

SECTION 3

LED SPECIFICATIONS

LIGHT EMITTING DIODE (LED) TRAFFIC SIGNAL 12" SPECIFICATION FOR SPAN WIRE AND MAST ARM MOUNTED SIGNALS

1. Purpose

The purpose of this specification is to provide the minimum performance requirements for 300 mm (12 in) LED traffic signal modules. An LED signal module shall be capable of replacing the optical unit of an existing vehicle traffic signal section.

2. Physical and Mechanical

Installation of a retrofit replacement LED signal module into an existing signal housing shall only require the removal of the existing optical unit components, i.e., lens, lamp module, and gaskets. The LED retrofit replacement shall not require the removal of the reflector and socket; shall be weather tight and fit securely into existing traffic signal housings built to the VTCSH "Vehicle Traffic Control Signal Heads" standard without modification to the housing.

3. Construction

The LED retrofit replacement shall not require the removal of the reflector and socket; shall be weather tight and fit securely in the housing. The power supply must be designed to fit and mount inside the traffic signal module. The external lens shall be smooth on the outside to prevent excessive dirt/dust buildup.

The assembly and manufacturing process for the LED signal assembly shall be designed to assure all internal LED and electronic components are adequately supported to withstand mechanical shock and vibration from high winds and other sources as per ITE requirements.

4. Environmental Requirements

The LED signal module shall be rated for use in the ambient operating temperature range of -40°C (-40°F) to +74°C (+165°F).

The LED signal module shall be protected against dust and moisture intrusion per the requirements of NEMA Standard 250-1991, for Type 4 enclosures to protect all internal LED, electronic, and electrical components.

The LED signal module lens shall be UV stabilized.

5. LED Signal Module Lens

Each module shall comprise of a smooth surfaced UV stabilized polycarbonate outer shell.

Red and Green LED indications shall meet the minimum luminous intensity values per the attached Table 1; Specifications for Span wire Mounted Signals for a minimum period of 60 months. Intensity

values shall be measured as per the ITE VTCSH (June 2005 version) specifications. The values in Table 1 equal or exceed the ITE VTCSH (June 2005 version) minimum luminous intensity values for every grid points.

Yellow LED indications shall meet the minimum luminous intensity values per the attached Table 1; Specifications for Span wire Mounted Signals for a minimum period of 60 months. Photometric, luminous intensity and color measurements for yellow LED signal modules shall be taken immediately after the modules are energized and at 25°C.

Initial intensity of the LED ball indications shall meet or exceed 120% of the values in Table 1; Specifications for Span wire Mounted Signals. This increased intensity shall be demonstrated on the independent lab reports. No optical lens shall be used in order to meet these visibility requirements.

The measured chromaticity coordinates of LED signal modules shall conform to the chromaticity requirements of Section 8.04 and Figure 1 of the ITE VTCSH standard (1998 version).

6. Materials

The multiple LED light source should be the latest technology available on the market. Materials used for the lens and signal module construction shall conform to ASTM specifications for the materials where applicable. Enclosures containing either the power supply or electronic components of the signal module shall be made of UL94VO flame retardant materials.

7. Chromaticity

The measured chromaticity coordinates of LED signal modules shall conform to the chromaticity requirements of Section 8.04 and Figure 1 of the VTCSH standard.

8. Electrical

All wiring and terminal blocks shall meet the requirements of Section 13.02 of the VTCSH standard. Two secured, color-coded, 914 mm (36 in) long 600 V, 20 AWG minimum, jacketed wires, conforming to the National Electrical Code, rated for service at +105°C, are to be provided for electrical connection. The module shall operate on a 60 Hz AC line voltage ranging from 80 volts rms to 135 volts rms with less than 10% light intensity variation. Nominal rated voltage for all measurements shall be 120 ± 3 volts rms. The circuitry shall prevent flickering over this voltage range. The module shall be ETL certified to meet applicable ITE standards (red and green).

9. LED Drive Circuitry (Power Supply)

The individual LED light sources shall be wired so that a catastrophic failure of one LED light source will result in the loss of only that one LED light source, and the loss of no more than 1% of the total LED's within the LED signal module. The power supply must current regulated. Independent third party laboratory reports shall be supplied to verify modules meet the above requirements.

10. Electronic Noise

The LED signal and associated on-board circuitry must meet Federal Communications Commission (FCC) Title 47, Sub-Part B, Section 15 regulations concerning the emission of electronic noise.

11. Power Factor (PF)

The LED signal module shall provide a power factor of 0.90 or greater at 25°C and at the nominal operating voltage.

12. AC Harmonics

Total harmonic distortion (THD), (current and voltage); induced into an ac power line by a signal module shall not exceed 20 percent, over the operating voltage range specified in Section 14 and within the ambient temperature range specified in Section 4.

13. Transient Voltage Protection

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, 1992.

14. Voltage Range

The LED signal module shall operate from a 60 ± 3 HZ ac line power over a voltage range from 80 Vac rms to 135 Vac rms. The current draw shall be sufficient to ensure compatibility and proper triggering and operation of load current switches and conflict monitors in signal controller units the procuring traffic authority customer has in use.

15. Signal Module Burn-in

All LED signal modules shall be energized for a minimum of 24 hours, at 100 percent on-time duty cycle, in an ambient temperature of 60°C (+140°F).

16. Design Qualification Testing

Independent lab test results showing the LED indications satisfy ITE Chapter 2a, VTCHS Part 2: Light Emitting Diode (LED) Vehicle Signal Modules (1998 version) sections 3, 4 and 5 (with the exception of 4.1), and attached Table 1, Specifications for Span wire Mounted Signals must be supplied.

Design Qualification testing shall be performed on new LED signal module designs, and when a major design change has been implemented on an existing design.

Testing shall be performed once every 5 years or when the module design or LED technology has been changed. Test data shall be retained by the manufacturer for a minimum period of 5 years.

17. Quality Assurance

LED signal modules shall be manufactured in accordance with a vendor quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance

MINIMUM LIGHT INTENSITY GRID SPECIFICATION FOR 12IN GREEN

Angle	27.5	22.5	17.5	12.5	7.5	2.5	-2.5	-7.5	-12.5	-17.5	-22.5	-27.5
22.5U	26	30	33	38	43	47	47	43	38	33	30	26
17.5U	29	35	47	70	112	132	132	112	70	47	35	29
12.5U	32	44	83	188	237	276	276	237	188	83	44	32
7.5U	35	62	168	286	348	420	420	348	286	168	62	35
2.5U	38	78	192	330	470	491	491	470	330	192	78	38
2.5D	43	81	193	341	527	590	590	527	341	193	81	43
7.5D	37	72	186	317	474	594	594	474	317	186	72	37
12.5D	35	59	151	270	360	443	443	360	270	151	59	35
17.5D	34	47	90	179	254	289	289	254	179	90	47	34
22.5D	33	38	50	78	110	137	137	110	78	50	38	33
27.5D	30	32	35	39	43	47	47	43	39	35	32	30
32.5D	27	27	28	29	29	29	29	29	29	28	27	27
37.5D	22	23	24	24	24	24	24	24	24	24	23	22

MINIMUM LIGHT INTENSITY GRID SPECIFICATION FOR 12IN YELLOW
(Measured Immediately After Modules are Energized)

Angle	27.5	22.5	17.5	12.5	7.5	2.5	-2.5	-7.5	-12.5	-17.5	-22.5	-27.5
22.5U	57	64	72	76	77	80	80	77	76	72	64	57
17.5U	62	73	86	103	116	129	129	116	103	86	73	62
12.5U	68	82	109	149	195	231	231	195	149	109	82	68
7.5U	71	94	142	227	364	432	432	364	227	142	94	71
2.5U	74	105	175	333	502	649	649	502	333	175	105	74
2.5D	82	155	291	501	728	892	892	728	501	291	155	82
7.5D	77	118	228	391	582	701	701	582	391	228	118	77
12.5D	75	101	157	264	415	461	461	415	264	157	101	75
17.5D	71	90	123	171	230	288	288	230	171	123	90	71
22.5D	64	78	95	117	140	158	158	140	117	95	78	64
27.5D	59	67	75	84	92	98	98	92	84	75	67	59
32.5D	52	58	63	67	69	70	70	69	67	63	58	52
37.5D	44	50	52	56	57	57	57	57	56	52	50	44

SECTION 4

12” LED Vehicle Arrow Traffic Signal Modules

1.0 PURPOSE

The purpose of this specification is to provide the minimum performance requirements for 12 in. LED vehicle arrow traffic signal modules. This specification refers to definitions and practices described in "Vehicle Traffic Control Signal Heads" published in the *Equipment and Materials Standards of the Institute of Transportation Engineers*, referred to in this document as "VTCSH".

2.0 PHYSICAL AND MECHANICAL REQUIREMENTS

2.1 General

LED vehicle arrow traffic signal modules (The Arrow) designed as retrofit replacements for existing signal lamps shall not require special tools for installation. Retrofit replacement LED arrow shall fit into existing traffic signal housings built to the VTCSH Standard without modification to the housing.

Installation of a retrofit replacement LED arrow into an existing signal housing shall only require the removal of the existing optical unit components, i.e., lens, lamp module and gaskets. The installation of the LED arrow shall not require removal of the reflector. It shall be weather tight, fit securely in the housing and shall connect directly to existing electrical wiring.

2.2 LED Vehicle Arrow Traffic Signal Module

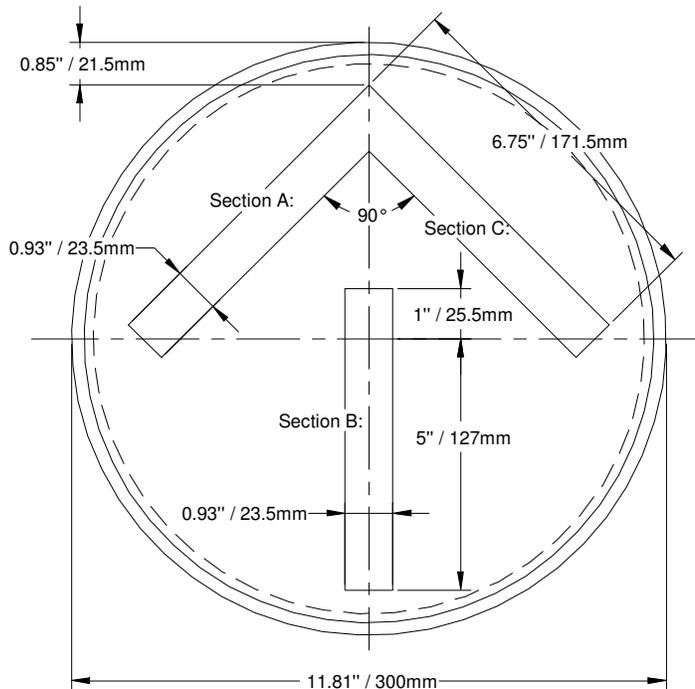
2.2.1 The retrofit LED arrow shall be capable of replacing the optical unit.

2.2.2 Tinting (Optional) -The lens shall be tinted or shall use transparent film or materials with similar characteristics.

2.2.3 The LED arrow lens shall be a replaceable part without the need to replace the complete LED arrow.

2.2.4 The configuration of the arrow icon is illustrated in Figure 1.

FIGURE 1



2.3 Environmental Requirements

2.3.1 The LED arrow shall be rated for use in the ambient operating temperature range, of -40°C (-40°F) to $+74^{\circ}\text{C}$ ($+165^{\circ}\text{F}$).

2.3.2 The LED arrow shall be protected against dust and moisture intrusion per NEMA Standard 250-1991 requirements, for Type 4 enclosures to protect all internal LED, electronic, and electrical components.

2.3.3 The LED arrow lens shall be UV stabilized.

2.4 Construction

2.4.1 The LED arrow shall be a single, self-contained device, not requiring on-site assembly for installation into an existing traffic signal housing. The power supply must be designed to fit and mount inside the LED arrow.

2.4.2 The assembly and manufacturing process for the LED arrow assembly shall be designed to assure all internal LED and electronic components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

2.5 Materials

2.5.1 Materials used for the module construction shall conform to ASTM specifications for the materials where applicable.

2.5.2 Enclosures containing the power supply and electronic components of the arrow shall be made of UL94VO flame retardant materials. The lens of the arrow is excluded from this requirement.

2.6 Module Identification

2.6.1 Each LED arrow shall be identified on the backside with the manufacturer's name and serial number.

2.6.2 The following operating characteristics shall be identified: nominal operating voltage, power consumption, and Volt-Ampere.

2.6.3 Arrows shall have a prominent and permanent vertical indexing indicator, i.e., UP ARROW or the word UP or TOP, for correct indexing and orientation inside a signal housing.

3.0 PHOTOMETRIC REQUIREMENTS

3.1 Luminous Intensity & Distribution

3.1.1 The maintained minimum luminous intensity values for LED arrows throughout the warranty period, under the operating conditions defined in Sections 2.3.1, and 4.2.1, and at the end of the warranty period, shall not be less than the values shown in Table 1.

3.1.2 The uniformity of the icon illumination shall meet a ratio of not more than 1 to 5 between the minimum and maximum illuminance measurements (in Cd/m²). A spot size of 12mm shall be used with at least three measurements taken in each of the three sections (A, B & C) shown in figure 1.

3.1.3 The optical lens shall reflect a light distribution look similar to that of an incandescent lamp, without the individual LED's being visible.

3.2 Chromaticity

The measured chromaticity coordinates of LED arrows shall be between 500 nm and 650 nm, conforming to the chromaticity requirements of Section 8.04 and Figure 1 of the VTCSH standard.

Table 1. Maintained Minimum Luminous Intensity for the LED Vehicle Arrow Traffic Signal Modules.

Candlepower Values (candelas (cd))

Vertical Down	Horiz. +/-	12-inch Signal		
		Red	Yellow	Green
2.5°	2.5°	60	150	90
	7.5°	44	110	66
	12.5°	25	62	38
	17.5°	14	35	21
7.5°	2.5°	40	100	60
	7.5°	36	90	54
	12.5°	26	65	39
	17.5°	16	40	24
	22.5°	7	17	11
	27.5°	3	7	4
12.5°	2.5°	9	23	14
	7.5°	9	22	14
	12.5°	8	20	12
	17.5°	6	15	9
	22.5°	4	10	6
	27.5°	3	7	4
17.5°	2.5°	4	10	6
	7.5°	4	10	6
	12.5°	4	10	6
	17.5°	4	9	6
	22.5°	4	8	5
	27.5°	3	7	4

The LED arrow wattage shall meet the following requirements:

Retrofit	Wattage
12" Red Arrow	5 or less
12" Yellow Arrow	10 or less
12" Green Arrow	5 or less

4.0 ELECTRICAL

4.1 General

All wiring and terminal blocks shall meet the requirements of Section 13.02 of the VTCSH standard. Two secured, color coded, 914 mm (36 in) long 600 V, 20 AWG minimum, jacketed wires, conforming to the National Electrical Code, rated for service at +105°C, are to be provided for electrical connection.

4.2 Voltage Range

4.2.1 LED arrows shall operate from a 60 ± 3 cycle ac line power over a voltage range from 80 Vac rms to 135Vac rms. The current draw shall be sufficient to ensure compatibility and proper triggering and operation of load current switches and conflict monitors in signal controller units the procuring traffic authority customer has in use.

4.2.2 Nominal operating voltage for all measurements shall be 120 ± 3 volts rms.

4.2.3 Fluctuations in line voltage over the range of 80Vac to 135Vac shall not affect luminous intensity by more than ± 10 percent.

4.2.4 The LED circuitry shall prevent flicker at less than 100 Hz over the voltage range specified in Section 4.2.1.

4.2.5 Low Voltage Turn Off

There shall be no illumination from the arrow when the applied voltage is less than 45 volts AC. To test for this condition the unit must first be fully illuminated at the nominal operating voltage. The applied voltage is then reduced to the point that there is no illumination. This point must be greater than 45 volts AC. The same requirement should apply in rising voltage from 0 to 45 with no visible illumination.

4.2.6 Turn-On and Turn-Off Time:

The modules shall reach 90% of their full illumination (turn-on) within 100 msec after the application of the nominal operating voltage. The arrows shall not be illuminated (turn-off) within 100 msec after the removal of the nominal operating voltage.

4.3 Transient Voltage Protection

4.3.1 The arrow 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, 1992.

4.4 LED Drive Circuitry

4.4.1 The individual LED light sources shall be wired so that the catastrophic failure of one LED will result in the loss of the light from only that one LED.

4.5 Electronic Noise

The LED arrow and associated on-board circuitry must meet Federal Communications Commission (FCC) Title 47, SubPart B, Section 15 regulations concerning the emission of electronic noise.

4.6 Power Factor (PF) and AC Harmonics

4.6.1 LED arrows shall provide a power factor of 0.90 or greater when operated at nominal operating voltage, and 25°C (77°F).

4.6.2 Total harmonic distortion induced into an ac power line by an LED arrow, at 25°C (77°F) shall not exceed 20 percent.

5.0 QUALITY ASSURANCE

5.1 General

5.1.1 Quality Assurance Program

LED arrows shall be manufactured in accordance with a vendor quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance, and (2) production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of LED arrows built to meet this specification.

5.1.2 Record Keeping

QA process and test results documentation shall be kept on file for a minimum period of seven years.

5.1.3 Conformance

LED arrows designs not satisfying design qualification testing and the production quality assurance testing performance requirements in Sections 5.3 and 5.4 shall not be labeled, advertised, or sold as conforming to this specification.

5.2 Manufacturers Serial Numbers

Each LED arrow shall be identified by a manufacturer's serial number for warranty purposes.

5.3 Production Quality Assurance (QA) Testing

All new LED arrows shall undergo the following Production Quality Assurance testing prior to shipment. Failure of any LED arrow to meet requirements of these QA tests shall be cause for rejection. QA test results shall be maintained per the requirement of Section 5.1.2.

5.3.1 Production Luminous Intensity Test

All arrows shall be tested for maintained minimum luminous intensity. A single point measurement with a correlation to the intensity requirements of Table 1 in Section 3.0 may be used.

5.3.2 Power Factor

All LED arrows shall be tested for power factor after burn-in per the requirements of Section 4.6.1. A commercially available power factor meter may be used to perform this measurement.

5.3.3 Current

All LED arrows shall be measured for the amount of current consumption. The measured current values shall be compared against current values resulting from design qualification measurements in Section 5.4.4.1. Measured current values in excess of 120 percent of the design qualification current values shall be cause for rejection.

5.3.4 Visual Inspection

All LED arrows shall be visually inspected for any exterior physical damage or assembly anomalies.

5.4.2 Maintained Minimum Luminous Intensity

5.4.2.1 For independent lab testing, the LED arrow modules shall be tested for maintained minimum luminous intensity at each of the points indicated in Table 1, Section 3.0. These measurements shall be recorded at an ambient temperature of 25°C after the signal has been operated for 60 min. The yellow arrow shall be measured at initial energization.

6.0 WARRANTY

6.1 LED arrows shall be replaced or repaired if it fails to function as intended due to workmanship or material defects within the first 60 months from the date of delivery.

6.2 LED arrows which exhibit luminous intensities less than the minimum values specified in Table 1 Section 3.0 within the first 60 months of the date of delivery shall be replaced or repaired.

7.0 DOCUMENTATION

7.1 Independent Lab reports from (Intertek Testing Services, ETL Semko), or LightMetrics, shall be supplied to verify modules meet the photometric requirements in table 1, per the guidelines in section 5.4.2.1, and power factor and AC harmonics requirements in section 4.6.

SECTION 5

PEDESTRIAN SIGNALS

GENERAL

Pedestrian signal shall be designed to fit the same mounting brackets employed by California type A, B, C, and G pedestrian signals. Construction design shall be compatible with clamshell mounting hardware.

5.1 LED PEDESTRIAN AND COUNTDOWN SIGNAL MODULE

(16" X 18" Type – Overlapping Fully Populated hand and man + countdown)

5.1.1 PRODUCTS

GENERAL

Pedestrian and countdown LED traffic signal modules shall be designed as a retrofit replacement for the message bearing surface of a nominal 16" × 18" pedestrian and countdown traffic signal housing built to the PTCSI Standard. The message-bearing surface of the module shall be supplied with a **fully populated** "HAND" and "MAN" symbol, overlapping, with the individual LED's being visible, that comply with PTCSI standard for these symbols for a message-bearing surface of the size specified. The numbers 00 to 99 on the numerical display shall have 2 rows of LED's that are side by side, not offset or staggered, with 14 segments and a minimum height of 9 inches. The 2-row countdown digit portion shall have no less than 180 LED's, to ensure even illumination and visibility. The Man symbol shall have no less than 72 LED's to ensure even illumination and visibility. The Hand symbol shall have no less than 120 LED's to ensure even illumination and visibility.

INSTALLATION

- a. LED pedestrian and countdown signal modules shall be designed as retrofit replacements for the existing pedestrian signals.
- b. LED pedestrian and countdown signal modules shall not require special tools for installation.
- c. LED pedestrian and countdown signal modules shall fit into the existing traffic housings built to the VTCSH Standard without any modification to the housing.
- d. LED pedestrian and countdown signal modules shall be weather tight, fit securely in the housing and shall connect directly to existing electrical wiring.
- e. Installation of a replacement LED module into the existing pedestrian housing shall only require the removal of the existing optical unit components, i.e., lens, lamp, gaskets, and reflector.

5.1.2 LED PEDESTRIAN AND COUNTDOWN SIGNAL MODULE CONSTRUCTION

- a. The LED pedestrian and countdown signal module shall be a single, self-contained device, not requiring on-site assembly for installation into the existing traffic signal housing and include an installed gasket.
- b. All Portland Orange LEDs shall be "AlInGaP" technology or equal, and rated for 100,000 hours or more at 25°C and 20 mA. White LEDs must be InGaN technology.
- c. All internal LED and electronic components shall be adequately supported to withstand mechanical shock and vibration from high winds and other sources.
- d. The signal module shall be made of UL94VO flame-retardant materials. The lens is excluded from this requirement.
- e. The lens of the LED pedestrian and countdown signal modules shall be polycarbonate UV stabilized.

- f. The exterior of the lens of the LED pedestrian and countdown signal module shall be uniform and frosted to reduce sun phantom effect.
- g. Each individual LED traffic module shall be identified for warranty purposes with the manufacturer's trade name, serial number and operating characteristics, i.e., rated voltage, power consumption, and volt-ampere.
- h. The walking person and hand icons shall be full (not outlines). The countdown digits shall be 9 inches in height and have a minimum of two aligned (non-staggered) rows of LED's. The configurations of the walking person icon and hand icon are illustrated in Figure 1 and Figure 2 respectively.



Figure 1.

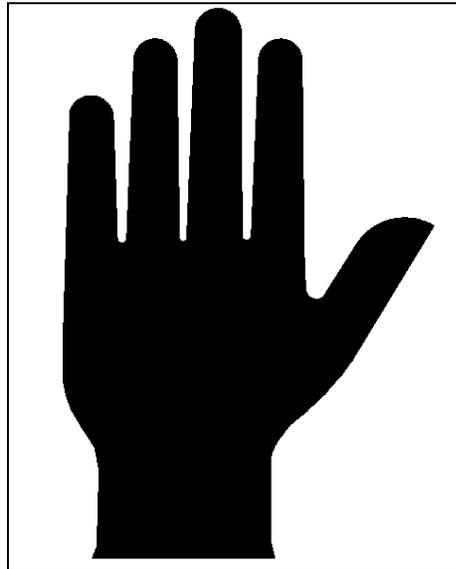


Figure 2.

Dimensions for Figure 1 and Figure 2

For each nominal message bearing surface (module) size, use the corresponding H (height) and W (width):

Bearing Surface	Module Size	Icon Height	Icon Width	Countdown Height	Countdown Width
A	406 x 457 mm (16 x 18 in)	297 mm or 11 in	178 mm or 7 in	178 mm or 9 in	165 mm or 6.5 in

5.1.3 ENVIRONMENTAL REQUIREMENTS

- a. The LED pedestrian and countdown signal modules shall be rated for use in the ambient operating temperature range of -40°C to +60°C (-40°F to +140°F).
- b. The LED pedestrian and countdown signal modules, when properly installed with gasket, shall be protected against dust and moisture intrusion per requirements of NEMA Standard 250-1991, sections 4.7.2.1 and 4.7.3.2, for type 4 enclosures to protect all internal LED, electronic, and electrical components.

5.1.4 PHOTOMETRIC REQUIREMENTS

a. **Luminance, Uniformity & Distribution**

For a minimum period of 60 months, the maintained minimum luminance values for the modules under the operating conditions defined in Sections 2.3.1 and 4.2.1, shall not be less than the values shown Reference 1 and Reference 2 for the walking person and hand icons respectively, when measured perpendicular to the surface of the module at nine (nine) separate points on the icon. These values may decrease up to 50% of these table values beyond 15° from the perpendicular in either to the left or right on a horizontal plane.

Reference 1. Maintained Minimum Luminance value for the Walking Person icon of the Module (candelas/meter square): **5300 cd/m²**

Reference 2. Maintained Minimum Luminance value for the Hand icon of the Module (candelas/meter square): **3750 cd/m²**

b. **Uniformity**

The uniformity of the walking person and hand icons' illumination shall meet a ratio of not more than 1 to 5 between the minimum and maximum luminance measurements (in Cd/m²).

c. **Chromaticity**

The standard colors for the LED Pedestrian Signal Module shall be White for the walking person and Portland Orange for the hand icon and countdown digits. The colors for these icons shall conform to the CIE chromaticity diagram x, y coordinates as follows. The white area is defined by the sum of these two areas that are contiguous, and are defined by the following lines:

First area:

Yellow boundary: $x = 0.400$

Blue boundary: $x = 0.280$

Green boundary: $y = 0.7917x + 0.0883$

Purple boundary: $y = 0.4600x + 0.1810$

Second area:

Yellow boundary: $x = 0.450$

Blue boundary: $x = 0.400$

Green boundary: $y = 0.7917x + 0.0483$

Purple boundary: $y = 0.4600x + 0.2210$

The Portland Orange area is defined as

Red boundary: $y = 0.331$

Yellow boundary: $y = 0.390$

White boundary: $y = 0.997 - x$

5.1.5 ELECTRICAL

- a. Maximum of 3ea secured, color coded, 914 mm (36 in) long, 600V, 16 AWG minimum, jacketed wires, conforming to the National Electrical Code, rated for service at +105°C, are to be provided for electrical connection.
- b. The LED pedestrian and countdown signal module shall operate from a 60 ±3 Hz AC line over a voltage range of 80 VAC to 135 VAC. Rated voltage for all measurements shall be 120 ±3 volts rms.

- c. The LED circuitry shall prevent perceptible flicker over the voltage range specified above.
- d. The LED pedestrian and countdown signal module circuitry shall include voltage surge protection against high-repetition noise transients and low-repetition noise transients as stated in Section 2.1.6, NEMA Standard TS-2, 1992.
- e. Catastrophic failure of one LED light source in Man & Hand Symbol shall not result in the loss of more than the light from that one LED.
- f. The individual LED light sources for the countdown numbers indication shall be wired so that a catastrophic failure of one LED light source shall not result in the loss of illumination of more than one display LED segment.
- g. The LED pedestrian and countdown module shall be operationally compatible with the currently used controller assemblies. The LED pedestrian and countdown module shall be operationally compatible with conflict monitors.
- h. The LED pedestrian and countdown module including its circuitry must meet Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of noise.
- i. The LED pedestrian and countdown module shall provide a power factor of .90 or greater over the operating voltage range and temperature range specified above for modules with 6 watts or more.
- j. Total harmonic distortion (current and voltage) induced into an AC power line by an LED pedestrian and countdown module shall not exceed 20% over the operating voltage range and temperature range specified above.

5.1.6 MODULE FUNCTIONS

a. **Basic operation**

The control and regulation module shall be of the “smart” type in order for the countdown displays to be automatically adjusted with the programmed intervals of the traffic controller. The module shall operate in one mode only: Clearance Cycle Countdown Mode. The module will start counting when the flashing clearance signal turns on and will countdown to “0” and turn off when the steady “Don’t Walk” signal turns on.

b. **Learning Cycle**

At power on, the module enters a single automatic learning cycle. During the automatic learning cycle, the countdown display shall remain dark.

c. **Cycle Modification**

The unit re-programs itself if it detects any increase or decrease of Pedestrian Timing. The counting unit will go blank once a change is detected and then take one complete pedestrian cycle (with no counter during this cycle) to adjust its buffer timer.

d. **Recycling**

The module shall allow for consecutive cycles without displaying the steady Hand icon (“Don’t Walk”).

e. **Preemption**

The module shall recognize preemption events and temporarily modify the crossing cycle accordingly. If the controller preempts during the walking man, the countdown will follow the controller's directions and will adjust from walking man to flashing hand. It will start

to count down during the flashing hand. If the controller preempts during the flashing hand, the countdown will continue to count down without interruption.

The next cycle, following the preemption event, shall use the correct, initially programmed values.

f. **“Don’t Walk” Steady**

If the controller output displays Don’t Walk steady condition and the unit has not arrived to zero or if both the hand and man are dark for some reason, the unit suspends any timing and the digits will go dark.

g. **Power Outage**

The equipment must maintain a consistent countdown during short power failures (<1 second). A longer failure or an absence of signal superior to one (1) second must turn off display and trigger a restart system remembering the last sequence, as it is done for the NEMA traffic controller.

h. **Operating Modes**

The module shall operate in one mode only:

Clearance Cycle Countdown Mode – The module will start counting when the flashing clearance signal turns on and will countdown to “0” and turn off when the steady “Don’t Walk” signal turns on.

Note: The units shall not have any external attachments, dip switches, toggle switches or options that will allow the mode to be changed from counting the clearance cycle, to the full walk/don’t walk cycle or any other modification to the icons or digits.

5.1.7 QUALITY ASSURANCE

- a. LED pedestrian and countdown modules shall be manufactured in accordance with a Vendor quality assurance (QA) program including both design and production quality assurance. All QA process and test result documentation shall be kept on file for a minimum of seven years.
- b. Samples: Submit within 7 business days of request, signal module sample. The samples will be inspected, tested, and evaluated for conformity to the specifications. Samples must be actual production unit modules and not a prototype or test unit. If Bidder fails to submit a sample for evaluation, or if the sample does not conform to the specification, the Bid will be rejected. Each module submitted shall be accompanied with a complete circuit schematic for the unit, one standard catalog cut and one manufacturer’s technical specification sheet for the unit, and specification describing individual LED light sources used in the unit.

5.1.8 WARRANTY

- a. The unit shall be repaired or replaced by the contractor if it exhibits a failure due to workmanship or material defect within the first 60 months of delivery.

Requirements Checklist to be filled out by Manufacturer to demonstrate compliance

Requirement	Comply
Fully populated Hand and Man with LED's fully visible	
Countdown digits – 2 rows of LED's side by side, not offset, not staggered, 9" high with 14 segments	
Countdown digits – minimum 180 LED's	
Man Symbol – minimum 72 LED's	
Hand Symbol – minimum 120 LED's	
Catastrophic failure of one LED light source in Man & Hand Symbol shall not result in the loss of more than the light from that one LED.	
Catastrophic failure of one LED light source in the digits shall not result in the loss of the entire segment. A maximum of 1 row of LEDs per segment is allowed to go out.	
Module operates in Clearance mode only	
The units shall not have any external attachments, dip switches, or options that will allow the mode to be changed from counting the <u>clearance cycle</u> , to the full walk/don't walk cycle.	
Provide Model Number	