

Category 1 Standard

S1066

Lighting of London Underground Assets

**Please read the Written Notices
attached to this standard**

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1 Purpose

The purpose of this standard is to specify all of the mandatory requirements for lighting systems for London Underground (LU).

LU lighting systems shall be:

- a) safe;
- b) enable the effective performance of all necessary tasks by both passengers and staff;
- c) meet the requirements of the visually and sensory impaired;
- d) provide a welcoming visual environment;
- e) designed to minimise energy usage;
- f) optimised design to minimise whole life cost.

2 Scope

This standard incorporates the technical requirements from the new Strategy and Service Development (S&SD) Station Design Idiom.

The Station Design Idiom shall be gradually implemented across the network; therefore there is a need to retain the legacy lighting requirements during this transition.

The project requirements shall specify whether the legacy lighting or Station Design Idiom lighting requirements shall be applicable.

The standard must be read in conjunction with the S&SD Standard titled 'Station Design' reference number S1351, for all non technical lighting design requirements.

This standard does not cover rolling stock, lift cars or lift shafts.

The standard addresses written notice LU-WN-0860.

The standard incorporates G-073 A1 and this is now withdrawn.

Note: During this transitional phase of Station Design Idiom implementation, this Standard has segregated the new and legacy lighting requirements into separate requirements sections.

3 Requirements

3.1 General

- 3.1.1 Lighting systems shall be fully co-ordinated with new and existing services and station structures.
- 3.1.2 Lighting circuits shall be designed, installed and tested in accordance with LU Cat 1 Standard S1069 and BS 7671.
- 3.1.3 Equipment shall meet the performance criteria specified by Department of Energy and Climate Change in the 'Enhanced Capital Allowance (ECA) Scheme for Energy Efficient Technologies - Energy Technology Criteria List'.
- 3.1.4 Before use Suppliers shall arrange listing of qualifying equipment that is not on the Energy Technology List.

- 3.1.5 Lighting loads shall be balanced over three phases of a three phase and neutral (TP&N) supply.
- 3.1.6 Adjacent luminaires shall be fed from different phases.
- 3.1.7 Where the floor area in a room exceeds 50m², the lighting shall be supplied from at least two separate circuits.
- 3.1.8 For sub-surface locations, where the floor area in a room is less than 50m², a minimum of one LU supply (normal) fed luminaire plus another emergency DNO/OLBI (LEPS) fed luminaire shall be provided.
- 3.1.9 For surface locations, where the floor area in a room is less than 50m², a minimum of one DNO (LEPS) fed luminaire shall be provided.
- 3.1.10 In sub-surface locations, spaces shall not be served by a single luminaire if it is only supplied either from the CEPS or the LEPS, as it will not function as an emergency luminaire when the normal supply fails.
- 3.1.11 Lighting circuits for public areas shall be segregated from lighting circuits serving non-public areas.
- 3.1.12 Lighting circuits shall achieve the specified disconnection times as tabulated in BS7671 without the need of additional devices.
- 3.1.13 All lighting shall comply with BS EN 55015 and BS EN 61547 for Electromagnetic Compatibility.
- 3.1.14 Lighting materials at sub-surface stations shall conform to LU category 1 standard 1-085.
- 3.1.15 The basis used for the calculation of maintenance factors used in lighting design calculations performed to meet this standard shall be declared by the designer, along with any assumptions made regarding the maintenance regime required to meet these maintenance factors.
- 3.1.16 The room service maintenance factor shall be a minimum of 0.7.
- 3.1.17 Designers shall demonstrate that dust and water ingress have been taken into account when specifying the IP rating of luminaires.
- 3.1.18 Uniformity values shall apply over the whole area of the task, excluding a boundary zone which limits are at a distance of 100mm from any wall, pillar, column or other hardware mounted in the space.
- 3.1.19 Platform uniformity values shall apply across the Platform Edge Lighting Zone.
- 3.1.20 Task analysis shall be undertaken to confirm the lighting task plane, which may be horizontal, vertical or both.
- 3.1.21 Lighting shall be designed so that the normal lighting illuminates the environment, with smooth transitions, so that the occupants can move around and perform all necessary tasks safely and effectively without sudden differences in lighting levels, excessively bright or dark areas or areas of strong shadows.
- 3.1.22 Reflections from artificial and natural light sources in surface finishes shall not be permitted to interfere with signal aspects.
- 3.1.23 Specular materials shall not be used in locations where it is likely that reflection of direct sunlight from them could interfere with train driver vision.
- 3.1.24 Lighting systems shall be designed in a manner sympathetic to heritage requirements and shall meet the requirements of LU category 1 standard 1-355.
- 3.1.25 Lighting system design includes the production of an Access and Maintenance strategy plan.
- 3.1.26 The Access and Maintenance strategy plan shall detail the specialist equipment required for access and maintenance of the lighting system.
- 3.1.27 The lighting designs for staircases or escalators shall assume a uniform task horizontal plane, rather than a simulation per step.
- 3.1.28 Lighting designs shall not take any contribution of borrowed light from third parties which may affect normal lighting levels within the station.

- 3.1.29 Lighting systems components (emergency lighting, supporting elements, cable management systems and cabling) shall be unobtrusive to the public.
- 3.1.30 Alterations to lighting system installations shall treat lighting, decor and signage treated holistically.
- 3.1.31 Alterations to lighting systems shall avoid "tidemarks".
- 3.1.32 Electric lighting equipment shall have a minimum power factor of 0.95.
- 3.1.33 Electric lighting equipment shall have a power factor not exceeding unity.
- 3.1.34 All luminaires shall be able to demonstrate compliance with BS EN 60598.
- 3.1.35 Luminaires shall have a minimum luminous efficacy of 80 lumens per circuit Watt.
- 3.1.36 Luminaires shall have a minimum number of 4 fixings to ensure that the weight of each fitting is distributed across all the support.
- 3.1.37 Luminaires shall be independently fixed to the structure of the building.
- 3.1.38 Luminaires that are located near sprinkler systems shall be rated IP65.
- 3.1.39 Luminaires that are located near sprinkler systems shall be fed from segregated circuits.
- 3.1.40 Accommodation areas with suspended ceilings shall have luminaries which are independently supported from the ceiling, such that should the ceiling be removed the lighting installation will remain in situ.
- 3.1.41 The positions of luminaires for externally illuminated signage shall comply with the required illumination levels as specified in BS 5266-7.
- 3.1.42 No signage other than for emergency exit and escape signs are to be supplied from the OLBI.
- 3.1.43 Lighting systems shall not spill light and glare to adjacent residential properties.
- 3.1.44 Luminaries shall be positioned so that they do not impact on the visibility of signage or passenger information systems.
- 3.1.45 Lighting equipment shall be located outside of the 25kV 2.5m exclusion zone in stations that are in close proximity to other rail providers running 25kV AC over head line (OHL).
- 3.1.46 Where rotary machines are used the lighting circuitry shall be wired to utilise at least two phases to reduce the stroboscopic effects.
- 3.1.47 When terminating at luminaires new cables should pass from point to point, 3 cables shall not be connected to a single connection point.
- 3.1.48 All luminaires and lamps shall provide colour stability for a minimum period of 3 years.
- 3.1.49 Luminaires shall be connected to the fixed wiring via robust and compliant industrial captive plug and sockets; the sockets shall be installed immediately above, or immediately adjacent to the luminaires.
- 3.1.50 Luminaire control gear and associated components shall be suitable for the lamp type, wattage and starting characteristics.
- 3.1.51 Luminaires shall be fitted with a fixed fuse holder and fuse in accordance with BS 1362. Fuse holders may be combined with the terminal block.
- 3.1.52 Luminaires shall be located to minimise the associated risks with maintenance access.
- 3.1.53 Sodium lighting shall not be used on new lighting installations.
- 3.1.54 Where the control gear is not mounted within the luminaire, it shall be mounted in a compliant enclosure with the same IP rating and finish as specified for the luminaire. The cable length between the control gear and the LED shall not to exceed the maximum recommended by the manufacturer.
- 3.1.55 Luminaires shall have a secondary safety support provided for diffusers, louvers and gear trays so that they are prevented from falling if their primary support should fail or is released.
- 3.1.56 Public area lighting shall have a minimum colour temperature of 3000K.

- 3.1.57 Glare shall be controlled so that reflections created by the lighting do not impair the view in mirrors or any CCTV equipment.
- 3.1.58 Means shall be provided for the control of glare caused by direct sunlight penetration.
- 3.1.59 Light fittings shall not be installed perpendicular to the track within platforms and tunnels.
- 3.1.60 All lighting structural and supporting elements and lighting column installations shall conform to prevailing LU category 1 civil engineering standards 1-053 or 1-057.
- 3.1.61 High mast lighting shall be designed such that columns and fittings can be maintained without the need to close sections of the depot.
- 3.1.62 High mast lighting shall be designed such that photocells and drivers are installed at low level.
- 3.1.63 Maintenance collapsible (folding) columns shall be positioned such that they can be lowered without fouling tracks.
- 3.1.64 Maintenance collapsible (folding) columns shall be designed to prevent damage to any other equipment (CCTV cameras, PA loudspeakers, signs) mounted on the column.
- 3.1.65 Running tunnels, cross-passages and access shafts shall be permanently equipped with adequate lighting.
- 3.1.66 Each section of running tunnel shall have a dedicated tunnel lighting system.
- 3.1.67 The tunnel lighting system shall be supplied with a single phase power supply.
- 3.1.68 Each section of running tunnel shall have a minimum of 2 No. circuits with supplies to alternate luminaires from alternate circuits.
- 3.1.69 The tunnel light fittings shall be located at a height which is level with the rolling stock windows.
- 3.1.70 Luminaires shall be located so that wherever a train stops in the tunnel, there is at least 2 No. luminaires per carriage, 1 No. per circuit.
- 3.1.71 The tunnel lighting switches at a station shall control the lighting to a point midway between stations.
- 3.1.72 Enhanced fire resistant cables shall be installed between the tunnel lighting board/panel and the first point on each circuit.
- 3.1.73 At least one supply to the tunnel lighting board shall be installed with enhanced fire resistant cables.
- 3.1.74 At cross-overs, lighting is to be permanently on.
- 3.1.75 At sidings, lighting is to be permanently on and shall provide a minimum emergency average horizontal illuminance of 5 Lux.
- 3.1.76 At sidings, lighting is to be controlled by motion detectors so that when a train or a person enters the sidings area, the lighting shall be increased to the normal average horizontal illuminance of 20 Lux.
- 3.1.77 At sidings, lighting is to be controlled by motion detectors which are fail safe, so that if the sensor fails the normal average horizontal illuminance of 20 Lux shall be activated automatically.

3.2 Luminaire and Lamp Requirements

Please refer to the following technical specifications for the requirements for luminaires and lamps:

Table 1: Luminaire and Lamps Technical Specifications

Specification Reference	Title	Revision
T0050	Luminaire – Column Head Lighting	A1
T0051	Luminaire – Square Ceiling Lighting	A1
T0052	Lamp – Edison Screw	A1
T0053	Lamp – Bayonet Mount	A1

T0054	Luminaire – Down Lighting	A1
T0055	Luminaire – Wall Washer Lighting	A1
T0056	Lamp – PL Type	A1
T0057	Luminaire – Outdoor Linear	A1
T0058	Luminaire – Bulkhead Lighting	A1
T0059	Lamp – Linear Lighting	A1
T0060	Luminaire – Flood Lighting	A1
T0061	Luminaire – High Bay Lighting	A1
T0062	Luminaire – Indoor Linear	A1

3.3 Platform Lighting

- 3.3.1 The normal lighting system on station platforms shall enable train operators to view the Platform Edge Lighting Zone in any mirrors provided for this purpose.
- 3.3.2 Lighting systems serving covered platforms on sections of railway at or above grade shall not create adaptation problems for train drivers entering or leaving the area.
- 3.3.3 Folding lighting columns shall be of the pivot type.
- 3.3.4 Fixed columns shall be used only where physical restrictions impose limited restraint.
- 3.3.5 The axis of the pivot shall be between a height of 0.5 and 1.3 metres from the ground level.
- 3.3.6 Lighting columns shall be fixed into the ground.
- 3.3.7 Concrete columns shall not be permissible except where replacing equipment on heritage installations, or adding additional columns to stations which merit such replication.
- 3.3.8 Lighting columns shall not be supplied with ladder rests.
- 3.3.9 Lighting columns shall be provided with a base compartment of a size suitable to house a double pole cut-out unit rated to a suitable IP rating.
- 3.3.10 If there is more than one circuit, each final circuit shall be protected.
- 3.3.11 Columns shall have good tonal contrast against the floor and background in which they are seen.
- 3.3.12 Columns shall be colour banded in accordance with the DDA requirements:
- Columns should be marked with a coloured band 140–160 mm wide, with its lower edge at 1500 mm from the ground.
 - An additional lower band should also be used to mark them as a hazard.
- 3.3.13 Pivot lighting columns shall be able to be lowered parallel to running tracks and roadways, or at an angle that is sufficient to clear any permanent structures or obstructions, but not impinge the track gauge when lowered.
- 3.3.14 Supports for signs fixed to columns shall be designed to meet the static and dynamic loading requirements.
- 3.3.15 Where columns are used to support signs or communication equipment, ensure structural load assessments are carried out as required.
- 3.3.16 Lighting columns shall not be used as masts for catenary wiring.

3.4 Verification

- 3.4.1 Illuminance meters shall be accompanied with the following documents so that the quality of the meters can be assured by a LU engineer
- 3.4.2 An in date calibration certificate
- 3.4.3 A datasheet showing the spectral sensitivity graph of the meter.
- 3.4.4 If the installation is illuminated by a single type of lighting then the manufacturer's value of colour rendering can be used to prove it is compliant.

- 3.4.5 If the installation is illuminated by multiple types of lighting and all the manufacturer's values of colour rendering can be obtained, then the lowest value shall be used as the colour rendering for the whole installation.
- 3.4.6 In lieu of using manufacturer's data, colour rendering can be measured using an approved illuminance spectrometer or another approved device capable of measuring colour rendering.

3.5 Emergency Lighting

Note: The Regulatory Reform (Fire Safety) Order 2005 requires that all permanently occupied places must have emergency lighting.

- 3.5.1 Emergency lighting in public and normally occupied non-public areas at sub-surface stations shall provide illuminance of 15 lux average (5 lux minimum) on designated escape routes.
- 3.5.2 Emergency lighting within 600mm of the Platform Train Interface (PTI) shall provide illuminance of 15 lux average (5 lux minimum).
- 3.5.3 Emergency lighting at surface stations, not normally occupied non-public areas of sub-surface stations and depots shall conform to the requirements of BS 5266 with autonomy suitable for the application.
- 3.5.4 Emergency lighting for areas not covered in this standard shall meet the requirements of BS EN 1838, BS 5266 and BS EN 50172.
- 3.5.5 For emergency lighting at sub-surface locations where central emergency power supplies do not meet the response times required by BS 5266, local emergency power supplies with minimum service duration of 180 minutes shall be provided.
- 3.5.6 Switching of emergency lighting shall meet the requirements of BS 5266-1.
- 3.5.7 A standby lighting system giving 50% of normal lighting levels shall be provided in SOR's and Control Rooms which may be used for the control, monitoring or supervision of station and other operational areas and trains.
- 3.5.8 The degree of security and redundancy offered by any given power supply arrangement shall be such that the level of supply loss risk is as low as reasonably practicable.
- 3.5.9 Emergency lighting shall be provided either by:
- a) self contained fittings (with self testing regime or remote centrally controlled monitoring/reporting facility);
 - b) OLBI; or
 - c) central battery system (i.e. UPS).
- 3.5.10 Emergency luminaires such as discharge lamps shall not be supplied from an OLBI due to the possibility of stroboscopic effects and re-strike times and the possibility that the luminaire may not re strike at all.
- 3.5.11 OLBI and their associated distribution boards shall be separated from the distribution boards and intakes for the Central Emergency Power Supply (CEPS) in order to ensure compliance with the requirement in BS 5266 to keep emergency loads separate from normal loads.
- 3.5.12 In areas not specifically covered by the standard in terms of stating emergency lighting requirements, the requirements of BS 5266 apply.
- 3.5.13 Illuminated emergency signage shall not be used to meet normal lighting requirements.
- 3.5.14 Emergency lighting in areas located above ground shall highlight the appropriate exit routes and any obstacles.

Note: In sub-surface stations, LEPS provision is provided by the OLBI (or UPS unit if there is no OLBI) as this facilitates maintenance and significantly eases the inspection and testing requirements for the emergency lighting system.

- 3.5.15 Emergency systems shall not use flashing lights.

Note: During a power failure, the CEPS system will support the emergency tunnel lighting system at a minimum of 5 lux for a minimum period of 3 hours. During a significant HV Network grid failure, preventing the operation of the tunnel lighting system, the train emergency battery powered lighting is designed to provide a minimum of 5 lux for a minimum of 30 minutes.

- 3.5.16 The position of any cross-passage, access shaft and tunnel telephone shall be indicated by permanently illuminated marker lights connected to the emergency lighting system and be provided with unique identification.
- 3.5.17 Joints in emergency lighting circuits shall only be acceptable when circuit rewiring is not practical and if located in an area evaluated by LU to be low risk.
- 3.5.18 All joints / termination points in emergency lighting circuits shall comply with BS5266-1:2011 section 8.2.4.
- 3.5.19 At sidings and cross-overs emergency lighting shall provide a level of 5 lux.

3.6 Legacy Station, Non Public Areas and Depot

- 3.6.1 Where LU standards differ from statutory, European or British Standard requirements the illuminance values for specific tasks and locations are specified in Table 1.
- 3.6.2 The illuminance levels in Table 1 are maintained average levels measured in the horizontal plane at floor level unless otherwise stated.
- 3.6.3 Where there is no LU specific requirement specified in this document, then European or British Standard requirements shall be followed with CIBSE guidance and DfT Code of Practice to be used for further support.

Table 2: Normal Lighting Illuminance levels

LOCATION	Average Horizontal Illuminance (Lux)	UNIFORMITY	MINIMUM CRI	NOTE
Stations				
Gate lines	150	0.8	80	1, 2
Ticket hall / Concourse	100	0.6	80	
Passageways / corridors	150	0.6	80	
Escalators	150	0.8	80	10
Stairs / Internal Ramps	150	0.8	80	
Escalator Landings	150	0.8	80	2
Stair Landings	150	0.8	80	2
Surface Platform – Open	50	0.4	80	
Surface Platform – Canopy	100	0.4	80	
Sub-Surface Platform only – Platform Edge Lighting Zone	150	0.5	80	
Sub-Surface Platform	100	0.5	80	
Sub-Surface platform wall	100	0.3	80	
Waiting Areas	150	0.4	80	
Station Exterior Walking Route	20	0.4	80	2
Station Entrance	20	0.4	80	
Storeroom	100	0.3	80	
Bin store	100	0.3	80	
Plant Rooms	150	0.4	80	3
Operational Areas – Secure Suite, Station, Booking Office and Other Control Rooms	350	0.4	80	2, 4, 13
Operational Areas – Mess Room	150	0.5	80	
Operational Areas – Cleaner's Stores	150	0.4	80	

LOCATION	Average Horizontal Illuminance (Lux)	UNIFORMITY	MINIMUM CRI	NOTE
Escalator Machine Rooms	150	0.4	80	5
Escalator Inclines	150	0.4	80	5, 11
Platform Inverts	10	0.4	80	6
Intervention Points	10	0.4	80	2
3.6.1.1 Overbridges	150	0.6	80	
Travelators	150	0.8	80	
3.6.1.2 ATM's	200	0.5	80	
3.6.1.3 Bicycle store rooms	100	0.3	80	
3.6.1.4 Retail facades	200	0.5	80	
3.6.1.5 Passenger help points	100	0.8	80	
3.6.1.6 Surface station car park area	20	0.1	80	
3.6.1.7 Surface station car park barrier/ramp	100	0.3	80	
3.6.1.8 Subsurface station car park area	20	0.1	80	
3.6.1.9 Subsurface station car park barrier/ramp	100	0.3	80	
3.6.1.10 Public toilets	100	0.3	80	
3.6.1.11 SVC	100	0.3	80	
3.6.1.12 Cleaners room	100	0.3	80	
3.6.1.13 Disused areas	20	0.1	80	12
Tunnels				
Running Tunnels	10	0.5	80	
Crossover/Junction - Tunnels	10	0.5	80	2
Sidings – normal / occupied	20	0.5	80	
Sidings – emergency / unoccupied	5	0.5	80	
Ventilation & Cable Shafts	10	0.4	80	7
Depots				
Depots – Exterior Stabling Area	10	0.1	80	8
Depots – Designated uncovered Exterior Walkways (Including footpaths & over bridges)	10	0.1	80	2
Depots – Designated covered Exterior Walkways	20	0.1	80	
Depots – Covered Stabling Areas	125	0.1	80	
Depots – Track within Depot (excluding Stabling Area)	10	0.1	80	
Depots – Roads	10	0.5	80	
Depots – Road Tunnels & Subways	50	0.5	80	
Depots – Swimming Pool Roads Underneath Train	150	0.5	80	
Depots – Swimming Pool Roads Walkways	200	0.5	80	
Depots – Standard Inspection Pit	125	0.7	80	9
Depots – Lifting Sheds	250	0.5	80	
Depots – Maintenance Sheds	200	0.5	80	

LOCATION	Average Horizontal Illuminance (Lux)	UNIFORMITY	MINIMUM CRI	NOTE
Depots – Cleaning Shed	125	0.5	80	
Depots – Loading Bay	150	0.5	80	
Depots – Stores: General & Flammable	150	0.5	80	
Depots – Stores: Open Compound	20	0.1	80	
Depots – Plant & Equipment Rooms	150	0.5	80	
Depots – Office	350	0.5	80	
Depots – Staff Accommodation	150	0.5	80	
Depots – Trip Cock Test	30	0.4	80	
3.6.1.14 Viaducts	20	0.1	80	
3.6.1.15 Subsurface Sidings	20	0.1	80	
Other areas covered by other lighting standards				
SERs/IMRs	See 1-197			
Lift Car Interior	See 1-093			
Lift Pits and Shafts	See 1-093			
Lift Motor Rooms	See 1-093			

Notes
1. Measurement taken at oyster card reader level.
2. This is the minimum value.
3. Includes CERs, substations, switchrooms, switch cupboards, pump rooms, fan rooms, OLBI, Hub, LEER, SVC rooms and transformer rooms.
4. Minimum 300lx measured on desk; 150lx on floor. Human factors assessment for any task lighting requirements.
5. Further information is held within LU Lift and escalator category 1 standard 1-092.
6. No lighting required if defined as confined space.
7. Figure stated where cat ladders and landings installed.
8. Figure stated with no trains stabled.
9. Illuminance measured in horizontal plane at rail height in centre of pit when train is present.
10. Uniformity figures are to be measured at 2 points on each leading edge tread along the pitch line.
11. Escalator inclines must incorporate a single switching arrangement to enable lighting in these areas to be easily turned on and off.
12. Disused areas that are not described elsewhere in the table.
13. Lighting in the booking office shall be 100 lux measured in the vertical plane at the counter to enable effective lip-reading. This may mean a recommended figure of 750 lux on the counter to ensure that this is effective.

- 3.6.4 Where works have any impact on an existing lighting installation, either the existing lighting installation shall be modified or new lighting shall be installed to deliver an equivalent level of lighting performance compliant with all other applicable requirements and standards.
- 3.6.5 Luminaries with LED lamp retrofits shall meet the required service life of 25 years.
- 3.6.6 Individual luminaires shall be replaced with a luminaire with the same specification as the adjacent luminaires.
- 3.6.7 Where existing luminaires has been converted to accept LED lamps, a warning label shall be installed stating the voltages available at lamp end cap or lamp-holder terminals.