ROAD TUNNEL LIGHTING

THE NEXT GENERATION

Thorlux Lighting


DRIVER COMFORT
SYSTEM LONGEVITY
REDUCED MAINTENANCE
SAFETY
SIMPLE INSTALLATION
RELIABILITY
VISUAL GUIDANCE
LIGHTING CONTROL
RUNNING COST SAVINGS
QUALITY

CONTENTS


Thorlux
Lighting

THORLUX TUNNEL HISTORY

UK PROJECTS

M25 Bell Common Tunnel	*(510m, 1300 luminaires)*
A1M Hatfield Tunnel	*(1.3km, 2200 luminaires)*
A3 Hindhead Tunnel	*(1.8km, 1000 luminaires)*
A107 Blackwall Tunnel	*(1.1km, 800 luminaires)*
A505 Weston Hills Tunnel, Baldock	*(230m, 368 luminaires)*
Birmingham Bull Ring Northern	*(650m, 145 luminaires)*
Heathrow (T5) Airside Road Tunnel	*(1.4km, 1300 luminaires)*
Heathrow (T5) Taxiway Bridge 6 Tunnel	*(100m, 200 luminaires)*
Heathrow (T5) Taxiway Bridge 5 Tunnel	*(100m, 150 luminaires)*
Heathrow (T5) Taxiway Bridge 4 Tunnel	*(200m, 250 luminaires)*
Heathrow (T5) Taxiway Bridge 3 Tunnel	*(300m, 450 luminaires)*
Heathrow (T5) Taxiway Bridge 1 Tunnel	*(200m, 300 luminaires)*

WORLDWIDE PROJECTS

N18 Limerick Tunnel, Ireland	*(675m, 700 luminaires)*
N6 Curraghmore Underpass, Ireland	*(200m, 100 luminaires)*
Cherry Street Tunnel, Hong Kong	*(100m, 700 luminaires)*
Cheung Tsing Tunnel, Hong Kong	*(2.4km, 6000 luminaires)*
Western Harbour Crossing, Hong Kong	*(2km, 5000 luminaires)*
Tai LamTunnel, Hong Kong	*(3.8km, 7500 luminaires)*
Tsing Yi South Bridge 3 and Underpass, Hong Kong	*(100m, 500 luminaires)*
Lion Rock Tunnel, Hong Kong	*(1.4km, 4200 luminaires)*

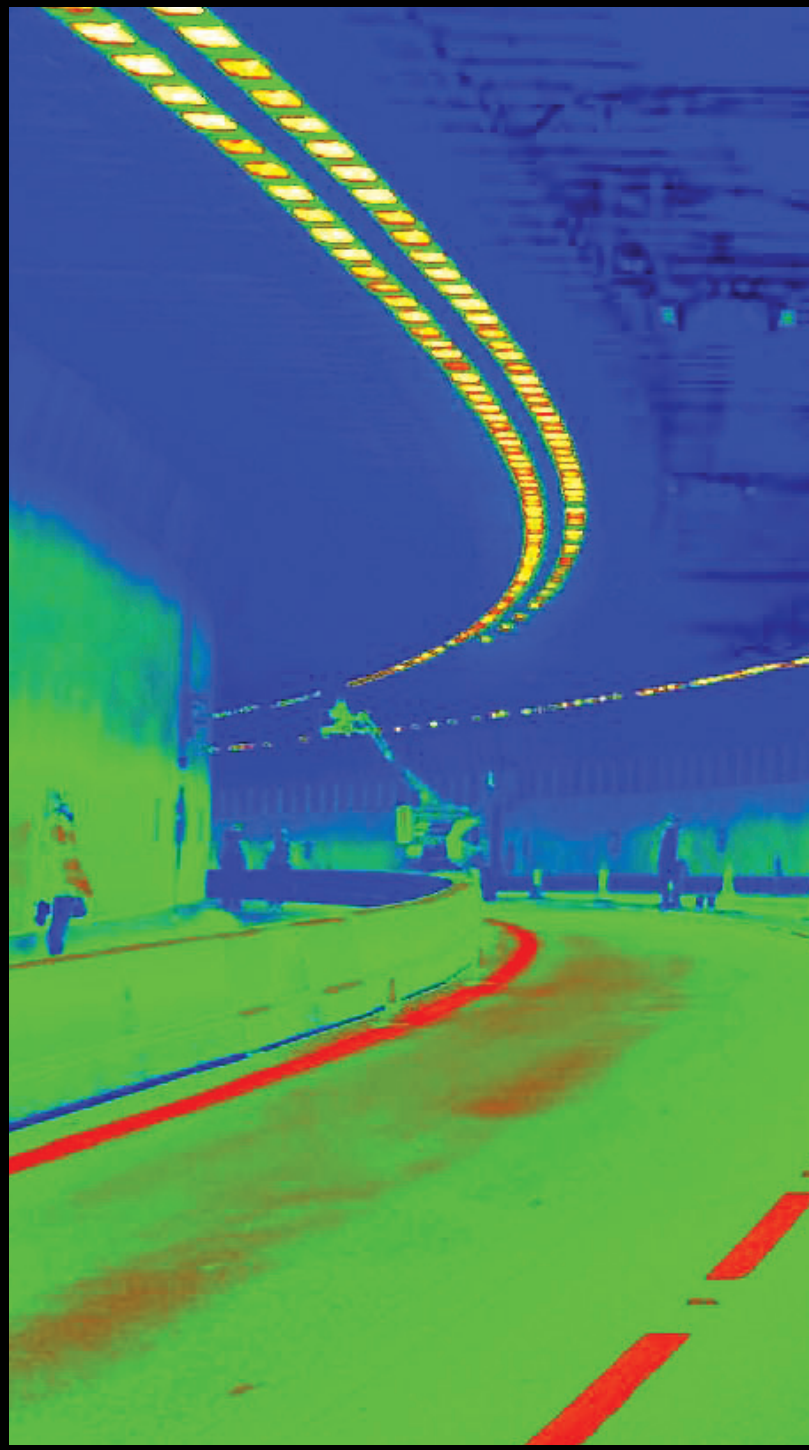
THORLUX TUNNEL LUMINAIRE DESIGN

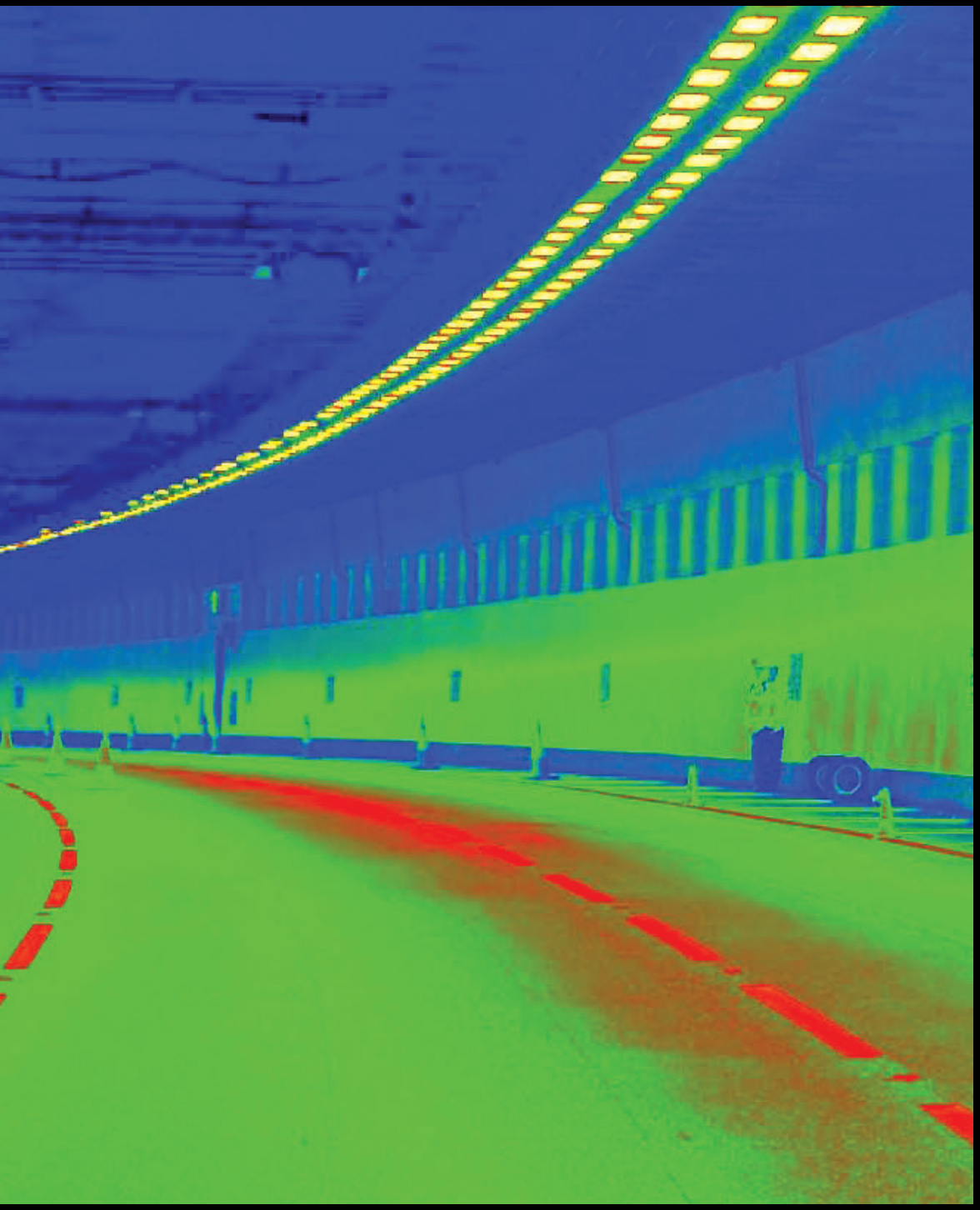
Thorlux has supplied over 30,000 luminaires worldwide since 1996 and is a major road tunnel lighting supplier to UK and export markets. Collaboration between Thorlux and P. Ducker Systems (tunnel control and monitoring specialists) capitalises on the latest lighting and control technology (Scanlight) to provide a reliable, energy efficient and user friendly solution for road tunnel applications.

Extensive innovative product development and factory testing ensures that even the most demanding project specifications are met. Working closely with consultants and contractors has enabled Thorlux to design and supply luminaires and associated control systems to the highest performance and quality standards required for the rigorous demands of road tunnel environments.

Bespoke installation solutions have been adopted on many projects providing the contractor with installation time saving benefits. Quick release cover latches, flexible mounting brackets, "plug and play" mains and data leads can all be provided to suit any given specification.

High quality control gear and lamps are used to achieve maximum luminaire and system longevity. Soft start, digitally dimmable control gear regulates each individual lamp output according to the external ambient light conditions offering extended maintenance periods and substantial running cost savings when compared to conventional tunnel lighting systems.





QUALITY & EXPERIENCE

Our team of in-house tunnel lighting engineers provides full lighting design proposals, technical support and on-site assistance.

From initial site surveys right through to project handover and beyond, our dedicated team and extensive resource provides any client with the belief and assurance of a quality service coupled with the most technically advanced lighting system available.

SAFETY

The safety of road tunnel users is paramount; traffic needs to enter, pass through and exit without any adverse effects to driving characteristics. At any time of the day or night, the transition from the open road in to a tunnel can present an increase in accident potential if the lighting is not correctly designed. Whilst there are many different design approaches they are all intended to create the correct visual environment for any type of road or user irrespective of the external ambient conditions.

Quality of light, visual guidance and user safety are all achieved in different ways with the 3 main light sources appropriate for road tunnel applications:

High Pressure Sodium

Traditionally the most efficient and generally most cost effective solution for Night, Basic and Boost Lighting.

Fluorescent

The traditional "white light" preference for Night and Basic Lighting.

LED

The future of road tunnel lighting . . . using some of the features and benefits of the 2 traditional methods whilst also introducing a new approach to how tunnels are lit.

LED TECHNOLOGY

Now that the LED lighting revolution is here, Thorlux has extended its comprehensive range of road tunnel luminaires to embrace the features, advantages and benefits of this technological breakthrough in lighting.

Our precisely controlled and varied optical distributions now allow the tunnel designer to create an enhanced visual scene within a road tunnel environment whilst also increasing the road user comfort, safety and visual guidance throughout the length of the tunnel. Crisp cool white LEDs with a high CRI provides increased clarity of colour and detail reducing the perception of being "enclosed" within a tunnel.

Linear lighting arrays of continuous LEDs achieve excellent carriageway and wall uniformities whilst also significantly reducing the Threshold Increment (TI) of each lighting zone compared with other lighting approaches. The ability to direct light only where it is needed also provides the end user with significant through life savings as power consumption can be reduced.

Thorlux, having its own dedicated automated LED production facility, has total control over the placement of LEDs on specifically designed boards to achieve exactly the right amount of light in the right direction. This allows designs to be tailored for any type of tunnel whether it is a long high speed motorway tunnel or short trunk road underpass.

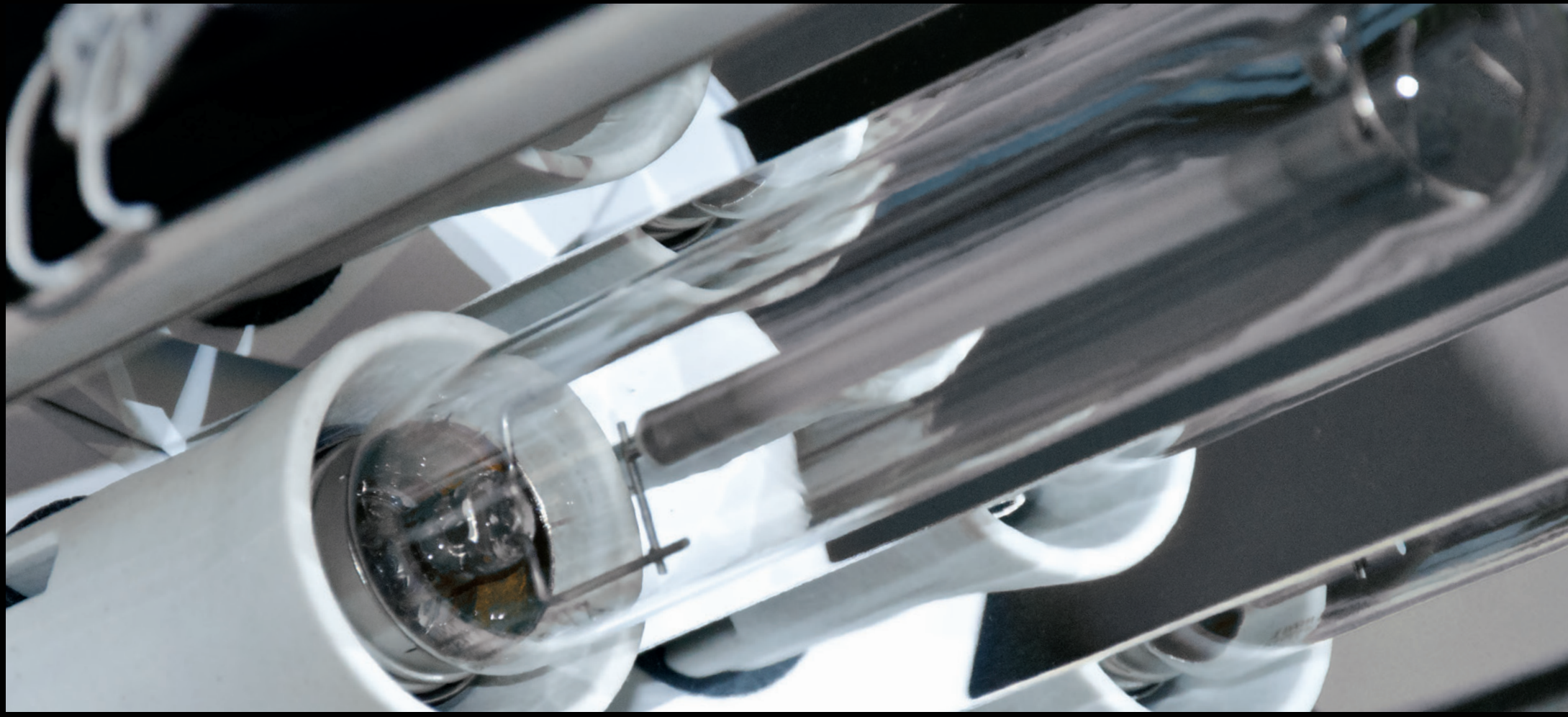
FLUORESCENT LIGHTING

Until the capabilities of LED lighting allowed its use in road tunnels, fluorescent lighting was the preferred method for providing high linear and overall uniformity of the road tunnel surfaces for the night time and dawn/dusk lighting stages. The required low luminance levels can easily be achieved using a continuous row of luminaires and similar to the LED solution creates a perceived visual guidance system through the tunnel.

Multi-faceted, highly specular, transversely symmetrical reflectors help to direct the light evenly onto the carriageway and walls creating a well-lit, white light environment improving the safety for the road users.

The fluorescent lamps provide high colour rendering properties therefore the perception of detail and colour are enhanced over monochromatic high intensity discharge lamp sources.

HIGH INTENSITY DISCHARGE LIGHTING



High pressure sodium lamps are one of the conventional choices for road tunnel lighting especially for high threshold zone lighting because of the high lumen requirement.

Dimming of high pressure sodium lamps brings other benefits such as extended lamp life and reduced energy. An intelligent control system can monitor lamp output over lifetime and dim lamps when new, maintaining the level through life by increasing lamp power only when required (maintenance factor compensation) providing the lowest through life costs.

Maximum lumen delivery and fewer lighting points can however create a few negative features when compared against LED and fluorescent options. The linearity and uniformity reduces and the colour appearance and rendering properties are less.

Tunnel luminaires are installed in the most arduous of conditions

Our luminaire design embraces the quality and construction features required for such applications.

Tunnel luminaires are expected to last 20 years plus

Our tunnel luminaires are IP66 rated and will be resistant over time to dirt, dust, moisture, impact, UV, heat, cold and pressure.

Tunnel luminaires are prone to collect dirt and moisture on all surfaces

Our tunnel luminaire is designed to minimise the negative effects on light output and efficiency through smooth external surfaces.

Tunnel luminaires are regularly washed down

Each luminaire will need to be regularly cleaned. Our smooth front glass cover ensures that there are no awkward lenses requiring localised attention to cleaning.

Plastics degrade in tunnel environments

A minimum of plastic materials are used to offer increased installation longevity.

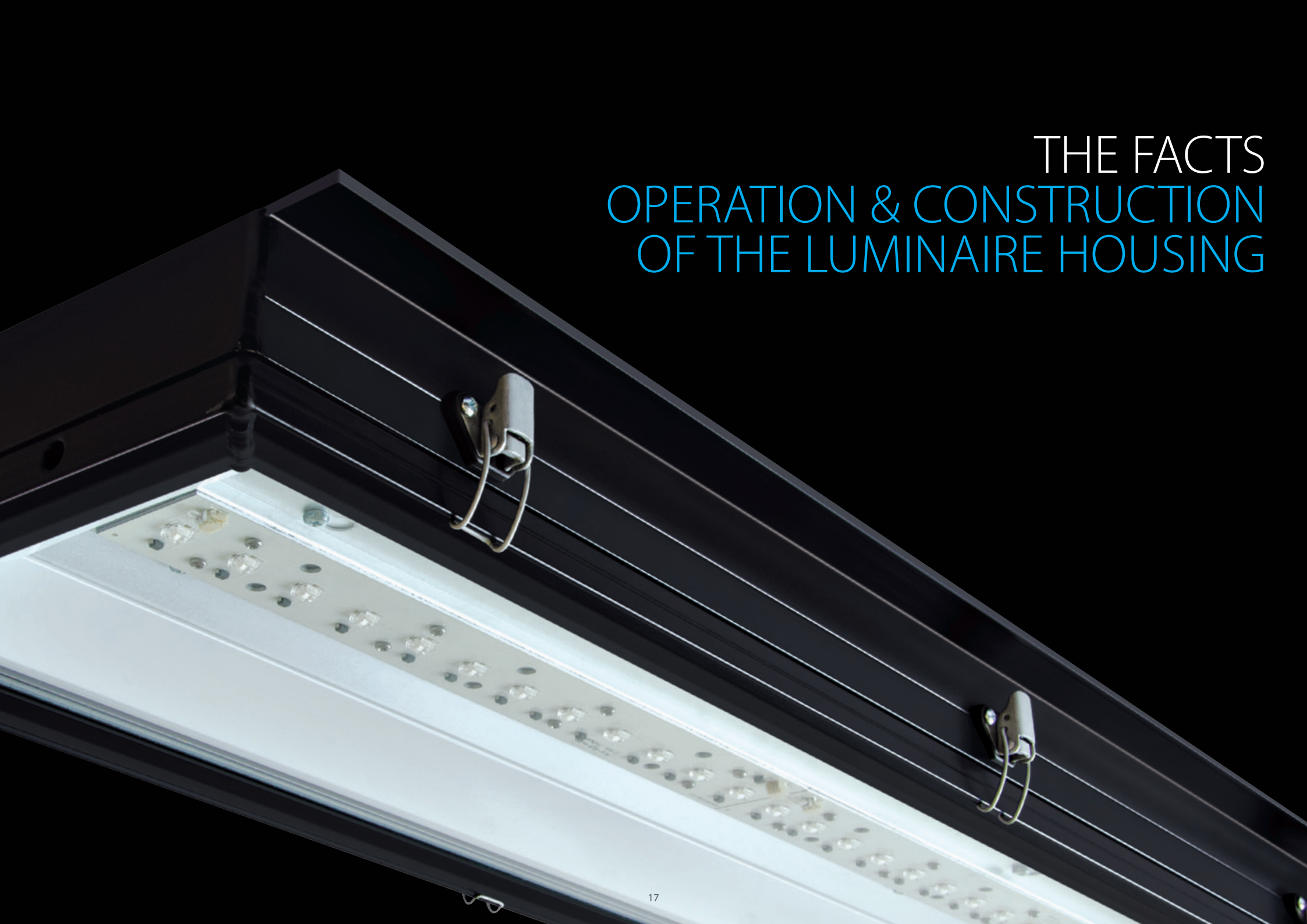
Ease of maintenance is a major consideration in tunnels

All control gear is on removable gear trays within a dedicated thermally segregated chamber fully integral within each luminaire negating any complex wiring back to central/remote gear enclosures.

Luminaire identification needs to be clear and unambiguous

Our tunnel luminaires have a dedicated luminaire identification system which can be seen from ground level.

THE FACTS
OPERATION & CONSTRUCTION OF THE LUMINAIRE HOUSING



THE FACTS
PREFERENCES FOR INSTALLATION

Reduced luminaire weight = reduced support structure cost

Using an aluminium extrusion we have optimised the weight of our tunnel luminaire.

Fast fix installation methods are preferable

Our simple clamp arrangement provides quick and easy installation increasing the number of luminaires installed per hour.

Avoiding electrolytic corrosion is paramount

Clamp brackets are available in any grade of steel or aluminium and are specifically designed to suit a given installation. Silicone isolation pads ensure there is a physical barrier between the brackets and mounting structure at all times.

Site storage and handling can be restrictive

The lightweight, low profile luminaire requires a minimum of storage space.

Ease of installation is paramount

Each luminaire is delivered to site in a working and tested state; the installer simply first fixes with our clamp brackets and plugs the luminaire in with our pre-made flying mains and control cables.

Height restrictions

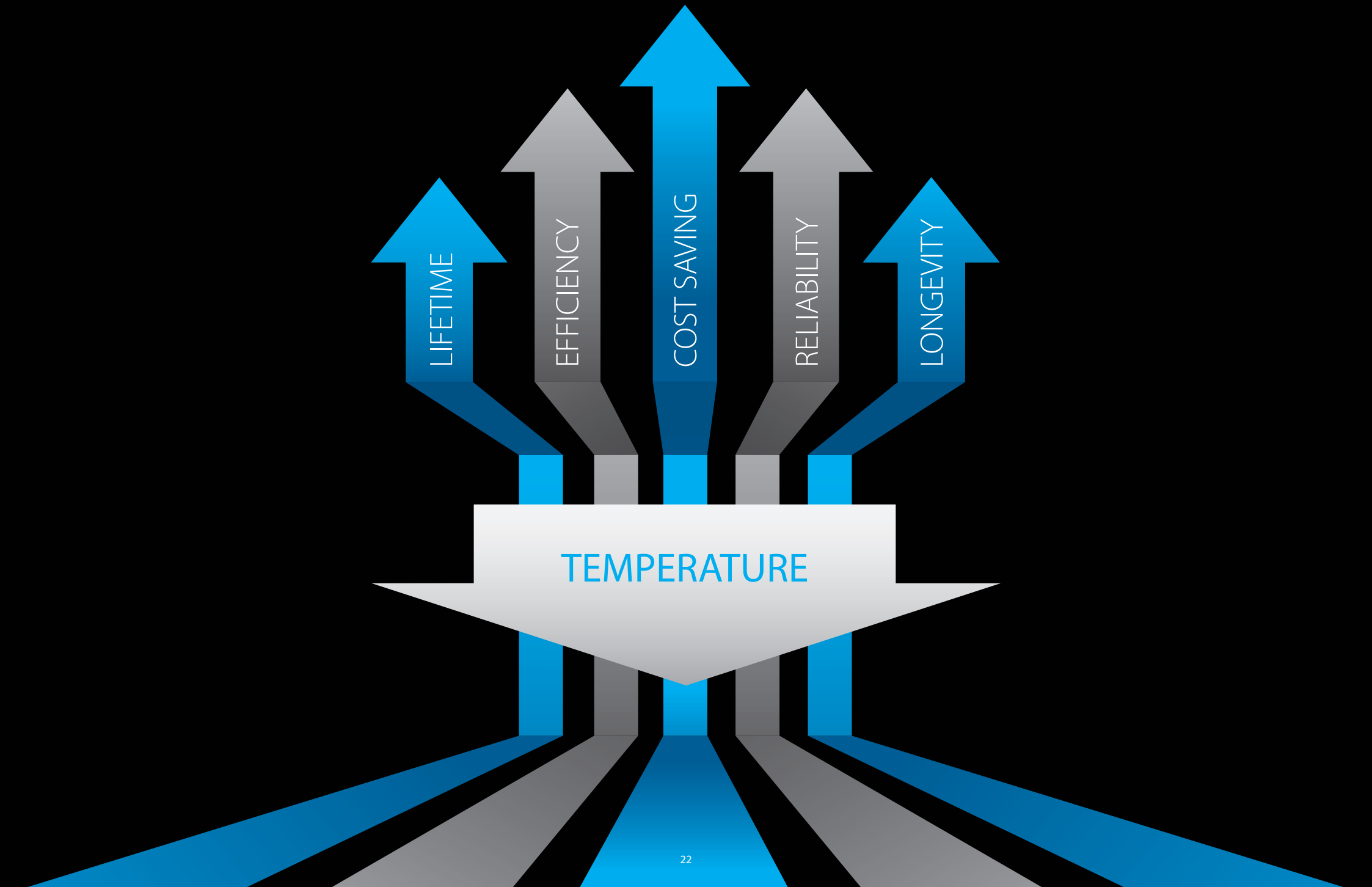
Many tunnels have restrictive mounting heights. Body options with varying depths can be specified as low as only 69mm deep.

A TRULY INSPIRATIONAL

At Thorlux, we listen to feedback and work closely with our clients to provide the most cost effective, technically market leading and robust lighting system available. These features are essential in a road tunnel environment offering minimum maintenance costs combined with maximum luminaire and system longevity.

Our LED tunnel lighting solutions are built on the experience of many years of tunnel lighting development and success. We see no advantage in designing a completely new tunnel luminaire concept just to adopt LED technology, in fact, we realised that in doing so disadvantages could be introduced. Key specification points such as toughened glass covers, removable gear trays, integral control gear, simple tool free access and lamp replacement, adjustable fixing points via external rail etc. should remain in all tunnel luminaires and not be discarded just to satisfy LED requirements.


LED LIGHTING SOLUTION


LIFETIME
EFFICIENCY
COST SAVING
RELIABILITY
LONGEVITY
TEMPERATURE

THORLUX LED THERMAL MANAGEMENT

Careful consideration has been given to not only the placement and distribution of the LEDs but equally to their operating temperatures.

The extruded aluminium body of Thorlux tunnel luminaires lends itself perfectly to act as the "heat sink" for the LEDs ensuring that maximum possible lifetimes are achieved. The added benefits of low ambient temperatures in tunnels and the ability to dim the light output also contribute significantly to increased lifetime.

Testing has allowed Thorlux to forecast Tunnel LED lifetimes in excess of 100,000hrs providing a very low maintenance lighting solution.

When technology improves the efficiency of LEDs will further increase thus requiring less LEDs for the same effective lighting levels whilst reducing heat and therefore providing even longer predicted lifetimes. The replaceable LED boards allow any installation to be upgraded in the future to achieve maximum energy saving and maintenance cost saving potential.

THE FACTS
OPERATION & EFFICIENCY OF THE LED LIGHT SOURCES

The less light that is internally reflected or refracted, the higher the efficiency of the luminaire

We utilise a "Primary LED Optic" with designated roadway distribution to achieve maximum output with minimal power consumption.

The cooler the LED's junction temperature the higher the light output of the LED

In addition to the dedicated LED boards and internal aluminium heat sink, the whole aluminium body of the luminaire also increases the dissipation of heat.

The LEDs are dimmable down to 10% further reducing the LED's junction temperature

Proven in our extensive fluorescent and HID installations, dimming of light sources increases lamp life and significantly reduces running costs.

The LEDs provide consistent colour appearance and rendering properties

We only specify our tunnel LEDs from two adjacent dedicated "bins" according to the ANSI binning references to ensure LED colour stability.

Designing a specific optic for a specific tunnel reduces power consumption

Our ability to "in house" manufacture each LED board provides us with the complete flexibility of controlling the number and distribution of the required LEDs.

LEDs can fail

We design all of our functional general lighting LED based products to incorporate protective LED devices ensuring that any individual LED failure does not affect other LEDs in the circuit.

LEDs will need replacing

All LED boards and circuitry are fully replaceable. Not only can failed LED boards be replaced but also each luminaire has the ability to retro fit fewer or more efficient LEDs in the future.

HID LIGHTING STILL HAS ITS PLACE

Whilst the LED revolution is taking place, other lamp and gear systems are not standing still. HID sodium based lamps are still by far the most efficient lamps available on the market and offer much higher lumen outputs when compared with LED sources. These characteristics lend themselves to road tunnel boost lighting as the lighting levels required are often many thousands of lux. High speed, high traffic flow tunnels will undoubtedly be lit for many years to come with HID lamps for the boost lighting.

Our latest development in HID solutions now extends to fully electronic dimmable 600W SON with full DALI capability for control and monitoring. Extensive design, testing and research has now allowed us to reach an unprecedented level of performance when compared with other current lighting systems available on the market.

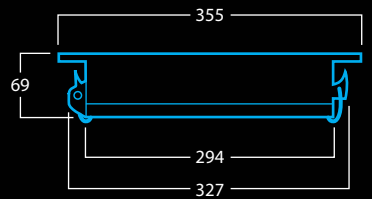
Dimming possibilities allow an almost infinite level of control whilst also providing excellent electrical characteristics at any level. The fully electronic control gear has very low inrush current, almost zero harmonics and a power factor >0.9 at any dim level. It can also operate at 415V reducing operating current and subsequent losses. Significant electrical infrastructure cost savings are possible.

LUMINAIRE SPECIFICATION

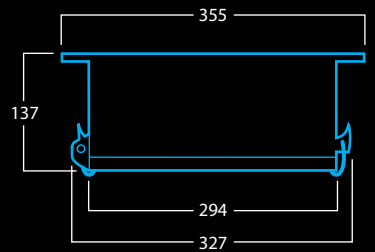
- Main body section and frame extruded from grade 6063T6 aluminium to BS EN 573-3 and BS EN 755-2. Main structural sections are nominally 3.0mm thick on the body and 2.0mm thick on the frame
- Body and frame are pre-treated using the latest conversion coating technology and finished full polyester powder black as standard
- Toughened/safety glass to BS 3193
- A floating glazing frame hinge allows the toggle catches to apply equal gasket pressure on all sides of the body for reliable ingress protection
- A deflection lip designed into the frame gives added gasket protection during water-jet cleaning
- Closed cell silicone gasket for direct body to glass seal
- Grade 316S16 stainless steel body/frame toggle catches are attached to the body in a manner to avoid metal contact between any component.
- Toggle catches are PTFE coated to further avoid electrolytic corrosion
- Quick release "tool free" front cover assembly
- Quick release hinged gear trays
- Side flanges for clamp fixing
- Choice of aluminium reflector options
- Integral emergency versions available
- Scanlight dimmable with addressable control
- LED, HID or fluorescent options
- Luminaire Classification IP66
- Impact Classification IK10

LUMINAIRE RANGE

LED BODY



HID/FLUORESCENT BODY

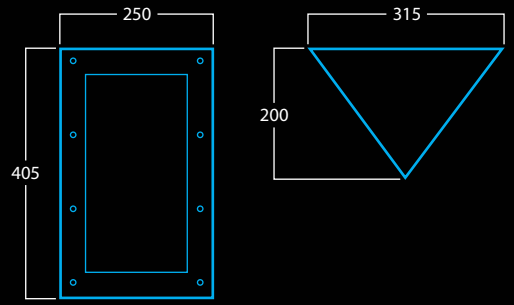


DESCRIPTION	LENGTH TYPE	(mm)
LED 20 -100 LEDs	(Basic & boost lighting)	797-1894
FLUORESCENT 1 or 2 x 28-80W T5 36-58W T8	(Basic lighting)	1294-1594
DISCHARGE (HID) 1 or 2 x 100-600W SON-T	(Basic & boost lighting)	797-1894

LED SOS SIGN

- Body in 1.2mm and front frame 1.6mm stainless steel
- Quick release front cover
- 5mm toughened/safety glass with legend
- Maintenance free low power LEDs

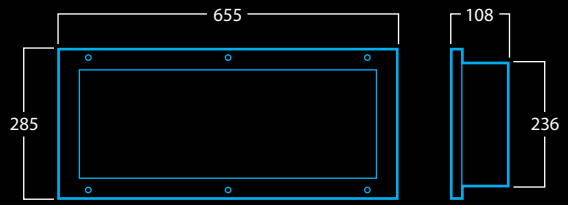
IP66 CE



LED WAY-FINDER SIGN

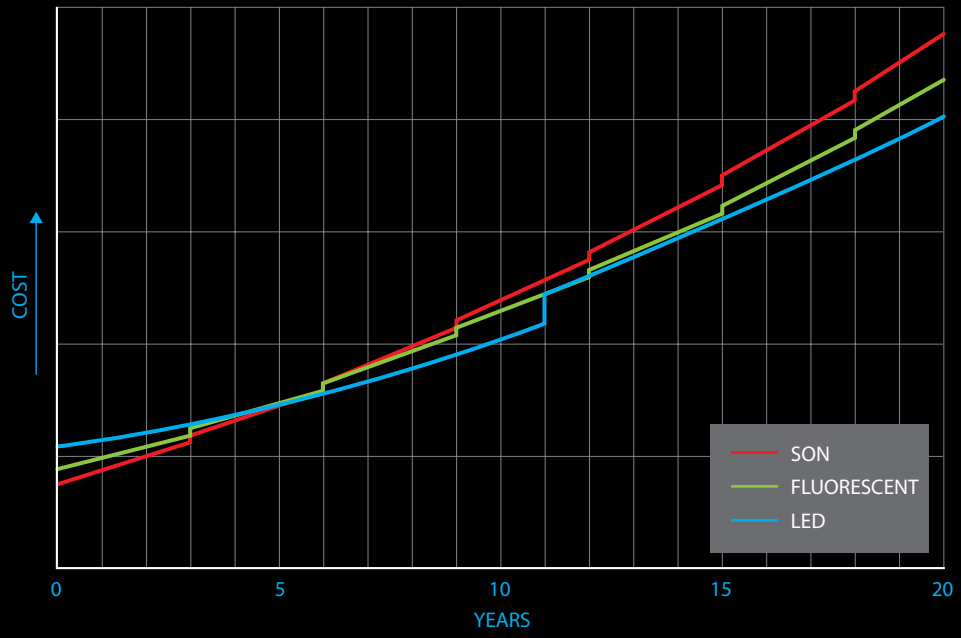
- Body in 1.2mm and front frame 1.6mm stainless steel
- Quick release front cover
- 5mm toughened/safety glass with legend
- Maintenance free low power LEDs

IP66 CE

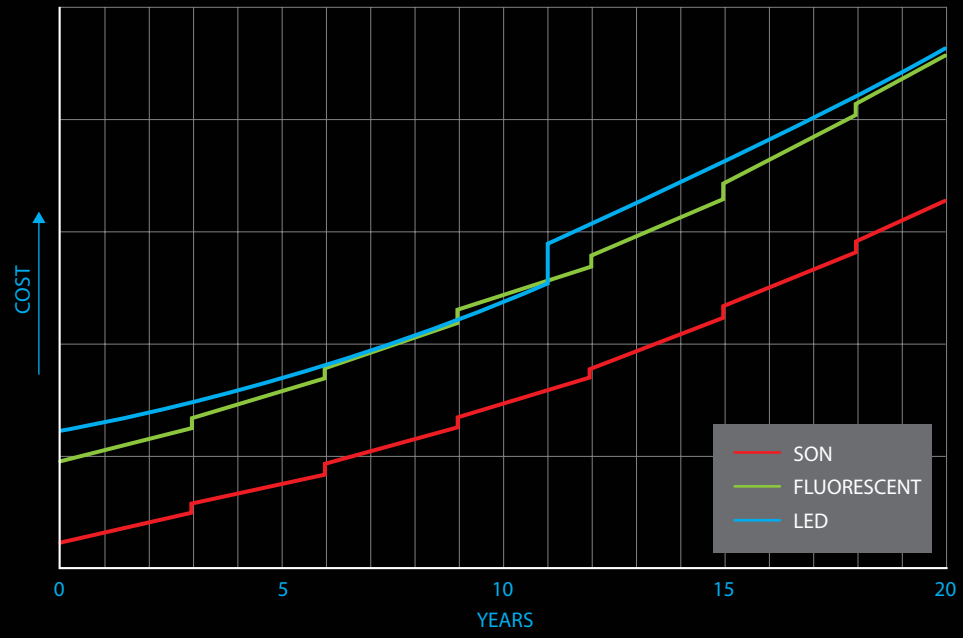


TOTAL COST OF OWNERSHIP

LOW SPEED INNER CITY TUNNEL



HIGH SPEED MOTORWAY TUNNEL



✱ Steps represent lamp changes

THE RIGHT LIGHT SOURCE FOR THE RIGHT TUNNEL

The graphs opposite show the total cost of ownership for HID, fluorescent and LED luminaires in two different types of tunnel. The total cost of ownership includes initial lighting capital outlay, total running cost, cost of cleaning and cost of re-lamping over a 20 year period. It is evident from the graphs that different light sources suit different tunnels depending upon the design specification.

THE NEED FOR REPLACEABLE LEDs

LED lighting is commonly referred to as "fit and forget"' but even LEDs will not last forever. Within a tunnel environment it is expected that mechanical and electrical services last for 20+ years providing the tunnel owner / operator with minimal maintenance closures. Operating 24 hours per day HID and fluorescent lamps will need replacing every 3-4 years to maintain the required lighting levels. Thorlux LED tunnel luminaires use "replaceable" LED light engines as on 24 hours per day operation even 100,000 hour life expectancy LEDs will need replacing after 11+ years. Luminaires with non-replaceable LED arrays would require complete replacement at this time.

SCANLIGHT TUNNEL PRINCIPLES

Collaboration between the Thorlux lighting engineers and PDS control system engineers has created the finely tuned Scanlight Tunnel lighting control system to meet the rigorous day to day demands of a road tunnel environment whilst delivering the ultimate road tunnel lighting experience with maximum energy savings.

The principles for road tunnel lighting are defined in BS 5489-2. Artificial lighting levels in the tunnel entrance zone must be balanced with that on the approach carriageway to enable drivers to have good visibility into the tunnel at least to the extent of their safe stopping distance.

Once inside the tunnel, as the driver's vision becomes adapted to lower lighting levels, the artificial lighting levels can be reduced in intensity as the distance travelled within the tunnel increases, a relationship known as the "Luminance Reduction Curve".

External entrance luminance is monitored by externally mounted photometers which instantaneously relay luminance data to a remote Lighting Management Unit (LMU).

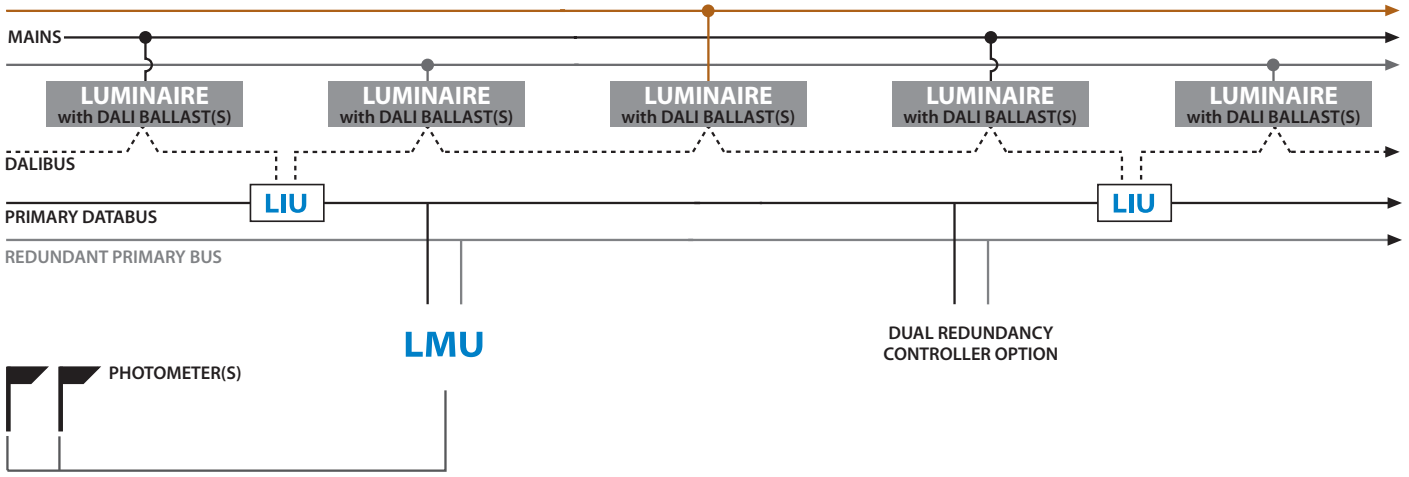
The LMU, reacting on luminance data received from the entry photometers selectively switches/dims individual lamp ways throughout the whole tunnel via Luminaire Interface Units (LIUs) mounted along its length, ensuring that lighting levels are maintained in accordance with the 'Luminance Reduction Curve'.

In addition to their control function the LMU collects, via the LIUs, luminaire operational details such as lamp power and hours burned allowing a planned maintenance regime to be adopted.

The system may be manually overridden at any time and system integrity can be enhanced by including a back-up LMU which will immediately take over system control in the event of a primary unit failure. Dual redundancy at other levels is provided as standard. LIUs can control up to 64 ballasts.

Intelligent Maintenance Factor (IMF) compensating photocells located within the tunnel also automatically monitor the internal illuminance at specified points and via the LMU reduce the lighting load according to the required levels within the maintenance period. A conventional tunnel lighting system will be operating in the region of 30% over the required levels at initial switch on therefore wasting considerable energy and money. The Scanlight IMF sensors and dimmable luminaires ensure only the required amount of light is present at any specific time and as the tunnel environment begins to deteriorate over time then the lighting demand is increased accordingly.

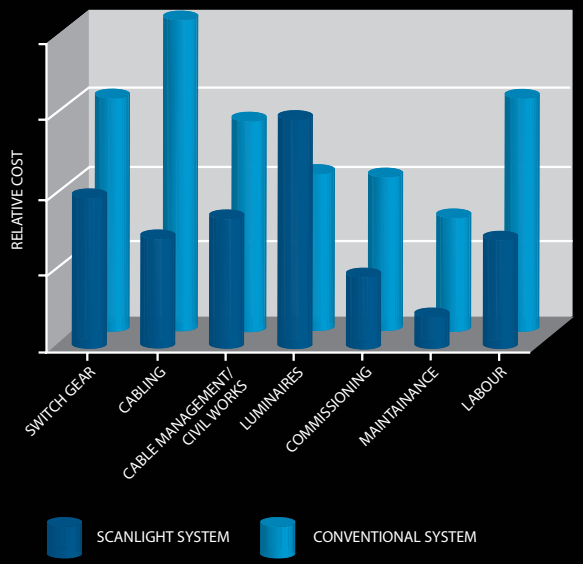
LIGHTING CONTROL SYSTEM
(TYPICAL WIRING TOPOLOGY)



SCANLIGHT vs CONVENTIONAL SWITCHING SYSTEM

Scanlight offers financial savings and environmental benefits over conventionally switched systems.

Below are typical comparisons of the two systems.



Switchgear

Lamp control is provided by the luminaire, eliminating the need for high current switchgear

Cabling

The Soft Start system avoids initial high currents, enabling the use of lower rated cables and fuses

Cable Management/ Civil Works

Less cabling means reductions in ancillary steelwork and cable management

Luminaires

Scanlight luminaires use more costly addressable control gear

Commissioning

Pre-configured lamp identities reduces commissioning time

Maintenance

Unlike switched systems, Scanlight uses no moving parts

Labour

Plug and play circuit wiring simplifies installation, cutting labour costs

Scanlight TUNNEL

FEATURES	BENEFITS
Modular wired electrical and control connection system	Avoids multiple stage switchgear and associated individual cabling, circuits significantly reducing installation costs
Luminaires supplied with plug and socket connections, data leads and lamps fitted	Reduces installation time and eliminates opening luminaire covers
Robust aluminium luminaire construction with continuous seals and bi-metallic corrosion protection	Expected luminaire life (excluding gear) of 25 years
Individual lamp output control and monitoring	Lamp output controls provide energy savings over conventional systems
Use of proven DALI dimmable technology	Ability to exactly control lamp output over a pre-defined luminance range
Use of modern, proven, solid state ballast technology extending lamp life compared to switched lamp solutions	Soft start, wide voltage range and dual frequency operation,
Lamp failure compensation	Automatically increases output of adjacent lamps when a failure occurs
Lamp address recognition – with lamp identity factory-set	Avoids the need to set address switches in each luminaire, simplifying the installation and commissioning periods
Lamp life prediction	Provides predictive lamp replacement report
Redundant system configuration	In the event of a cable fault, data communication between luminaires and control devices is maintained throughout the system
Unique lamp burn equalisation	Ensures extended lamp life and maximises time between re-lamping

APPLICATION CENTRE

The new Thorlux Application Centre at Redditch provides 350 square metres of fully interactive demonstration area showcasing the latest advancements in lighting control system, lamp and design technology.

"Hands-on" tunnel lighting demonstrations can be arranged by appointment together with a factory tour of our UK based ISO 9001 and ISO 14001 accredited facility.

Designers, manufacturers and suppliers
of professional lighting systems
INDUSTRIAL LUMINAIRES
COMMERCIAL LUMINAIRES
FLOODLIGHTING LUMINAIRES
ARCHITECTURAL LUMINAIRES
CONTROLS AND SYSTEMS
TUNNEL LIGHTING SYSTEMS

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