PROJECT: FDOT - Port of Miami Tunnel
LOCATION: Miami, FL
SPECIFIER: Jacobs Engineering
Demand Kenall for Tunnel Lighting

Your goal when lighting a tunnel is to safely support the drivers’ comfort and visual perceptions. Tunnel lighting ranks among the most challenging of lighting applications. Not only does the intricate topology of a tunnel, with its “Black Hole” effect and critical transition zones require painstaking attention to detail, but also the tough, corrosive atmosphere caused by a combination of pollutants, moisture, chemicals, and galvanic couple differences (electrolytic ionization) add to the challenge. Luminaires installed in this type of environment can deteriorate rapidly causing unsafe tunnel conditions. Reliable lighting designed to last for many years is critical, especially in an area where access is restricted and minimal maintenance is a must.

For these reasons, Kenall tunnel luminaires have been designed with your needs in mind, including stainless steel housings that last for decades and optimal light levels to ensure the safe flow of traffic throughout the tunnel.

Our new LuxTran™ LED luminaires are more powerful than their predecessors with lumen outputs ranging from 8,531 to 90,295—more than enough to obliterate the “Black Hole” effect—and LED life times up to 150,000 hours.

Because tunnel lighting must endure the most challenging environmental conditions, Kenall has applied over 50 years experience in designing, testing and manufacturing luminaires to meet and exceed the highest industry standards, including ANSI, CSI and NEMA, so you can specify Kenall tunnel luminaires with complete confidence.

Table of Contents

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Custom Products. Expert Service.</td>
<td>3</td>
</tr>
<tr>
<td>Port of Miami Testimonial</td>
<td>4-5</td>
</tr>
<tr>
<td>Products Designed to Last for Decades</td>
<td>6</td>
</tr>
<tr>
<td>Built &amp; Tested to Exceed Industry Standards</td>
<td>7</td>
</tr>
<tr>
<td>Understanding the Science of the Space</td>
<td>8</td>
</tr>
<tr>
<td>Tunnel Lighting Best Practices</td>
<td>9</td>
</tr>
<tr>
<td>What’s New in LED Tunnel Lighting</td>
<td>10</td>
</tr>
<tr>
<td>New LED Lighting with Remote Driver Option</td>
<td>11</td>
</tr>
<tr>
<td>Remote Driver Adds Convenient Servicing</td>
<td>12-13</td>
</tr>
<tr>
<td>Woodall Rodgers Testimonial</td>
<td>14-15</td>
</tr>
<tr>
<td>LuxTran™ Family of Tunnel Lighting</td>
<td>16-17</td>
</tr>
<tr>
<td>Ordering Information, Testing</td>
<td>18</td>
</tr>
<tr>
<td>Listings, Certifications &amp; Warranty</td>
<td>19</td>
</tr>
</tbody>
</table>

- Over 50 years of expertise in developing stainless steel housings
- Lighting performance that meets and exceeds industry standards
- Optical control provides visual acuity for comfort and safety
- LED luminaires for increased energy savings and less maintenance

Challenging Applications... Demand Kenall™
Because each tunnel has its own unique characteristics, Kenall specializes in customized tunnel lighting to meet your exact specifications and industry standards. Our expertise in service and support addresses the many complexities and challenges of lighting a tunnel. From clearly defined project objectives to product selection, design and layout assistance, our tunnel experts are available when you need them. Then, once your luminaires are ready for delivery, sequenced, palletized shipments with simple instructions support a flawless installation. The Kenall team is committed to taking the complexities out of tunnel lighting.
Ready to Combat Corrosion?
Kenall’s LuxTran is Up to the Challenge
Tunnel lighting prepared to resist corrosion for decades

“The lighting provided for the Port of Miami Tunnel has met all of the performance requirements of the demanding specification prepared by the project designer and approved by the Florida Department of Transportation.”

— Steven Dusseault, P.E.
CEI Resident Engineer, Florida Dept. of Transportation,
Port of Miami Tunnel project

PROJECT: FDOT - Port of Miami Tunnel
LOCATION: Miami, FL
SPECIFIER: Jacobs Engineering
Read the entire case study at www.kenall.com
LuxTran™ Tunnel Lighting

Products Designed to Last for Decades

Passivation post-welding protects the stainless steel from corrosion.

Fully sealed housing with molded or extruded solid silicone gaskets ensure ingress protection (IP) ratings.

Sealed polycarbonate or tempered glass lens options reduce glare.

External stainless steel mounting brackets are adjustable and customizable for ease of installation.

Stainless steel housing for superior corrosion resistance.

Long-life LED (L70) to 150,000 hours available in various wattages and color temperatures.

Stainless steel, lockable, rotary latches and tethers allow for tool-less access to the electrical compartment.

Note: All stainless parts are 316 or 304.

LuxTran™ Heat Sinks

LEDs are housed in an isolated aluminum heat sink to eliminate the possibility of dissimilar metal corrosion. Double sealed using a 5,000 hour salt spray electrodiposition coating and powder coating, the heat sink is designed to last the lifetime of the LEDs.
Built & Tested to Exceed Industry Standards

Kenall delivers tough tunnel lighting systems designed, built and tested to meet or exceed industry standards.

- **Stainless Steel**
  Kenall’s LuxTran™ series is specifically designed and manufactured to eliminate corrosion and last for decades. Using only 316 and 304 stainless steel, typically used in marine environments, our tunnel products resist corrosion, rust and staining.

- **Passivated Welds**
  With forming and fabrication being two of our key competencies, Kenall ensures that all welds on LuxTran products are passivated; restoring a uniform chromium oxide film on the material’s surface to eliminate the potential for corrosion or rouging.

- **Custom Mounting Bracketry**
  Unlike many products in the industry, mounting brackets on Kenall’s LuxTran products can be customized to your unique tunnel characteristics.

- **Minimal Maintenance**
  Kenall’s LuxTran LED luminaires provide longer L70 life times — up to 150,000 hours — lasting 5x longer than traditional tunnel luminaires for reduced operating cost and maintenance.

- **Tested to Meet Certified Performance Standards**
  Kenall LuxTran luminaires go through many rigorous testing procedures to meet the following industry standards: ANSI C136.27-2012 temperature cycling/100 PSI water test, C136.31 vibration testing, UL1598/A, CSA22.2, NEMA 4X rating, IP66 rating per IEC 60598, as well as IESNA LM-79-08 standard photometry testing. See page 18 for a list of Kenall’s standard testing procedures.
Understanding the Science of the Space

The human eye requires more time to adapt from brightness to darkness than the reverse. For this reason, tunnel lighting must gradually transition to interior light levels. During nighttime hours, the area outside the tunnel is dark, whereas interior levels...

Tunnel Topology

Fixation
The point from which the driver fixates on the opening of the tunnel to identify tunnel roadway hazards. This is the point where adaptation begins.

Approach
During daytime hours, drivers’ eyes may have to adapt from over 10,000 footcandles to less than 1% of that level very quickly, while traveling at a high rate of speed. To facilitate this, the design must include the approach, which extends from the point that the tunnel opening becomes the principal feature in the driver’s field of vision (also known as the adaptation point), to the actual entrance of the tunnel.

Adaptation Distance
The adaptation distance is the distance between the adaptation point and the portal. (The portal is the plane of entrance into the tunnel, where the roadway changes from uncovered to covered.)

Threshold Zone
The first phase of visual adaptation occurs in the Threshold Zone as the driver enters the tunnel. The lighting levels in this zone are specified in CIE 88 2004, and depend upon the length of the tunnel, the Average Annual Daily Traffic (AADT), wall reflectances and whether cyclists are present or the exit is visible.

Definition of tunnel topology reference: ANSI/IES RP-22-11, Section 2.0.

Types of Tunnel Lighting: Symmetrical Light Distributions for Tunnels

Transverse Lighting
- Uniform luminance throughout tunnel interior
- Generally low contrast values
- Maximizes wall luminances
- Maximizes candlepower to walls

Axial Lighting
- Uniform luminance throughout tunnel interior
- Generally low contrast values
- Maximizes flux parallel to traffic flow
- Maximizes candlepower to vehicle

Refer to ANSI/IES RP-22-11, Section 7.0 for complete lighting application techniques.
Tunnel Lighting Best Practices

are similar to those of an illuminated open roadway; making the transition minimal. Tunnel lighting is comprised of distinct zones, each with unique lighting needs as illustrated below. For a detailed explanation, refer to ANSI/IES RP-22-11, Section 2.0.

Transition Zone

The second zone inside the tunnel is the transition zone, in which ambient illumination decreases from the relatively high levels found in the Threshold Zone to the lower levels found in the Interior Zone. In this zone, the light levels are decreased in stages, allowing the driver’s eyes time to adapt. The total length of the Transition Zone may be equivalent to 25 seconds of travel time.

Interior

The Interior Zone is comprised of the light level required for the remainder of the tunnel, once eye adaptation has been completed in the preceding Transition Zone.

Exit Zone

The Exit Zone is not a requirement as per ANSI/IES RP-22-11. The eye’s ability to adapt from dark to light occurs very quickly, although higher light levels are sometimes specified to help adapt back to higher exterior illuminance levels. Exit Zone lighting may or may not be required depending on local codes and practices.

Types of Tunnel Lighting: Asymmetrical Light Distributions for Tunnels

Negative Contrast (Counter-Beam)

– Predominantly distributed towards the driver, but in a controlled manner to reduce glare
– Provides high pavement luminance and low object luminance to enhance negative contrast
– Light above 45° must be strictly controlled

Positive Contrast (Pro-Beam)

– Minimal glare towards the driver
– Primary disruption is in direction of traffic flow
– Provides high object luminance and low pavement luminance to create positive contrast

Counter Beam

Light that radiates parallel to the tunnel axis and against the directional flow of traffic

Pro Beam

Light that radiates parallel to the tunnel axis with the directional flow of traffic

This product complies with the Buy American Act: manufactured in the United States with more than 50% of the component cost of US origin. It may be covered by patents found at www.kenall.com/patents. Content of specification sheets is subject to change; please consult www.kenall.com for current product details.
LuxTran™ Tunnel Lighting

What’s New in LED Tunnel Lighting?

Kenall has expanded its family of tunnel luminaires to address a range of specialized needs to meet your specific tunnel applications. New LED lamp options not only provide maintenance-friendly choices, but also provide additional energy savings.

LuxTran™ Drivers
- Developed specifically for tunnel lighting
- Anodized aluminum extruded case
- 277-480 VAC topology
- 92% efficiency
- 200,000 hr MTBF (Telecordia standard)
- Sensitive components contained directly on heat sink compartment
- Driver placed on luminaire heat sink to create a direct path to cooling air
- Flicker-free dimming down to 1%; dim-to-dark (turn luminaires off via 0-10 vdc dimming)
- Aluminum heat sink galvanically isolated from stainless steel enclosure by a single piece 1/8” thick Dow Corning Xiameter White Duro silicone gasket
- 90° Celsius maximum case temperature
- 100W, 200W, 300W, and 400W output level options

LTSI Series
- Powered by integral driver
- Suitable for interior and exterior supplemental lighting in all zones
- Corrosion resistant, one-piece, type 304 or 316 stainless steel housing; one-piece, seam-welded construction
- Stainless steel doorframe secured to housing with lockable stainless steel rotary latches
- Clear tempered glass or polycarbonate lens
- Lumen range 27,434 – 90,295
- Type II, III, IV, IV-Narrow and V-Square distributions
- Customizable mounting brackets for ease of installation
- Vibration tested to ANSI C136.31
- Water tested to ANSI C136.27-2012 (100 PSI water test)

For additional performance data consult spec sheets at www.kenall.com

For more information, visit www.kenall.com/patents.

Content of specification sheets is subject to change; please consult www.kenall.com for current product details.
LuxTran™ Tunnel Lighting

Kenall’s LTL and LTS are maintenance friendly. Powered by a remote driver installed at arms reach, the system is designed to facilitate ease of servicing. See pages 12 and 13 for additional information.

**LTL Series**
- Suitable for continuous row mounting in all zones
- Powered by RD700 distributed DC driver system; remotely located for servicing convenience
- Corrosion resistant, one-piece, type 304 or 316 stainless steel housing; one-piece, seam-welded construction
- Stainless steel doorframe secured to housing with lockable stainless steel rotary latches
- Clear tempered glass or polycarbonate lens
- Lumen range 10,901 – 12,420
- Type II, Pro-Beam, Type V-Narrow Round and Type V-Square distributions
- Customizable mounting brackets for ease of installation
- Vibration tested to ANSI C136.31
- Water tested to ANSI C136.27-2012 (100 PSI water test)
- NEMA 4X Rated

**LTS Series**
- Suitable for supplemental lighting in transition zones
- Powered by RD700 distributed DC driver system; remotely located for servicing convenience
- Corrosion resistant, one-piece, type 304 or 316 stainless steel housing; one-piece, seam-welded construction
- Stainless steel doorframe secured to housing with lockable stainless steel rotary latches
- Clear tempered glass or polycarbonate lens
- Lumen range 27,434 – 90,295
- Type II, Pro-Beam, Type V-Narrow Round and Type V-Square distributions
- Customizable mounting brackets for ease of installation
- Vibration tested to ANSI C136.31
- Water tested to ANSI C136.27-2012 (100 PSI water test)
- NEMA 4X Rated

For additional performance data consult spec sheets at www.kenall.com

For additional information, see pages 12 and 13.
LuxTran™ Tunnel Lighting

Remote LED Driver Adds Convenient Servicing...

The RD700 Remote Driver powers Kenall’s LuxTran™ LTL and LTS Series LED luminaires for ease of serviceability. Hot-swappable drivers can be simply removed or replaced without shutting the system down. A patent-pending, tool-less, quick-release mechanism also makes servicing the drivers easy.

**RD700 Series**

- Remotely powers Kenall LTL and LTS Series LED luminaires via constant-current DC
- Hot-swappable; service drivers without shutting down the power
- Simplified servicing of drivers via patent-pending tool-less, quick-release mechanism
- Corrosion resistant, one-piece, type 316 or 304 stainless steel housing; one-piece, seam-welded construction
- High-efficiency (>90%) drivers with dedicated heat sinks and 20kV built-in surge suppression for long-life operation
- UL Certified IP66 per IEC 60598
...Without Shutting Down the Tunnel

With Kenall’s LuxTran™ RD700 remote driver, you no longer have to shut down the tunnel to service luminaires. The remote driver is installed low on the interior wall to facilitate ease of maintenance.

Maintenance personnel walk along the catwalk toward the remote driver for easy servicing. Wires are run along the wall from the box to the luminaires to connect the remote driver to Kenall’s LuxTran™ LTL and LTS LED tunnel luminaires as shown in the wiring schematics below. Various wiring configurations are dependent on the type and amount of lighting fixtures installed.

**Wiring Schematic**

![Wiring Schematic Diagram]

**Electrical Characteristics**

<table>
<thead>
<tr>
<th>Product Compatibility</th>
<th>Driver Qty</th>
<th>Output Current</th>
<th>Output Voltage</th>
<th>Max. Input Current (per Driver)</th>
<th>Max. Input Power per Driver</th>
<th>Max. Total Input Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTS</td>
<td>4</td>
<td>1050 mA</td>
<td>240-320 VDC</td>
<td>1.39 A 1.11 A 0.80 A</td>
<td>385 W</td>
<td>1540 W</td>
</tr>
<tr>
<td>LTS</td>
<td>6</td>
<td>1050 mA</td>
<td>240-320 VDC</td>
<td>1.39 A 1.11 A 0.80 A</td>
<td>385 W</td>
<td>2310 W</td>
</tr>
<tr>
<td>LTS/LTL</td>
<td>4</td>
<td>1400 mA</td>
<td>240-320 VDC</td>
<td>1.86 A 1.48 A 1.07 A</td>
<td>514 W</td>
<td>2056 W</td>
</tr>
<tr>
<td>LTS/LTL</td>
<td>6</td>
<td>1400 mA</td>
<td>240-320 VDC</td>
<td>1.86 A 1.48 A 1.07 A</td>
<td>514 W</td>
<td>3084 W</td>
</tr>
</tbody>
</table>
“Lighting five lanes of roadway from the wall was a challenge which was met by the [LuxTran] wall fixture provided by Kenall.”

— Randy Walker
Director of Electrical Engineering
Jacobs Global
Powerful Performance

PROJECT: TXDOT - Woodall Rodgers Tunnel
LOCATION: Dallas, TX
SPECIFIER: Jacobs Engineering
Read the entire case study at www.kenall.com
LuxTran™ Tunnel Lighting

LuxTran™ Family of Tunnel Lighting

WFT Series
- Corrosion resistant, one-piece, stainless steel, seam-welded housing
- Detachable doorframe with stainless steel spring loaded release hinges and stainless steel latches
- Clear tempered glass lens sealed to doorframe
- Type III or IV distributions
- Removable gear tray for ease of maintenance
- UL Certified IP66 per IEC 60598

CFT Series
- Corrosion resistant, one-piece, stainless steel housing; seam-welded construction
- Detachable doorframe with stainless steel spring loaded release hinges and stainless steel latches
- Clear tempered glass lens sealed to doorframe
- Type III or IV distributions; forward throw option
- Tool-less access to ballast compartment for ease of maintenance
- External mounting brackets for ease of installation
- UL Certified IP66 per IEC 60598

LTD14 Series
- Corrosion resistant, one-piece, stainless steel housing; seam-welded construction
- Doorframe secured to housing with stainless steel cam latches for ease of maintenance
- Clear tempered glass lens sealed to doorframe
- Symmetrical transverse distribution
- UL Certified IP66 per IEC 60598
- Vibration tested to ANSI C136.31
- Water tested to ANSI C136.27-2012 (100 PSI water test)
- NEMA 4X Rated

Nominal Size 12.5” x 21”
Installation Types Surface - Wall mount
Lamp Types HPS, MH
Wattages 100W, 150W

Nominal Size 12” x 28”
Installation Types Surface - Ceiling mount
Lamp Types HPS, MH
Wattages 100W, 150W, 250W, 400W

Nominal Size 12” x 48”
Installation Types Surface - Ceiling or wall mount
Lamp Types T5, TSHO
Wattages T5 28W, TSHO 54W

This product complies with the Buy American Act: manufactured in the United States with more than 50% of the component cost of US origin. It may be covered by patents found at www.kenall.com/patents. Content of specification sheets is subject to change; please consult www.kenall.com for current product details.
LuxTran™ Family of Tunnel Lighting

TSQD Series
- One-piece, cold rolled steel, corrosion resistant stainless steel or marine-grade, aluminum housing available
- One-piece doorframe sealed to housing with closed cell neoprene gasket and fasteners
- Type V distribution
- External mounting brackets for ease of installation
- Available in a variety of lens types
- Vibration tested to ANSI C136.31

LTD2424 Series
- Corrosion resistant, one-piece, stainless steel housing; seam-welded construction
- Doorframe secured to housing with stainless steel cam latches for ease of maintenance
- Clear tempered glass lens
- Probeam and counter beam asymmetric distribution
- UL Certified IP66 per IEC 60598
- Vibration tested ANSI C136.31
- Water tested to ANSI C136.27-2012 (100 PSI water test)
- NEMA 4X Rated

LTD1224 Series
- Aluminum alloy housing; anodized finish
- Isolated, external stainless steel hardware for corrosion resistance
- One-piece, seam-welded doorframe with rotary pull latches for ease of maintenance
- Clear tempered glass lens
- Symmetrical axial distribution
- Vibration tested to ANSI C136.31
- UL Certified IP65 per IEC 60598

Nominal Size
Installation Types
Lamp Types
Wattages

TSQD Series
20” × 20”
Surface - Ceiling mount
HPS, MH, Induction Fluorescent
HPS 100W, 150W, 250W; MH 250W; IND 150W

LTD1224 Series
12” × 24”
Surface - Wall or ceiling mount
HPS

LTD2424 Series
24” × 24”
Surface - Wall or ceiling mount
HPS, MH
100W, 250W, 400W
**Testing**

Whether testing for Ingress Protection or stringent vibration testing, Kenall is equipped, with a state-of-the-art certified safety laboratory, to provide the following testing capabilities:

- Certified for safety testing by Underwriters Laboratory and Intertek Testing Laboratories for Incandescent, Fluorescent and HID Luminaires (UL 1598), LED Luminaires (UL 8750) Hazardous Locations (UL 844, Class I Div II, Class II Div II, Class III), and Emergency Lighting (UL 924).
- Ingress Protection testing (dust and water chambers)
- Highly Accelerated Stress Screening (-50°C to 150°C Environmental Chamber)
- MIL-STD-461F- Conducted electromagnetic interference (EMI)
- 25°C and 40°C thermal testing rooms
- LM-79 accredited photometric laboratory—including a Type C goniophotometer and 2-meter integrating sphere with spectroradiometer—providing credentials for the Department of Energy’s Lighting Facts® listings and DesignLight Consortium® approvals.
- Select Kenall LuxTran™ luminaires are independently tested for vibration, wind and shock according to ANSI standard C136.31 ensuring their ability to withstand the environmental challenges of tunnels.
- Select Kenall LuxTran luminaires are independently tested to ANSI standard C136.27-2012 (100 PSI water test) ensuring their ability to withstand extreme hose down procedures in tunnels.
- Because it is inherently robust, stainless steel is exempt from the salt spray test.
Listings, Certifications and Warranty

Fixtures designed for use in tunnel applications must satisfy a large number of demanding lighting and environmental requirements. Listings applicable to tunnel luminaires are shown below. Please refer to the product descriptions within each section of this guide to determine specific product listings.

UL/CUL Listed—The UL symbol signifies that Underwriter’s Laboratory (UL) has determined that a manufacturer has demonstrated the ability to produce a product complying with UL’s requirements with respect to specific risk, performance under specific conditions, compliance with regulatory codes and specified standards, or any other conditions as determined by UL.

ETL—Products bearing the ETL Listed mark is determined to have met the minimum requirements of prescribed product safety standards as certified by a Nationally Recognized Testing Laboratory (NTL). The mark also indicates that the manufacturer’s production site conforms to a range of compliance measures and is subject to periodic follow-up inspections to verify continued conformance.

IP65—UL Certified IP65 per IEC 60598 ensures that the enclosure is dust-tight and protected against jet streams of water from any direction without any harmful effects.

IP66—UL Certified IP66 per IEC 60598 ensures that the enclosure is dust tight and protected against water projected in powerful jets without any harmful effects.

ADA Compliant—Although ADA is not specific to lighting, it does impact fixture design by creating standards for wall sconce projection space and hanging light clearance. Section 4.4 of the ADA states that “objects projecting from walls with their leading edges between 27” and 80” above the finished floor shall protrude no more than 4” into walks, halls, corridors, passageways or aisles.”

3G—Products bearing the 3G listing are independently tested for vibration, wind and shock according to ANSI Standard C136.31 ensuring their ability to withstand the environmental challenges of tunnels.

NEMA 4X—Products bearing the NEMA 4X rating mark are enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); that provides an additional level of protection against corrosion; and that will be undamaged by the external formation of ice on the enclosure.

100 PSI—Products bearing the 100 PSI listing are independently tested for temperature cycling and 100 PSI water spray according to ANSI Standard C136.27-2012; ensuring the luminaires ability to withstand extreme hosedown procedures in tunnels.

10-Year Limited Product Warranty

Kenall promises to stand behind our tunnel luminaires. Our commitment to excellence enables us to offer a 10-year limited product warranty. For detailed, product specific warranty information, please visit our website at www.kenall.com.