incorporated into the next update of the Standard Specification.

PURPOSE:

The purpose of this EI is to modify §724-04 - Traffic Signal Heads.

TECHNICAL INFORMATION:

- The 2003 edition of the Federal MUTCD (Section 4E-04) eliminates "outlined" Man and Hand symbols used in Pedestrian Signal Head Modules. The MUTCD now requires the entire symbols to be illuminated rather than just the outline.

- Existing pedestrian head signal indications with lettered or outline style symbol messages may be retained for the remainder of their useful life.

IMPLEMENTATION:

- Main Office Design Quality Assurance Bureau will replace the shelf note "Traffic Signal Heads" with the attached shelf note and insert it with contract proposals beginning with projects submitted for the letting of 09/06/04.

- The attached changes to the Standard Specifications update the specifications to current industry standards and add four standard pay items in addition to the ones already issued by EI 02-017. These pay items are:

Item No	Item Description
680.813102M	PEDESTRIAN SIGNAL MODULE - 300 mm by 300 mm MAN LED
680.813107M	PEDESTRIAN SIGNAL MODULE - Size "A" 410 mm by 450 mm Bi-Modal HAND/MAN LED
680.813108M	PEDESTRIAN SIGNAL MODULE - Size "B" 405 mm by 425 mm Bi-Modal HAND/MAN LED
680.813109M	PEDESTRIAN SIGNAL MODULE - Size "C" 390 mm by 450 mm Bi-Modal HAND/MAN LED

TRANSMITTED MATERIAL: Attached are specification shelf notes revising the requirements for Section 724-TRAFFIC SIGNAL HEADS for the January 2, 2002 Specifications book.

BACKGROUND: Light Emitting Diode (LED) Traffic Signal Modules are inserts that can be installed in any standard signal head. These modules replace the bulb, reflector, socket, gasket, and lens assembly of the conventional incandescent signal section.

The LED modules' energy consumption is very low when compared with incandescent bulbs. For example, the energy consumption of LEDs is approximately 8 watts for a 300 mm red arrow (135 watts for a bulb), 9 watts for a Pedestrian Hand (116 watts for a bulb), and 14 watts for a 300 mm red ball (135 watts for a bulb). LEDs are designed to last 10 years, and incandescent bulbs are generally designed to last one year. Therefore, not only do LED modules last longer, resulting in lower maintenance costs and reduced liability for outage-related accidents, but they use considerably less power. LED modules are easy to retrofit, easy to maintain and result in immediate savings. Their use is preferred over incandescent bulbs in new and existing installations. Hence their use in traffic signals installations is encouraged and approved by the Department.

The disadvantage of LED modules is their initial cost although the cost is generally dropping over time (an average of 15% in the last two years). The payback period of these units, at current module prices and metered electric charges is short: less than two years for all but yellow LEDs. Yellow LEDs have a payback period of less than ten years because they are "on" so rarely in a 3-color signal (about 6 percent of the time). The payback period would be much less if yellow LEDs are used in flashing signals because the yellow indication will be on much of the time. Also, even though the electricity savings payback time is longer for energy-face billed signals, significant labor savings may result when they are used at remote location signals.

CONTACT: Direct questions regarding this EI to Mark Pasko of the Traffic Engineering and Safety Division at (518) 485-1890 or via email to mpasko@gw.dot.state.ny.us.

TRAFFIC SIGNAL AND PEDESTRIAN SIGNAL MODULES

Make the following ***changes*** to Volume 2 of 3 of the Standard Specifications of January 2, 2002.
Page 6-222, ***add*** the following pay items:

680.810103M	Traffic Signal Module-300 mm Yellow Ball, LED	Each
680.810104M	Traffic Signal Module-300 mm Yellow Arrow, LED	Each
680.810303M	Traffic Signal Module-200 mm Yellow Ball, LED	Each
680.810304M	Traffic Signal Module-200 mm Yellow Arrow, LED	Each
680.813102M	Pedestrian Signal Module - 300 mm by 300 mm MAN LED	Each
680.813107M	Pedestrian Signal Module - Size "A" 410 mm by 450 mm Bi-Modal HAND/MAN LED	Each
680.813108M	Pedestrian Signal Module - Size "B" 405 mm by 425 mm Bi-Modal HAND/MAN LED	Each
680.813109M	Pedestrian Signal Module - Size "C" 390 mm by 450 mm Bi-Modal HAND/MAN LED	Each

Make the following ***changes*** to Volume 3 of 3 of the Standard Specifications of January 2, 2002.
Delete pages 7-249, line 1 through 7-252, line 36 and ***add*** the following:

LED TRAFFIC SIGNAL MODULES. In addition to applicable material requirements for STANDARD SIGNAL HEADS, and STANDARD PEDESTRIAN SIGNAL HEADS, the following additional requirements apply to Ball, Arrow, and Pedestrian LED Traffic Signal modules.

General. This specification refers to definitions and practices described in the Institute of Transportation Engineers (ITE) publication ST-017B "Vehicle Traffic Control Signal Heads" (referred to in this document as "VTCSH"), and "Pedestrian Traffic Control Signal Indications" (referred to in this document as "PTCSI"). LED traffic signal modules designed as retrofit replacements for existing signal lamps shall not require special tools for installation. They shall be a single, self-contained device, not requiring on-site assembly for installation into an existing traffic signal housing. The module shall be sealed to provide a weather tight enclosure and an insulating covering for all electrical connections and electronic components and shall fit securely in the housing. A one piece "U-shaped" cross section rubber gasket shall be provided with each module. This gasket shall fit around the perimeter of the module to ensure a weather tight fit between the door and the housing of the module. The module shall connect directly to existing electrical wiring by means of 6.35 mm (0.25 inch) female quick connect push on type terminals.

Material Requirements. Materials used for the lens and signal module construction shall conform to ASTM specifications for those materials.

Each LED signal module shall be identified on the back side with the manufacturer's trade mark, serial number, voltage rating, Volt-Ampere rating, power consumption (watts and volt amperes) and, if applicable, a vertical indexing indicator (i.e., "up arrow", or the word "UP" or "TOP"). Each LED signal module shall also be identified on the back side with the part number as shown in the NYSDOT LED Traffic Signal Module QPL and the date of manufacture (month and year minimum). Single units shall have identification markings as to the type and color of the module. Bi-Modals shall be marked with model type.

Each LED signal module shall have a permanent sticker stating compliance to FCC Title 47, Subpart B, Section 15 regulations. The sticker will be located on the rear exterior of the unit.

A. Ball and Arrow Modules (Single and Bi-Modal) Only. Retrofit replacement LED signal modules shall fit into existing traffic signal housings built to the VTCSH Standard without modification to the housing. Installation of the retrofit replacement LED signal module into an existing signal housing shall only require the removal of the existing lamp components (i.e., lens, lamp module, gaskets, and reflector).

Red LED signal module lenses shall be tinted with the appropriate color to enhance on/off contrast. The material used to tint the lens shall not affect the luminous intensity or chromaticity and shall be uniform across the face of the lens. The Yellow and Green units shall be supplied with a clear lens. If a polymeric lens is used, a surface coating or chemical surface treatment shall be used to provide front surface abrasion resistance. The module lens shall be replaceable without the need for replacing the complete module unit.

The Arrow LED signal modules shall produce a pattern that conforms to the VTCSH standard for color, size and shape. The Arrow LED signal modules shall not require a specific orientation or have a variance in light output, pattern or visibility for any mounting orientation.

The lens of the LED signal module shall be capable of withstanding ultraviolet light (direct sunlight) exposure for a minimum time period of five years without exhibiting evidence of deterioration.

Each Ball LED shall have a sticker attached stating compliance to the ITE Standard for Color and Luminous Intensity and each Arrow LED shall have a sticker attached stating compliance to the ITE Standard for Color as specified in the VTCSH.

B. Pedestrian Modules (Single & Bi-Modal) Only. Pedestrian LED traffic signal modules shall be designed as a retrofit replacement for the message bearing surface of a 300 mm by 300 mm, a 410 mm by 450 mm, a 405 mm by 425 mm, and a 390 mm by 450 mm pedestrian traffic signal housing built to the PTCSI Standard. The Single Pedestrian module shall be designed to display either a "HAND" or "WALKING MAN" symbol that complies with PTCSI standard for this symbol for the size specified. The Bi-Modal Pedestrian module shall be designed to display both "HAND" and "WALKING MAN" symbols that comply with the PTCSI standard for these symbols for the size specified.

The "HAND" and "MAN" symbols for both the Single and Bi-Modal Pedestrian shall be designed so that the entire area comprising the symbol appears illuminated. Outlined shapes will not be accepted.

The LED signal module shall fit into existing Pedestrian signal housings without the need to modify the housing. The 410 mm by 450 mm, 405 mm by 425 mm, and 390 mm by 450 mm modules shall be furnished to accommodate minor dimensional variations of Pedestrian housings between manufacturers (see table below). Installation of the retrofit replacement Pedestrian LED signal module into pedestrian signal housing shall only require the removal of the existing message bearing surface, existing lamp components (i.e., lens, lamp module, gaskets, and reflector), and insertion of the retrofit replacement into the area once occupied by the removed assembly.

Each pedestrian module shall have a sticker attached stating compliance to the ITE standard for chromaticity as defined in the PTCSI.

Table 724-04-1 Size Requirements for Larger Pedestrian Signal Modules

SIZE	HEIGHT	WIDTH	CORNER RADIUS	FITS HOUSINGS DESIGNED BY
A	410 mm	450 mm	60 mm	ICC, IDC & McCAIN
B	405 mm	425 mm	31 mm	GTE & WINKOMATIC
C	390 mm	450 mm	60 mm	ECONOLITE

The above dimensions and size letter (A ,B or C) shall be clearly marked on the back of each module.

Optical

A. Ball and Arrow Modules (Single & Bi-modal) Only. The measured chromaticity coordinates of Ball and Arrow LED signal modules shall conform to the chromaticity requirements of Section 8.04, Limits of Chromaticity Coordinates and the associated Figure 1 of the VTCSH standard.

The light output distribution for Ball LED traffic signal modules shall be as defined in Section 11.04 and Table 1 of the VTCSH standard. The minimum luminous intensity values for Ball LED traffic signal modules shall be, at a line voltage of 120 ±3 volts rms, as listed in Table 1 of the VTCHS standard. Variations in operating line voltage of between 80 and 135 volts rms shall have minimal effect (less than ±10%) on luminous output of the signal module. Minimum Initial Luminous Intensities of units supplied shall equal or exceed, at 2° C, 117.5% of the values defined in Table 1-Maintained Minimum Luminous Intensity Table-of the VTCSH standard for LED signal modules.

Ball LED signal modules, except for yellow modules, shall be designed so that when operated over the specified operating ambient temperature and voltage ranges during the luminous intensity warranty period , the luminous intensity of the unit shall exceed or equal the values shown in Table 1, "Maintained Minimum Luminous Intensity Table" of the VTCSH standard for LED signal modules.

Yellow modules shall be designed so that when operated at 25° C over the specified voltage range during the luminous intensity warranty period, the luminous intensity of the unit shall equal or exceed the values shown for the color Green.

Arrow LED signal modules shall be designed so that when operated over the specified ambient temperature and voltage ranges, the signal is clearly visible and attracts attention for a distance of at least 400 m under normal atmospheric conditions.

B. Pedestrian Modules (Single & Bi-Modal) Only. The measured chromaticity coordinates of Pedestrian LED signal modules shall conform to the chromaticity requirements of Section 5.3, Color and the associated Figure C of the PTCSI standard.

Pedestrian LED signal modules shall be designed so that when operated over the specified ambient temperature and voltage ranges, the signal shall attract the attention of, and be readable to, a viewer (at both day and night) at all distances from 3 m to the full distance to be crossed.

Performance Tests

A. All LED Modules. Prior to shipment, the vendor shall energize (burn in) each LED signal module for a minimum of 24 hours, at rated voltage, and at a 100 percent on-time duty cycle. This test shall be conducted at the rated voltage in an ambient temperature of 60° C. Any failure within an LED signal module occurring during burn-in shall be cause for rejection.

After burn-in procedure is completed, the following additional tests shall be performed. These tests shall be performed at rated operating voltage and at 25° C unless otherwise specified.

All units shall be powered off for a period of 1 second and then powered back on. Any unit failing to turn on after power restoration shall be rejected. This test shall be performed a minimum of 10 times.

A sample of 10% of units of each configuration, Balls or Arrows or Pedestrian signal modules, on the order shall be randomly selected and tested by the vendor in a flashing mode of operation, at 50 percent duty cycle with a 0.5 sec on time, and for a 24 hour period at 60°C. Any unit failing to function properly shall result in failure of the entire lot from which the sample was selected. Should this occur, the entire quantity ordered shall be tested as described above, and units not functioning properly shall be rejected.

Each LED signal module shall be visually inspected for any exterior physical damage or assembly anomalies. Careful attention shall be paid to the surface of the lens to ensure there are no scratches (abrasions), cracks, chips, discoloration, or other defects.

Each LED signal module shall be tested to ensure light output at 80 and 135 volts without adverse operational effects. Each LED signal under test shall be operated at each voltage level for a time period of five minutes. Signal modules illuminating with any adverse operational effects shall be rejected.

Contractors shall provide, with each shipment, a Manufacturer's Certification of compliance. The certification shall certify that the LED signal modules comply with the requirements of these specifications.

In addition to the certification, the modules shall be supplied with a list of the serial numbers of the units, copies of all applicable test reports on the LED signal modules, and signature of the person responsible for certifying the tests.

B. Ball Modules only. Each Ball LED signal module shall be tested for rated initial intensity. A single point measurement (at -2.5° V, 2.5° R or L) with a correlation to the minimum intensity requirements specified herein may be used. This test shall be performed after the burn-in procedure is completed, at rated operating voltage and at 25° C unless otherwise specified.

Electrical

A. All LED modules. All wiring and terminal blocks shall meet the requirements of Section 13.02 Wiring of the VTCSH standard. Each wire shall be approximately 1 m long.

Units shall be supplied with color coded wires as defined below:

Red Balls & Red Arrows-Red & White
Yellow Balls & Yellow Arrows-Yellow & White
Green Balls & Green Arrows-Brown & White
Bi-Modal Arrows- Brown (Green Arrow), Yellow & White (Common)
Bi-Modal Pedestrians- Red (Hand), Brown (Man) & White (Common)
Single Pedestrians (Hand)- Red & White
Single Pedestrians (Walk Man)- Brown & White

The LED signal module shall operate with AC line voltage ranging from 80 volts to 135 volts rms 60±3 Hz. The circuitry shall prevent flicker over this voltage range. Rated voltage for all optical and power measurements shall be 120±3 volts rms.

The signal module on-board circuitry shall 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.

Each LED signal module shall be designed so that there is no noticeable light output when connected to rated voltage through an impedance of 15 kohm (either resistive or capacitive).

The signal module shall be designed so that, under normal operation, an AC voltage of no greater than 10 volts rms shall be developed across the unit when it is connected in series with any value of impedance greater than 15 kohm and for any applied AC voltage between 80 and 135 volts rms that is connected across this series combination. In addition, the signal module shall be designed so that the voltage across the module shall reduce in value to less than 10 volts rms within 100 msec when the module is switched off by any solid state switch or switchpack having an impedance of 15 kohm or greater.

The individual LED light sources shall be wired so that a catastrophic failure of one LED light source will not result in the loss of illumination of more than four LED light sources.

The LED signal module and associated on board circuitry shall meet Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise. All modules shall contain filtering dedicated to prevent inducing electronic noise into the AC power lines.

Modules shall be fused using a time-delay fuse. The fuse shall be located so that it can be easily changed without the need to disassemble the module. If in-line fuses are added into module wire leads, they will be installed in the colored wires of the units. Each individual circuit in the Bi-Modal models shall be fused separately.

All printed circuit boards used in the module shall be coated with a conformal coating containing an ultraviolet tracer.

All unit types shall be operationally compatible with the traffic signal equipment that each type is designed and intended to interface with. This equipment includes all controllers, conflict monitors, current monitors, switchpack and flashers currently in use by the Department.

B. NYSDOT Standard & Type A LED Module Definitions. NYSDOT Standard Units shall be designed so that a normally functioning signal module will generate the needed current to prevent a Model 215 Current Monitor from detecting a loss of current over the voltage range of between 95 and 135 volts rms. The

minimum current required to prevent the Model 215 monitor from detecting a loss of current is a 500 milliamp peak AC or pulsed current with a minimum pulse width of 3 msec. Signal modules designed to specifically generate current pulses to prevent the monitor from tripping shall, as a minimum, generate 6 pulses per second. Generated current pulses shall be evenly spaced, with the first pulse generated within 100 msec after the application of AC power. (Additional information regarding the operation of the Model 215 Current Monitor can be obtained in the latest "New York State Transportation Management Equipment Specifications").

NYSDOT Standard Units shall incorporate circuitry to reliably detect the total loss of LED current due to failures such as, but not limited to, open circuits and power supply problems. Upon detection of this failure, this circuit will disable any current generating circuitry within 400 msec to allow detection of this failure by a Model 215 current monitor.

Type "A" units shall be supplied without the necessary circuitry to function with a Model 215 current monitor.

Total harmonic distortion (current and voltage) induced into an AC power line for Type A units operating at rated voltage shall not exceed 20 percent for units consuming greater than 15 watts at 25° C and 40 percent for units consuming less than 15 watts at 25° C..

All Ball and Single Arrow LED modules may be procured using this specification as either NYSDOT Standard or Type A units. Single Pedestrian, Bi-Modal Pedestrian, and Bi-Modal Arrows will be procured as Type A only.

The maximum power consumption shall not exceed the following wattages at 25 degrees C:

300 mm Balls	Red-14	Yellow-24	Green-18
200 mm Balls	Red-10	Yellow-13	Green-13
300 mm Arrows	Red-10	Yellow-10	Green-10
Bi-Modal Arrows		Yellow-10	Green-10
300 mm by 300 mm Signal Pedestrian		Hand-9	Man-9
300 mm by 300 mm Bi-Modal Pedestrian		Hand-9	Man-9
Size "A" 410 mm by 450 mm Bi-Modal Pedestrian		Hand-12	Man-12
Size "B" 405 mm by 425 mm Bi-Modal Pedestrian		Hand-12	Man-12
Size "C" 390 mm by 450 mm Bi-Modal Pedestrian		Hand-12	Man-12

NYSDOT standard units supplied will meet the same low distortion standards without the current generating circuitry included in the measurement.

LED signal modules supplied in conformance with this specification shall have power factors of 0.90 or greater without the current generating circuitry included in the calculations for power factors for NYSDOT Standard units.

C. Pedestrian Modules (Single & Bi-Modal) Only. The maximum power consumed by a pedestrian LED unit shall not exceed 15 volt-amps (VA) at 120± 3 volts rms.

Environmental. All LED signal modules shall be rated for use in the ambient temperature range of -40° C to +74° C. LED signal modules shall be sealed against dust and moisture intrusion per the requirements of NEMA Standard 250-1991 for Type 4 enclosures to protect all internal LED and electrical components. LED signal modules shall be capable of operating at rated voltage in an environment of +74° C /85% RH for 1000 hours without the formation of internal condensing moisture.

BASIS OF ACCEPTANCE. Acceptance of signal heads, sections, and/or LED signal modules will be based on manufacturer's certification of compliance with these specification requirements, a list of serial numbers of the units being supplied, copies of all applicable test reports on the signal modules, and signature of the person responsible for certifying the tests. In addition, LED module model number and manufacturer's name must be listed on the NYS Signal Qualified Products List (QPL). The QPL can be obtained from the NYSDOT website.