11121.1. **Description.** This Specification describes the minimum acceptable design and performance requirements for a 12 in. (300 mm) light emitting diode (LED) traffic signal lamp unit for span wire and mast arm applications.

11121.2. **Units of Measurements.** The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

11121.3. **Material Producer List.** The Traffic Operations Division (TRF), Traffic Signals Branch maintains the Material Producer List (MPL) of all materials conforming to the requirements of this Specification. Materials appearing on the MPL, entitled “Traffic Signals,” need no further sampling or testing unless deemed necessary by the Project Engineer or TRF.

11121.4. **Bidders’ and Suppliers’ Requirements.** The Department will purchase or allow on projects only those products listed by manufacturer and product code or designation shown on the MPL.

Use of pre-qualified product does not relieve the contractor of the responsibility to provide product that meets this Specification. The Department may inspect or test material at any time and reject any material that does not meet the specifications.

11121.5. **Pre-Qualification Procedure.**

   **A. Pre-Qualification Request.** Submit requests for evaluation to the Texas Department of Transportation, Traffic Operations Division, Traffic Engineering Section (TRF-TE-CP), 125 E. 11th Street, Austin, Texas, 78701.

   **B. Pre-Qualification Samples.** Prior to shipping any samples, contact TRF-TE, Traffic Signals Branch at (512) 506-5100. Ship two samples of each color indication and type from a normal production run of each LED traffic signal lamp unit to the Texas Department of Transportation, Traffic Operations Division, Traffic Engineering Section (TRF-TE-CP), 9500 North Lake Creek Parkway, Austin, Texas 78717.

   Provide additional samples when directed by the Department.

   Submit all products for pre-qualification evaluation at no cost to the Department.

   Provide the following with the pre-qualification samples:

   - Manufacturer name and contact information
   - Brand and model number of LED traffic signal lamp unit
   - Manufacturer’s recommended drive current and degradation curves
• One schematic diagram for each LED traffic signal lamp unit model being evaluated, along with any necessary installation instructions

• Copy of the manufacturer’s International Organization for Standardization ISO 9000 certification, or latest revision (including date)

• Copy of the manufacturer’s quality assurance (QA) testing procedures

• Letter from the manufacturer confirming compliance to this Specification

• Testing procedures explaining compliance to this Specification, in addition to the Institute of Transportation Engineers (ITE) tests

• Independent laboratory reports confirming that each LED traffic signal lamp unit model is in compliance with this Specification
  ▪ Test reports must state that the LED traffic signal lamp model submitted meets or exceeds the latest ITE Vehicle Traffic Control Signal Heads (VTCSH) LED Supplemental Standards.
  ▪ Laboratory reports must include documentation of tests and verification of compliance to the additional provisions of this standard. Testing must follow all the instructions documented in the latest ITE VTCSH LED Circular Signal Supplement or latest ITE VTCSH LED Vehicle Arrow Traffic Signal Supplement as it pertains to the product being tested.

• Proof of Nationally Recognized Testing Laboratory (NRTL) status, as outlined in Section 11121.6.F, “Production Testing Requirements,” documented and submitted with each model of LED traffic signal lamp unit. Notify the Department in writing prior to changing testing labs.

• Completed checklist detailing the page and paragraph in the laboratory report where ITE and Department compliance has been tested

• Manufacturer’s written warranty against defects in materials, design and workmanship for LED traffic signal lamp units for a period of 60 months after installation

• Compliance letter and certification document specified in Article 11121.8, “Warranty Requirements”

C. Sampling and Testing. TRF will connect all samples submitted to the Department’s TS-2 Traffic Signal Control Cabinet and will test to NEMA TS-2 2003 environmental standards. All LEDs must be operational at the conclusion of the test and must not cause MMU trip conditions in the controller/cabinet during testing.

During the environmental testing, TRF may evaluate the samples for chromaticity and intensity after 8 hours of soaking at −40°F (−40°C) and 165°F (74°C), at low (80 VAC) and high (135 VAC) voltages.

TRF will conduct destructive testing to determine that the units are in conformance with the catastrophic LED failure clause.
D. Evaluation. TRF will return to the submitting party a letter of confirmation or rejection for each model submitted. For each rejected model, TRF will issue a test report along with the letter of rejection.

1. Qualification. If approved for use by the Department, TRF will add the material to the MPL.

Any deviation in product design after testing and Department approval constitutes a new model, which must be resubmitted for acceptance.

If a manufacturer determines there is reason to remove a model from the MPL, it must submit a letter to TRF identifying the problem in writing. TRF will remove the model without prejudice. Once the problem has been resolved to TRF’s satisfaction, the manufacturer may apply for re-qualification for the new model.

All submitted materials become the property of the Department.

2. Failure. Products not qualified under this Specification may not be furnished on Department projects and must be corrected of all deficiencies before reconsideration for qualification.

If products fail to meet any of the specification requirements, the producer may not resubmit for pre-qualification until 1 year from original evaluation date. TRF may waive this time limit if provided with documentation from an independent testing facility stating the product meets all requirements. TRF will enforce the 1-year time limit if, after retesting, the product again fails any of the specification requirements.

Costs of sampling and testing are normally borne by the Department; however, the costs of sampling and testing products failing to conform to the requirements of this Specification are borne by the contractor or supplier. The Director of TRF will assess this cost at the time of testing for each recurring non-compliant submittal.

Amounts due to the Department will be deducted from monthly or final estimates on contracts or from partial or final payments on direct purchases by the Department.

E. Periodic Evaluation. TRF may perform random sample testing on shipments, to be completed within 30 days after delivery.

TRF will perform optical testing with the module mounted in a standard traffic signal section, but without a visor or hood attached to the section or housing. The quantity of each model in the shipment will determine the number of modules tested. The sample size will conform to ANSI/ASQC Z1.4. TRF will determine the sampling parameters used for the random sample testing. All parameters of the specification may be tested on the modules. Acceptance or rejection of the shipment will conform to ANSI/ASQC Z1.4 for randomly sampled shipments.

F. Disqualification. The following conditions are cause for immediate removal from the MPL:

- A problem is found to exist with a LED traffic signal lamp unit (e.g., unsafe failure condition or excessive failure rate)
Excessive complaints about a manufacturer’s compliance with Article 11121.8, “Warranty Requirements”

Manufacturer deviates LED traffic signal lamp units from pre-qualified units without prior testing and approval from the Department

If TRF removes a model from the MPL for cause other than manufacturer’s recommendation, the manufacturer may not resubmit for approval for a minimum of one year.

TRF may reinstate a model on the MPL under a different model number, if all problems identified are corrected, and the new model does not exhibit the same problems. TRF must approve of the new model as a successful replacement.

11121.6. Material Requirements.

A. General Requirements. All LED traffic signal lamp units must conform to the latest versions of the ITE Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement standard, the ITE Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Circular Signal Supplement standard, and this Specification. In the case of conflicts between standards and specifications, the latest Department specifications will govern.

The LED traffic signal lamp unit must be designed as a retrofit replacement for existing signal lamps and will not require any special tools for installation. The 12 in. retrofit replacement LED traffic signal lamp unit must fit into existing traffic signal housings without modifications. Provide a gasket with each LED module to ensure proper fitting into every signal housing approved by the Department.

Installation of a retrofit replacement LED traffic signal lamp unit into existing signal housing must only require removal of the existing lens, reflector, and incandescent lamp; fitting of the new unit securely in the housing door; and connecting to existing electrical wiring or terminal block by means of simple connectors.

If proper orientation of the LED traffic signal lamp unit is required for optimum performance, prominent and permanent directional marking(s), i.e., an “UP arrow” or equivalent, for correct indexing and orientation must exist on the unit.

The manufacturer's name, serial number, manufactured date (minimum week and year), and other necessary identification must be permanently marked on the backside of the LED traffic signal lamp unit. A label must be placed on the unit certifying compliance to the latest ITE Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement or latest ITE Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Circular Signal Supplement standards, including standard title and date. All lamps manufactured must be affixed with an Intertek ETL Verified label or label from other third-party laboratory with NRTL status.

Any deviation to product design after testing and approval from the Department will constitute a new model and must have a new model number. The new model must be submitted for acceptance. Failure to adhere to this requirement will be grounds for automatic removal from the MPL until the Department approves an alternative solution.
Random testing of average production LED traffic signal lamp units will be conducted to ensure compliance with this Specification.

B. Physical and Mechanical Requirements. The LED traffic signal lamp unit must be a single, self-contained device, not requiring on-site assembly for installation into existing traffic signal housing.

The assembly and manufacturing process for the LED traffic signal lamp unit must ensure that all internal LEDs and electronic components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

Each LED traffic signal lamp unit must be comprised of a UV stabilized polymeric outer shell, multiple LED light sources, and a regulated power supply. LEDs must be mounted on a polycarbonate positioning plate or PC board.

C. Optical and Light Output Requirements. The LEDs must be manufactured using AlInGaP (Aluminum-Indium-Gallium-Phosphide) technology or other LEDs with lower susceptibility to temperature degradation than AlGaAs (Aluminum-Gallium-Arsenic). AlGaAs LEDs will not be allowed.

Designs that require LEDs to be operated at currents greater than the LED manufacturer’s recommended drive current will not be allowed.

The color of the LED traffic signal lamp units must be as specified in the Invitation for Bids.

Each LED traffic signal lamp unit must meet minimum laboratory light intensity values and light output distribution as described in ITE VTCSH LED Supplemental Standards for a minimum period of 60 months, based on normal use in traffic signal operation over an operating temperature range of $-40^\circ F (-40^\circ C)$ to $165^\circ F (74^\circ C)$.

Measured chromaticity coordinates of LED traffic signal lamp units must conform to the chromaticity requirements detailed in the ITE VTCSH LED Circular Signal Supplement, Section 4.2, “Chromaticity,” or in the ITE VTCSH LED Vehicle Arrow Traffic Signal Supplement, Section 4.2, “Chromaticity,” for circular or arrow indications respectfully for a minimum period of 60 months.

LED traffic signal lamp units tested or submitted for testing must be representative of typical production units. Perform optical testing with LED units mounted in standard traffic signal sections without visors or hoods attached to the signal sections.

A copy of the lab test report from an independent lab for each LED traffic signal lamp model must include light intensity values at each ITE specific distribution test point (balls supplement Table 1 or 2, arrow supplement Table 1 or 2). The lab report must document current, voltage, and total harmonic distortion (THD) for each test point. The power factor (PF) associated with each model must be documented.

D. Electrical Requirements. Each LED traffic signal lamp unit must incorporate a regulated power supply engineered to electrically protect the LEDs and maintain a safe and reliable operation. The power supply must provide capacitor filtered DC regulated current to the LEDs per the LED manufacturer specification. The power supply must be designed so that
the failure of an individual component or any combination of components cannot cause the signal to be illuminated after AC power is removed.

LED traffic signal lamp units must be operationally compatible with TS1, TS2 cabinet designs, and 170 cabinet designs. Under normal operating conditions, the LED lamp unit must operate without inhibiting any Conflict Monitor/MMU monitoring features.

LED lamp units with an incandescent appearance and meeting the criteria of this specification will be eligible for bid.

Arrow and circular LED traffic signal lamp units must be designed to sense a loss of light output due to catastrophic LED failure and react in compliance with the failed state impedance provision of the ITE VTCSH Circular Signal Supplement, Section 5.7. The LED unit must always be recognizable as an arrow indication for any loss of LEDs before the MMU trips.

Two, captive, color coded, 600 V, 18 AWG minimum jacketed wires, 3 feet (1 meter) long, conforming to the National Electric Code, rated for service at 22°F (105°C), are to be provided for an electrical connection.

The LED traffic signal lamp units must have on-board circuitry including voltage surge protection, to withstand high-repetition noise transients and low-repetition high-energy transients as stated in NEMA Standard TS 2-2003, Section 2.1.8, except voltage must be 2000 V instead of 1000 V. The circuitry must also be able to withstand high-repetition low-energy transients as stated in NEMA Standard TS 2-2003, Section 2.1.6.

E. Environmental Requirements. Environmental requirements must meet or exceed ITE VTCSH LED Standard Supplements.

The LED traffic signal lamp units must be rated for use in the ambient operating temperature range of −40°F (−40°C) to 165°F (74°C).

The LED traffic signal lamp units must be dust and moisture tight to protect all internal LED and electrical components.

The LED traffic signal lamp units must consist of a housing that is a sealed, watertight enclosure to eliminate dirt contamination and allow for safe handling in all weather conditions. Perform moisture resistance testing on LED signal modules in conformance with the requirements in the ITE VTCSH LED Standard Supplements. Evidence of internal moisture after testing will be cause for rejection.

F. Production Testing Requirements. The manufacturing facility must have a quality assurance (QA) program in place to ensure product reliability. All lamps must be certified in a LED Traffic Signal Module Certification Program by Intertek ETL or other third-party laboratory with NRTL status.

All lamps must be affixed with an Intertek ETL Verified label or label from other third party NRTL to demonstrate compliance to Section 6.3, “Production Tests & Inspections,” of the latest revision of ITE VTCSH Full Ball Specification for LED Ball modules or the latest revision of ITE VTCSH Arrow Specification for LED Arrow modules.
Each new LED traffic signal lamp unit must be energized at the manufacturer’s facility for a minimum of 24 hours at nominal operating voltage (120 VAC RMS) at room temperature in order to ensure electronic component reliability prior to shipment.

11121.7. **Documentation Requirements.** Provide each LED traffic signal lamp unit with the following documentation:

- Complete and accurate installation wiring guide
- Contact name, address, telephone number and email address or webpage for the representative, manufacturer, or distributor for warranty repair
- If requested by the purchaser, the bidders must supply schematics for all electronics
- Compliance letter specified in Article 11121.8, Warranty Requirements
- Certification document specified in Article 11121.8, Warranty Requirements

If requested by the purchaser, bidders must submit a copy of a test report, certified by an independent NRTL laboratory, stating that the LED traffic signal lamp model submitted meets or exceeds the latest ITE VTCSH LED Supplemental Standards. The laboratory report must include documentation of tests and verification of compliance to the additional provisions of this standard. Tests performed by the independent lab must follow all the instructions documented in the latest ITE VTCSH circular signal supplement or latest ITE VTCSH arrow supplement as it pertains to the product being tested. Criteria in Article 11121.6.C, “Optical and Light Output Requirements,” must be documented in the test report.

Manufacturers must be International Organization for Standardization ISO 9000 certified, or latest revision.

11121.8. **Warranty Requirements.** Manufacturer must comply with all requirements of the following warranty. Failure to comply with the requirements of this warranty is cause for the manufacturer/supplier to be removed from the MPL.

The manufacturer/supplier must submit a letter of compliance indicating understanding and willingness to abide by the provisions of this Specification. The manufacturer/supplier must provide the name and telephone number of the person to contact regarding potential claims under the provisions of this warranty. Address the compliance letter to the Texas Department of Transportation, Attn: TRF-TE Signal & Radio Operations Branch Manager, 125 E. 11th Street, Austin, Texas 78701.

The LED traffic signal lamp units must be warranted against any failure due to design, workmanship, material defects, or intensity within the first 60 months of field operation. Units must meet or exceed minimum requirements of this Specification for at least 60 months of field operation.

Repair or full replacement will be required if a LED traffic signal lamp unit fails to operate as specified under normal operating conditions. Provide repaired or replaced units at no cost to the Department. The replaced or repaired units will inherit the remainder of the failed unit’s warranty.

Repair or replace LED traffic signal lamp units within 5 business days after receipt of failed LED units at no cost to the Department, except the cost of shipping the failed units to the responsible
vendor. The cost of shipping the LED units back to the Department will be borne by the vendor or manufacturer.

If a lamp unit fails with no visible damage to electronic/electrical components, (not including fuses or components designed to act as a fuse) or wiring, the unit is considered to have failed under normal operating conditions. A blown fuse or a component acting as a fuse, without any other permanent failure to electrical, electronic components will be considered to have failed under normal operating conditions. Natural phenomena (e.g. lightning) are not acceptable as excusable unit failures without visible damage.

The manufacturer/provider must submit a certification document with each lot or shipment stating that the LED lamp units provided meet all the requirements of this Specification. The certification document must show individual lot numbers and manufacturer dates.

The Department reserves the right to select a sample from the field during the warranty period and perform evaluation tests to determine extended compliance and/or deterioration of the LED traffic signal lamp unit. Any model that shows deterioration of unit causing the unit to fail the evaluation tests during the warranty period will be automatically removed from the MPL, and the submitting party may be held legally responsible for all damages.

11121.9. Archived Versions. Archived versions are available.