A. Purpose

This Manual Part recommends design criteria and functional/operating guidelines for an LED light unit used in Wayside Signal Applications.

B. Definitions Pertaining to this Manual Part

1. Cold Filament Test: A test of incandescent bulbs to verify that the bulb filament is intact when the bulb is not lit (i.e. light is capable of being emitted, but is not being emitted during the test). For LED signals, the equivalent test will verify that the wiring and associated circuitry is intact up to the signal head.

2. Hot Filament Test: A test of incandescent bulbs to verify that the bulb filament is intact while the bulb is lit (i.e. light is being emitted). For LED signals the equivalent test will verify that at least 50% of the individual LED’s installed are operable.

3. Light Out Detection: Light out detection is a method of verifying if a signal is still operable. On an incandescent signal it is accomplished by monitoring the circuit to ensure the circuit is still complete (no break). Light out detection for an LED or LED array shall ensure the LED is still operating at a minimum level. For an LED array the minimum operable level is considered 50% of the installed diodes on an array.

C. Design

LED Wayside Signal Units shall be designed in compliance with the following design requirements:

1. LED Wayside Signal units shall be designed to operate in the appropriate environment as specified in Manual Part 11.5.1 Recommended Environmental Requirements for Electrical and Electronic Railroad Signal System Equipment.

2. LED Wayside Signal units shall be designed to meet environmental requirements as specified in Manual Part 11.5.1.


5. LED Wayside Signal Units shall be designed in accordance with Manual Part 17.3.1 Recommended Safety Assurance Program for Electronic/Software-Based Equipment and Systems Used in Vital Signal Applications. The following failure modes shall be considered unacceptable in design of LED Wayside Signals. (This includes secondary failures in combination with non-self-revealing failures as defined in Manual Part 17.3.1, Section C.12.)

   a. LED Wayside Signal Units shall not flash (at any rate or for any duration) when the operating voltage is steady and between 0 volts and the max rated input voltage. This applies under both normal and failure conditions of the LED Wayside Signal Unit.

   b. LED Wayside Signal Units shall not flash (at any rate or for any duration) in response to processor-based check signals, where used, under normal or failure conditions of the LED Wayside Signal Unit.

   c. Where Light Out Detection is required, the detection system shall operate properly under normal or failure conditions of the LED Wayside Signal Unit. This includes all voltages where the LED Wayside Signal may light, not just the minimum rated voltage.

   Note: While it is not required for the LED Wayside Signal to operate below the minimum rated voltage, the Light Out Detection Circuits must work to whatever levels that allow the LED to generate light.

   d. LED Wayside Signals shall not display an incorrect color aspect (for single units displaying multiple colors) under normal or failure conditions of the LED Wayside Signal Unit.

   e. For LED Wayside Signals interfacing to systems with both Hot and Cold Filament Checks, the Cold Filament Check shall not be successfully passed if the Hot Filament Check would fail. This applies under normal or failure conditions.
Note: Failure to achieve this may lead to a flashing signal as the signal is downgraded due to a Hot Filament Failure, then upgraded again when the Cold Filament Test is passed.


7. The LED Wayside Signal Unit shall be designed to minimize the occurrence of a phantom aspect from being displayed due to an external light source.

8. The LED Wayside Signal Unit shall generate at least its specified candela output over its rated lifetime and operating range. Manufacturer shall supply photometric table of luminous intensity vs. horizontal and vertical spread.

9. The LED Wayside Signal Unit shall be designed to prevent operation due to inductive coupling from adjacent wiring.

   Note: This is a particular concern for signals described in E.1 below that may operate on very low power levels. This refers to both design and installation issues.

10. Manufacturer shall clearly define the operating lifetime for the wayside LED signal unit to maintain its rated light output.

11. To enable LED's to be used in flashing aspect applications, the rise and fall time to and from 90% illumination, when voltage is supplied to or removed from the unit, should not exceed 50 milliseconds (approximately 10% of the on and off durations at 65 flashes per minute).

D. LED Wayside Signals for Use with Existing Relay and Processor-based Systems

1. LED Wayside Signals may consist of one of the following two options. For the remainder of these recommendations, the term “LED Wayside Signal” shall refer to either option.
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a. An LED Wayside Signal may be a single unit capable of being directly mounted in a signal head and directly connected to the existing control circuitry.

b. An LED Wayside Signal may consist of two portions. The first portion may be mounted in an existing signal head. The second portion is an interface control unit and may be mounted in the wayside enclosure or other appropriate location. When LED Wayside Signals interface with an external interface control unit, they shall be clearly labeled as requiring such interface control unit.

2. Each of options 1.a and 1.b above shall contain Light Out Detection if required by the application.

3. Where Light Out Detection is not provided, the LED Wayside Signal shall be clearly labeled as not providing this function. LED Wayside Signals without “Light Out” detection are still required to operate safely under the failure conditions identified in Section B.3 of this Manual Part.

4. A “Light Out” condition shall be determined when 50% or less of the rated candela output is being generated during the rated lifetime of the wayside LED signal.

5. LED Wayside Signal Units shall be designed to interface with control circuits with the following attributes.

   a. Operating voltages of the LED Signal Unit shall be one of the following:

      1. 8.5 volts to 16 volts dc and 8.5 volts to 16 volts ac, 60 Hz to 100 Hz. (12 volts dc and ac nominal)
      2. 8.5 volts to 16 volts ac, 60 Hz to 100 Hz.(12 volts ac nominal)
      3. 8.5 volts to 16 volts dc. (12 volts dc nominal)
      4. 85 volts to 135 volts ac, 60 Hz to 100 Hz (110 volts ac nominal)

      (1) 8.5 volts to 16 volts dc and 8.5 volts to 16 volts ac.
      (2) 8.5 volts to 16 volts ac.
      (3) 8.5 volts to 16 volts dc.

      110 volts ac nominal.
Note: Unit must be clearly marked for operating voltage range and polarity where applicable.

6. DC powered LED Wayside Signal Unit shall draw at least 1 ampere at the minimum rated voltage when it is energized and generating greater than 50% of its rated output (or greater than 50% of the LED's are generating light output). When equipped for “light out” detection, dc powered LED Wayside Signal Unit shall draw less than 5 mA at the maximum rated voltage when it is in a “light out” condition.

7. The LED Wayside Signal Unit shall not generate visible light of any duration during the periodic operational check pulses used by many processor-based devices. These pulses may be of full output power but of less than 5 ms duration. The repetition rate of these pulses may vary from 100 ms to 1 s.

E. LED Wayside Signals for Use with Alternative Control Interfaces

LED Wayside Signal Units may be designed for alternative control interfaces when a complete LED Wayside Signal System (including drive circuitry) is installed. For these applications, the LED Wayside Signal shall be clearly marked as to the required interface.