



High Efficiency Troffer Performance Specification

Version: 6.0

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Summary

The U.S. Department of Energy's (DOE) Better Buildings Alliance (BBA) has developed this specification for the performance characteristics of high-efficiency lighting troffers. The purpose of the specification is to provide a description of requirements that will result in energy savings for troffers, reliable performance, and energy cost savings. It also includes options for additional requirements such as emergency lighting, dimming, and controls. This specification was developed through collaboration with Better Buildings Alliance Lighting & Electrical Team members and with input from manufacturers and other interested parties.

This specification defines the photometric and colorimetric performance characteristics for a product that is in the top efficiency tier – which is considered approximately less than the top 10% of the current market. The specification can be used in a request -for-proposal by copying the language on the following pages.

DOE and BBA have produced this specification because half of all commercial fluorescent lighting fixtures are troffers. With operating hours of 10+ hours per day – troffers collectively consume nearly 159.7 billion kilowatt-hours (kWh) of electricity annually, representing approximately 16.6 billion dollars; this is as much energy as 14.6 million homes consume in a year. By adopting this specification for troffers, building owners can save up to 70% based on a one-for-one replacement-basis and up to 80% with controls. If all troffers in the nation met this specification, the nation could save approximately 64.3 billion kilowatt-hours (kWh) of electricity annually, worth approximately 6.7 billion dollars.

Additional information on the DOE and BBA activities, including other energy saving purchase specifications and demonstration case studies can be found on the BBA website (<http://betterbuildingssolutioncenter.energy.gov/alliance/>).

Specification requirements start on the next page. The cover page and summary should not be submitted to the manufacturer.

1.1 Scope

- I. **This specification applies to high efficiency troffers that meet all of the following criteria:**
 - a. Nominal dimensions:
 - i. 1'x4' – width = 12", length = 48"
 - ii. 2'x2' – width = 24", length = 24"
 - iii. 2'x4' – width = 24", length = 48"
 - b. Maximum height (depth) = 5"
 - c. Mounting
 - i. Recessed
 - ii. Surface-mounted

1.2 Standards

- I. **American National Standards Institute:**
 - a. ANSI/NEMA/ANSI C78.377-2015, Specifications for the Chromaticity of Solid State Lighting (SSL) Products
- II. **Illuminating Engineering Society of North America:**
 - a. IES LM-79-08, Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
 - b. IES LM-80-08, Approved Method: Measuring Lumen Maintenance of LED Light Sources
 - c. IES TM-21-11, Projecting Long Term Lumen Maintenance of LED Light Sources
- III. **UL:**
 - a. ANSI/UL 1598-08 NMX-J-307/1-ANCE/C22.2 NO.250.0-08, Luminaires
 - b. ANSI/UL 8750-2015
 - c. Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.3 Application

- I. **Ceiling Application and types**
 - a. F (Flanged)
 - b. M (Modular) and Z (Z Spline)
 - c. G (Grid)
 - d. SS (Screw Slot)
 - e. Plaster Frame Kit
- II. **Construction / Finish**
 - a. No visible welding, no plane-protruding screws, latches, springs, hooks, rivets or plastic supports viewed from the occupied (room) side are allowed.
 - b. Air-handling capability (optional)
 - c. Recessed, Type IC (intended for insulation contact) (optional)
 - d. Earthquake clips (optional)
 - e. NYC electrical code compliant (optional)
 - f. Chicago electrical code compliant (optional)
- III. **Maintenance**
 - a. Power supplies/drivers/ballasts, LED arrays, boards or light engines shall be easily field replaceable using common hand tools (e.g., screwdrivers, pliers, etc.) and without uninstalling the luminaire

1.4 Electrical and Photometric Requirements

I. Electrical

- a. Operating voltage: 24 Vdc, 120 Vac at 60 Hz, 277 Vac at 60Hz, or universal voltage (120, 220/240, 277 Vac at 50/60 Hz)
- b. Power factor: ≥ 0.90 (at full luminaire output and across specified voltage range)
- c. Total harmonic distortion: $\leq 20\%$ (at full luminaire output and across specified voltage range)
- d. Transient and surge protection: ANSI C62.41-2002 Category A surge protection standards up to and including 2.5 kV
- e. Sound: Class A not to exceed a measured value of 24dB
- f. Maximum standby power: 1W
- g. Warranty: 10 years on equipment
- h. LED arrays in the product(s) will be considered defective in material or workmanship if a total of 5% or more of the individual light-emitting diodes in the product(s) fail to illuminate during normal operation after installation.
- i. LED Power Supply/Driver
 - i. Driver efficiency (at full load):
 - ii. $\geq 85\%$ for drivers capable of ≥ 50 watts
 - iii. $\geq 80\%$ for drivers capable of < 50 watts
 - iv. Federal Communications Commission (FCC) compliance: FCC 47 Part 15 Non-Consumer limits for EMI/RFI emissions

II. Photometric & Colorimetric Performance

- a. Colorimetric
 - i. Correlated Color Temperature (CCT): Fixed output luminaires should be capable of maintaining color temperatures between 2200K and 5000K (tunable white luminaires may have larger range, as long as 3000K-5000K is included)
 - ii. Acceptable tolerances as provided in ANSI C78.377-2015 (LED)
 - iii. Color Rendering Index (CRI) $[R_a] \geq 80$ with a positive R_9 value
 - iv. TM-30 ratings: $R_f \geq 75$, $R_g \geq 95$, and $R_{cs,h1} \geq -8\%$
- b. Life
 - i. Minimum rated life of 68,000 hours at L_{70}

Photometric Performance for Fixed CCT Luminaires

Size	Minimum Initial Delivered Lumens	Minimum Luminaire Efficacy (LE)	Spacing Criteria (SC)* 0° – 180° Plane or 90° – 270° Plane
1'x4'	1,500	125 lm/W	1.0 – 2.0
2'x2'	2,000	125 lm/W	1.0 – 2.0
2'x4'	3,000	125 lm/W	1.0 – 2.0

*The ratio of center-to-center fixture spacing to mounting height (ceiling-to-workplane)

Photometric Performance for Tunable White Luminaires							
Size	Minimum Initial Delivered Lumens			Minimum Luminaire Efficacy (LE)			Spacing Criteria (SC)* 0° – 180° Plane or 90° – 270° Plane
CCT**	Min CCT	3500 K	Max CCT	Min CCT	3500 K	Max CCT	
1'x4'	1,350	1,500	1,350	110 lm/W	125 lm/W	110 lm/W	1.0 – 2.0
2'x2'	1,800	2,000	1,800	110 lm/W	125 lm/W	110 lm/W	1.0 – 2.0
2'x4'	2,700	3,000	2,700	110 lm/W	125 lm/W	110 lm/W	1.0 – 2.0

*The ratio of center-to-center fixture spacing to mounting height (ceiling-to-workplane)
** Provide LM-79 reports at the minimum CCT in the range, 3500 K, and maximum CCT in the range

1.5 Options

I. Emergency lighting

- a. Emergency battery pack available factory or field installed

II. Dimming

- a. Manufacturers shall provide listing of compatible dimmers that have been tested to conform to at least one of the dimming protocols listed below and approved for use with their products
- b. Dimming protocols and performance expectations
 - i. No phase-cut dimming
 - ii. Step dimming from 100% to at least one preset level between 70% and 10%
 - iii. Continuous, minimum modulation frequency of 120 Hz and less than 10% flicker from 100% to 5%
 - iv. DALI, DMX/RDM, ZigBee, and EnOcean

III. Integrated Controls

- a. Sensors
 - i. Dual-tech (passive-infrared and ultrasonic) occupancy sensor that can be used either as an occupancy sensor or a vacancy sensor
 - ii. Sensor coverage must be at least 140 square feet assuming an 8' mounting height
- b. Daylight or ambient lighting sensor
- c. Constant lumen management
- d. Load shedding/demand response

IV. Centralized power conversion/controls/metering

- a. Power conversion
 - i. System shall have centralized power conversion from high voltage AC to low voltage DC
 - ii. Capable of powering a minimum of four discrete luminaires
- b. Controls/metering
 - i. Standby power draw: <10W at the central power supply
 - ii. Contains ambient temperature sensor(s)
 - iii. Contains fixture current and voltage sensor for integrated power metering
 - iv. Field-upgradeable for new fixture types or future sensor package upgrades and modifications

