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GE PE DN CC OP AM RE

Specification for Electrical Work for Road Lighting and Traffic Signs

CC-SPW-01400

May 2019

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TII Publication Title	<i>Specification for Electrical Work for Road Lighting and Traffic Signs</i>
TII Publication Number	<i>CC-SPW-01400</i>

Activity	<i>Construction & Commissioning (CC)</i>	Document Set	<i>Standards</i>
Stream	<i>Specification for Works (SPW)</i>	Publication Date	<i>May 2019</i>
Document Number	<i>01400</i>	Historical Reference	Series 1400

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TII Publications



Activity:	Construction & Commissioning (CC)
Stream:	Specification for Works (SPW)
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**Updates to TII Publications resulting in changes to
Specification for Electrical Work for Road Lighting and Traffic Signs CC-SPW-01400**

Date: May 2019

Page No: General

Section No: General

Amendment Details:

Incorporation of:

New format to match TII format (from UK SHW format);
Updating of referencing to TII publications;
Incorporation of new lighting technology specification (e.g LED);
Removal of older lamp technologies such as SOX which does not meet current EU standards;
General updating across the document to reflect current best practice etc. when implementing lighting on the National Road network.

Date: October 2019

Page No: General

Section No: General

Amendment Details:

Document Title has been updated from “Specification for Road Works Series 1400 – Electrical Work for Road Lighting and Traffic Signs” to “Specification for Electrical Work for Road Lighting and Traffic Signs”

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1. General

Materials equipment and workmanship required under the Contract shall comply with National Standards Authority of Ireland and the rules and regulations of ESB Networks who provide the supply.

The installation under the Contract shall be carried out in accordance with the current edition of the National Rules for Electrical Installations (ET 101) and the latest ESB and ESN Regulations, Codes of Practice and Guidelines.

The following definitions shall apply:

- i. A Road Lighting Unit shall consist of the following as described in the Contract: column, bracket, wall mounting, Electrical Equipment as defined in (iv) below and wiring excluding electrical supply cable;
- ii. A Lit Sign Unit shall consist of a traffic sign requiring an electricity supply and Electrical Equipment and wiring as in (i) above;
- iii. The term Lighting Unit applies to both Road Lighting Units and Lit Sign Units;
- iv. Electrical Equipment for Lighting Units shall consist of the following as described in the Contract: luminaires, photo-electric control units (PECUs), shorting plugs, lamps, time switches, ballasts, ignitors, starters, capacitors, cut-outs, fuses, fuse holders and miniature circuit breakers (MCBs);
- v. The network is the electrical distribution system installed by the Contractor from the electricity supplier's interface to the Lighting Units;
- vi. Each network shall operate on a single phase 230V -6% to +10% or three phase 400V - 6% to +10%; and
- vii. The Contractor shall provide facilities for ESB Networks for service connections and commissioning of the network.

A dedicated feeder pillar shall be provided for Transport Infrastructure Irelands network. Supplies provided to electrical equipment and lighting units for third parties shall not be connected to the Transport Infrastructure Irelands lighting network. Electrical isolation pillars shall be provided on the network at the maintenance boundaries between Transport Infrastructure Ireland lighting network and third parties, with the prior agreement of the Employer's Representative.

2. Site Records

The Contractor shall, on the completion of the electrical work, provide a set of as-built drawings showing as a minimum the position and identification mark (including luminaire type, modification status, lamp setting, lamp type and serial numbers) of equipment requiring electrical connections, ducts, underground cables and joints and the type and depth of cables.

The Contractor shall ensure 'As-Built' drawings are in accordance with the requirements stated in CC-CMG-04001 – Preparation and Delivery Requirements for As-Built Records.

The Contractor shall also supply test certificates and Operation and Maintenance manuals.

Any additional requirements for records shall be as described in Appendix 14/1.

Locational measurements shall be taken of the underground equipment to the nearest 100 mm from the nearest edge of the carriageway or fence line. Offsets to cables and ducts shall be recorded at 20 m intervals along their line. Offsets shall be defined longitudinally by distance from a permanent road feature, a marker post or other suitable point.

The Contractor shall keep a daily record of the work in sufficient detail, including the type and drum number of underground cables, to enable site records to be completed. A copy of the daily record shall be provided by the Contractor on the next working day for retention and use by the Employer's Representative.

The Contractor shall supply to the Employer's Representative one master and two prints of the 'as-built' drawings of power supply arrangements for road lighting and traffic signal installations immediately upon completion of the installation work.

The requirements for handover into operation documentation shall follow the format detailed in DN-LHT-03038 and include lighting inventory information in accordance with AM-LHT-06058.

The Contractor shall also submit the Health & Safety File for the project in accordance with his duties under the Safety, Health and Welfare at Work (Construction) Regulations 2013.

3. Location of Lighting Units and Feeder Pillars

The position of Lighting Units and feeder pillars is described in Appendix 14/2. The exact location will be agreed on site with the Employer's Representative before commencement of any associated ground work. The Contractor shall be responsible for recording the actual location.

In cases where the location of an item has been determined as indicated above and it is impossible because of underground obstruction to install the item then any excavation shall be backfilled and reinstated to its original condition.

Where lighting units are to be installed in the vicinity of safety barriers, they shall be located behind the safety barrier outside of the working width. Care shall be taken that unhindered maintenance access to the cable door is provided.

The Contractor shall be responsible for liaison and co-ordination with ESB in respect of the supply connection to new feeder pillars.

4. Change of Lighting Arrangements

No Lighting Unit shall be switched on or off, dismantled, re-sited, replaced or removed without prior approval of the Employer's Representative.

5. Temporary Lighting

Where possible, the use of temporary lighting shall be avoided or kept to a minimum by phasing works to allow a smooth transition between the existing and proposed scheme.

The standard of temporary Lighting Units shall conform to the Clauses in this Series and Appendix 14/3.

The Contractor shall ensure that any temporary lighting provided does not cause glare to traffic using any road nor annoyance to occupants of surrounding property.

The Contractor shall install temporary lighting at locations where, due to traffic management measures or for any other reasons arising from the Works, the safety of the public may be compromised.

Temporary lighting shall not be removed or disconnected until the permanent installation has been inspected and approved by the Employers Representative.

The Contractor shall ensure that the temporary lighting shall comply with the BS 5489-1 and IS EN 13201 lighting classes and stated in Appendix 14/3.

6. Radio Interference

Electrical equipment shall be installed so that levels of radio interference given in IS EN 55014-1 are not exceeded.

7. Road Lighting Luminaires

Where described in Appendix 14/4, luminaires fitted with integral control gear shall have a fuse holder adjacent to the terminal block with a cartridge fuse protecting each set of control gear.

Luminaires for road lighting shall:

- i. comply with IS EN 60598-2-3, and be as described in Appendix 14/4;
- ii. be fitted in accordance with manufacturers' instructions with no gap between the luminaire and the shoulder of any bracket arm;
- iii. for the luminaire optical system (lamp housing) have degree of protection rating IP 54 to IS EN 60529 unless a higher rating is specified in Appendix 14/4;
- iv. for the luminaire control gear housing have a degree of protection rating IP 43 to IS EN 60529 unless a higher rate is specified in Appendix 14/4;
- v. be fitted with a PECU socket (NEMA or SR) located in the canopy unless otherwise specified in Appendix 14/4;
- vi. meet the structural design and aesthetic approval requirements of CC-SPW-01300 – Specification for Road Lighting Columns and CCTV Masts – Section 2;
- vii. be flat, clear glass type with a low threshold increment (LTI) type;
- viii. incorporate control gear which must be plug and play, fully electronic, high frequency & compatible with luminaire type being used;
- ix. incorporate a diffuser that, if openable, shall have all opening parts retained by a simple catch arrangement designed to facilitate removal and replacement without the use of tools;
- x. incorporate opening parts that shall be hinged and positively retained when open to prevent them falling off accidentally due to wind or other influences;
- xi. have a body made from die-cast aluminium with a polyester powder coated paint finish which will withstand the standard cross cut tests as defined in BS EN ISO 2409 and BS3900;
- xii. have a body that will incorporate sockets for either mounting on a post top spigot or a side entry spigot, as required. The body should incorporate drain holes to allow moisture or condensation to escape;
- xiii. incorporate setting markings for adjustment of the luminaire optical system that shall be clear and indelible. Optical settings shall not be prone to accidental movement or alteration during cleaning or re-lamping operations; and
- xiv. Incorporate a raised gear tray to prevent moisture ingress to the control gear components.

8. Traffic Sign Luminaires

Traffic sign luminaires shall comply with IS EN 12899-1, Appendix 12/1 and the following:

- i. For externally illuminated signs the mean illuminance (Class E) and uniformity of illuminance (Class UE) shall be in accordance with IS EN 12899-1 National Annex NA.2 Table NA.1 and as stated in Appendix 14/5;
- ii. For internally illuminated signs the mean luminance (Class L) and uniformity of luminance (Class U) shall be in accordance with IS EN 12899-1 National Annex NA.2 Table NA.1 and as stated in Appendix 14/5; and
- iii. External lighting luminaires shall be correctly positioned to meet the luminance requirements of the sign.

9. Light Emitting Diodes (LED) Light Sources

The luminaires shall be suitable for connection to a single phase electrical supply with a nominal voltage of: 230Vac +10% to -6% at 50Hz.

The luminaire shall provide a connection facility for the main incoming supply cable.

The luminaires shall be designed, manufactured and tested in accordance with the essential requirements of:

- i. IS EN 60598-1, Luminaires, General requirements and tests;
- ii. IS EN 60598-2-3, Luminaires, Particular requirements. Luminaires for road and street lighting;
- iii. IS EN 62031, LED modules for general lighting, safety specifications;
- iv. IS EN 55015 - Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment;
- v. IS EN 61547, Equipment for General Lighting Purposes – EMC Immunity Requirements;
- vi. IS EN 61000-3-2, Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current ≤ 16 A per phase);
- vii. IS EN 61000-3-3, Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection; and
- viii. IS EN 62471, Photo biological safety of lamps and lamp systems and shall meet the requirements of risk group 'Exempt'.

The luminaires shall be designed, manufactured and tested in accordance with the requirements of:

- i. IS EN 62262, Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK Code) And shall meet a rating of at least IK08 for the whole luminaire (including the housing, gear canopy and glass cover); and
- ii. IS EN 60529, Degrees of protection provided by enclosures (IP Code) And shall meet a rating of at least IP66 for the whole luminaire (including the housing, gear canopy and glass cover).

The luminaire shall be fully compliant with all relevant European/British/Irish standards and EC Directives as required to demonstrate full compliance with the Construction Products Regulations (CPR) and be clearly marked accordingly.

All LED life extrapolations must be based upon the Illuminating Engineering Society (IES) standard LM-80 provided by the LED source manufacturer. The LED source manufacturer must use a valid method for projecting LM 80, or equivalent, with test results to LM-80 based on recommended operating conditions.

Long term life projections must be developed in accordance with the Illuminating Engineering Society (IES) recommendations contained in TM-21 or equivalent using data obtained in accordance with LM-80.

The luminaires shall be suitable for operation within ambient temperatures between -20°C and +35°C.

The minimum performance requirements of the luminaire shall be L90B10 at 100,000hrs across the full range of outputs when subjected to a luminaire outside ambient temperature of 25°C.

All testing and certification, including lifetime projections shall have been undertaken with the luminaires mounted within a controlled environment at an ambient operating temperature of +25°C with the LED chipset installed within the luminaires. Any testing undertaken, or data acquired at lower temperatures, or indeed based upon LED manufacturer's lifetime projections calculated at a nominal LED junction temperature (T_j) for example must not be used to demonstrate compliance with any of the minimum requirements herein.

Luminaires shall be WEEE and RoHS compliant.

The luminaire housing shall be constructed from die cast corrosion resistant marine grade aluminium alloy in accordance with: IS EN 1676:2010 + IS EN 1559-1:2011 + IS EN 1559-4:2015 LM6 (IS EN 1706:2010 / EN AC-44100) and be powder coated conforming to appropriate European standards and with a minimum average thickness of 50 microns.

The closing catch, hinges, exposed screws and other fixings shall be manufactured from a corrosion resistant material and protected in a manner commensurate with the luminaire housing.

The luminaire shall incorporate a robust bracing arrangement that shall securely support the canopy when open.

The luminaire shall be available with mounting spigots that accommodate the following requirements as a minimum:

- | | | |
|-----|---------------------|--------------|
| i. | Side-entry mounting | 32mm to 60mm |
| ii. | Post-top mounting | 60mm to 76mm |

When mounted, the luminaire shall be capable of facilitating each of the following tilt settings as a minimum:

- | | | |
|-----|-----------------------|--------------------------|
| i. | Side entry tilt angle | -10°, -5°, 0°, +5°, +10° |
| ii. | Post top tilt angle | 0°, +5°, +10° |

The luminaire must be available with optics that can meet the full range of glare classifications G1 to G6.

Luminaire maximum upward light output ratio (ULOR) shall be a maximum of 0% when mounted in a horizontal position.

Levels of uniformity should not be adversely affected in the event of individual LED failures.

The LEDs shall have a Correlated Colour Temperature (CCT) category and a nominal initial value, stated in Appendix 14/4.

The colour rendering index (CRI) shall be a minimum of: Ra 70.

The initial Colour Temperature tolerance shall be no more than: 5-step MacAdam Ellipse.

10. Light Emitting Diodes (LED) Drivers

The LED drivers shall comply with the essential requirements of the following standards:

- IS EN 61000-3-2, Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current ≤ 16 A per phase).
- IS EN 61000-3-3, Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection.
- IS EN 61347-1, Lamp control gear. General and safety requirements.
- IS EN 61347-2-13, Lamp control gear. Particular requirements for DC or AC supplied electronic control gear for LED modules.
- IS EN 61000-4-5, Electromagnetic compatibility (EMC). Testing and measurement techniques. Surge immunity test.

The LED driver components shall be integral to the luminaire housing and mounted within a driver compartment separated from the LED module.

Access to the driver compartment shall be via a hinged upward-opening canopy that shall be secured when in the closed position via a robust closing catch that facilitates tool-less operation.

The drivers shall include Surge Immunity and be capable of withstanding multiple surges of up to 8kV in differential mode, up to 6kV in common mode and up to 10kV single pulse.

A maximum drive current of 1,000mA must be adhered to for all luminaires.

The LED drivers shall have terminals which are shrouded and indelibly marked to indicate all wiring connections and operating voltages.

The LED drivers shall be fitted with an automatic re-setting thermal cut out.

The LED drivers should achieve a power factor of ≥ 0.9 when operated at full load.

The LED drivers shall have a minimum operational lifetime of 100,000 hours with a minimum of 90% survival during this period.

All drivers shall be CE certified and marked.

Should the Employer's Representative require it, the LED driver shall include a communications protocol. This protocol shall be included within Appendix 14/4.

11. Central Management Systems (CMS)

The requirements for Central Management Systems will be as described in Appendix 14/4.

12. Dimming

The LED driver as described in Section 10, shall be capable of linear multi-stage dimming using variable drive currents.

The driver shall be pre-programmable to a set dimming regime if necessary. If a CMS enabled driver is specified, then remote configuration shall also be supported.

The requirements for Dimming will be as described in Appendix 14/4.

13. Photo-Electric Control Units (PECUs)

13.1 Photo-Electric Control Units (PECUs)

Photo-electric control units (PECUs) shall comply with BS 5972. They shall have differential switch on - switch off levels as described in Appendix 14/4. They shall be designed where possible so that in the event of a fault occurring in the unit they cause the load to be switched 'on'.

All PECUs shall incorporate a phototransistor arranged to switch a 10A inductive load, all complying with I.S. 428:1991 and enclosed in a housing rated IP 67. The PEC shall have a minimum guaranteed operating life of 6 years. The weathering performance of the PEC cover shall show a decrease of no more than 1% over the guaranteed life of the unit. A test switch to allow daytime testing of the lantern and wired to bypass the PEC in the 'ON' position shall be provided in the base compartment of each column.

PECUs shall:

- i. be secured as appropriate to the:
- ii. road lighting luminaire canopy;
- iii. top of pole located close to feeder pillar;
- iv. top of sign post;
- v. internally illuminated sign housing; or
- vi. luminaire of externally illuminated sign;
- vii. include a delay device to prevent the lamp being switched in response to transient changes in light conditions;
- viii. be indelibly marked with the (a) manufacturer's identification mark (b) model number and (c) switch on level;
- ix. be provided with a gasket or grommet to maintain the IP protection rating of the luminaire; and
- x. be installed to the manufacturer's instructions.

Where luminaires are a pair mounted on twin arm brackets, unless otherwise specified in Appendix 14/4, one luminaire shall be fitted with a PECU to control both luminaires and the other luminaire shall be fitted with a shorting plug. The luminaire to be fitted with the shorting plug shall be as described in Appendix 14/4.

Where described in Appendix 14/4, circuits shall be group switched as specified therein.

Shorting plugs (Dummy PECUs) shall:

- i. be interchangeable with PECUs;
- ii. have the line and load terminals permanently connected internally; and
- iii. be clearly distinguishable from PECUs.

14. Time Switches

Time switches shall:

- i. be electrically or electronically driven;
- ii. have an electrically wound spring or battery reserve of not less than 12 hours unless otherwise described in Appendix 14/4;
- iii. be equipped with a solar dial suitable for the geographic location or equivalent means of setting and seasonal adjustment;
- iv. have 2 switched on/off periods per 24 hours; and
- v. be capable of switching a 10 A inductive load current at the specified operating voltage of the network.

15. High Intensity Discharge (HID) Lighting

15.1 HID Lamps

Lamps shall be compatible with the luminaires used.

Lamps shall not be fitted until columns, brackets and sign posts have been erected and the luminaires have been installed.

Low pressure and high pressure sodium vapour lamps shall comply with IS EN 62035.

15.2 High Intensity Discharge (HID) Lighting Control Gear

15.3 Ballasts

Unless otherwise specified in Appendix 14/4 ballasts shall comply with IS EN 61347-1, IS EN 61347-2-1, IS EN 61347-2-8, IS EN 61347-2-9 and IS EN 60921 or IS EN 60923 as appropriate and be tap selected to the specified operating voltage of the network.

The terminals shall be indelibly marked to indicate all wiring connections and operating voltages.

15.4 Ignitors

Unless otherwise specified in Appendix 14/4, ignitors shall not be incorporated in the lamps.

Ignitor, lamp and ballast shall be mutually compatible.

15.5 Starter for Fluorescent Lamps

Starters shall comply with IS EN 60155 and shall be incorporated in the electrical equipment where applicable.

15.6 Capacitors

Capacitors shall comply with IS EN 61048 and IS EN 61049 and be supplied complete with fixing clips, discharge resistors, and either sealed-in cable tails or shrouded terminals.

Capacitors shall correct the lamp circuit power factor to not less than 0.85 lagging.

16. Cut-outs, Fuse Holders, Fuses, Residual Current Devices (RCDs) and Miniature Circuit Breakers (MCBs)

Cut-outs, fuse holders, RCDs and MCBs shall have moulded drip-proof housings to IP 31 or above.

Cut-outs shall be double pole and comply with BS 7654.

Terminals shall be sufficient for the conductors as described in Appendix 14/4. They shall be clearly labelled to differentiate circuits and phases.

When fuse holders are intended to be used as isolating devices, special tools or protective measures shall not be necessary to extract them.

Fuse links shall comply with the requirements of either IS EN 60269-1, IS HD 60269-2 (BS 88-2), BS 646/BS 2950, or IS HD 60269-3 (BS 88-3) IS HD 60269-3 (BS 88-3).

Fuses shall be high rupturing capacity (HRC) cartridge fuses with a fusing factor corresponding to Class Q1 and of a value specified in Appendix 14/4 to protect the circuit. Every fuse shall incorporate a device designed to give visual indication when the element has operated. Fuse carriers shall be fully skirted, to ensure that the operator cannot accidentally come into contact with live parts while inserting or removing the carrier, no matter how the carrier is held.

Miniature circuit breakers shall be in accordance with IS EN 60898 and IS EN 60947-2 for use on the specified operating voltage of the network at single or three phase as appropriate. Their short circuit current rating and type shall be as described in Appendix 14/4. Thermal or magnetic excess current tripping devices shall be provided with a mechanism to ensure that the contact cannot be held closed against a fault.

MCB's shall be air-break thermal-magnetic circuit breakers with sealed cases of suitable insulating material. They shall have fixed non-adjustable time-current characteristics. In general, they shall be type 'C' for lighting. Short circuit breaking capacities shall be the same as the rating of the board in which they are installed.

Where MCBs are intended to be used as isolating devices, a 'lock off' facility shall be provided.

Residual Current Devices' shall be in accordance with IS EN 61008 and IS EN 61009.

17. Base Compartment Fixing Arrangements

Electrical equipment described in this Specification and installed within the base compartment of columns or posts shall be positioned as described in Appendix 14/4 and Appendix 14/5 and fixed in accordance with manufacturers' instructions with corrosion resistant fixing screws.

Terminations in the column shall be by means of a single-phase cut-out, with proprietary extension troughs. The cut-out used must comply with the latest version of BS 7654. A 6-amp fuse shall be provided in the cut-out, the fuse shall be type LS cartridge, suitable for fitting in fuse carriers. Fuse link shall comply with the latest version of BS 88, rating 6 amps, 240 volts AC, breaking range and utilisation category gG, rupturing capacity 20 kA at 415 volts AC. The cut-out shall be securely mounted on the baseboard. Appropriate circuit discrimination shall be provided.

18. Feeder Pillars

Feeder pillars shall be constructed in the materials described in Appendix 14/4. They shall comply with IP 34 of IS EN 60529. They shall include a full size back board of varnished marine plywood at least 15 mm thick or other suitable non-hygroscopic material. Intumescent varnish should be applied to the backboard in three coats to provide protection against fire propagation. Alternatively, a purpose-designed equipment mounting system may be used. The entry for cables shall be via the roof.

The distribution MCBs or fuse boards shall have sufficient spare capacity to accommodate at least one extra circuit. (One three phase spare way on a three phase distribution unit and one single phase spare way on a single phase distribution unit). There shall be at least 25% usable spare space on the back board.

The feeder pillar shall be fitted with a suitably rated 1 to 3-phase and neutral switch fuse to IS EN 60947-3 as appropriate for the supply cable.

The pillar doors shall be fitted with tamper-proof locks, all locks being identical in pattern and two sets of keys shall be provided. All hinges and locks shall be of stainless steel unless otherwise stated in Appendix 14/4.

Distribution boards shall be provided with an external earth, phase barriered and colour coded. They shall be fitted with the same number of live and neutral bus bar terminals as there are outgoing circuits plus at least one spare way.

Circuit details and labelling shall be provided in each feeder pillar as described in Appendix 14/4.

The main earthing terminal in each feeder pillar shall be connected to earth as described in Appendix 14/4.

Unless otherwise stated in Appendix 14/4, feeder pillars shall be mounted on a 150 mm thick foundation of ST2 concrete in compliance with CC-SPW-02600 – Specification for Road Works Series 02600 – Miscellaneous – Concrete for Ancillary Purposes section. After completion of the cabling the feeder pillar base shall be filled to 25 mm below the door with rounded coarse aggregate conforming with Table 2 of IS EN 12620, 4/14 aggregate with a grading category of GC90/15. Annex C, Table C.1 of PD 6682-1:2009+A1:2013, grading category GC90/15, 2/14 aggregate.

A durable warning sign indicating 'Danger 415 Volts' or 'Danger 230 Volts' as appropriate, shall be fixed to the front of the pillar where applicable.

Requirements for ESNB equipment shall be in accordance with the latest ESNB Regulations, Codes of Practice and Guidelines.

19. Wiring

All wiring and installation of components within the column, post or Lit Sign Unit shall be as described in Appendix 14/4 and Appendix 14/5.

Wiring between the terminal block in the luminaire and the components in the base of the column or sign unit shall be PVC or XLPE insulated and sheathed single, multi-core or composite cable to BS 6004 of 300/500 volt grade. Phase and neutral copper conductors shall be not less than 2.5 mm² in cross-sectional area except that where the vertical unsupported length does not exceed 6 metres their cross-sectional area may be reduced to 1.5 mm². Cable types and sizes shall be selected to ensure that the operation of the lighting systems shall not be adversely affected.

Where electronic ignitors are used with remote control gear, single core cable shall be used.

The final connection between equipment mounted in the base compartment and the cut out shall be made using PVC or XLPE insulated and sheathed single core cable of a minimum cross-sectional area of 2.5 mm².

All cables shall be correctly colour coded throughout their length and labelled appropriately at the feeder pillar and the cut-out.

Unsupported lengths of cable shall be kept to a minimum and shall not be allowed to come into contact with components by their freedom of movement. Where there is more than one cable they shall be secured together at one metre intervals throughout the unsupported length. Vertical cables within posts or columns shall be adequately supported along their length at the top of the cable run.

On double bracket columns the wiring shall connect PECU sockets in series, unless otherwise specified in Appendix 14/4.

Wiring shall wherever possible be housed inside columns, wall brackets and posts or stiffening members. Where it is external it shall be as described in Appendix 14/4. Connections between conduit and sign housings, switchboxes and other components shall be waterproof and be smooth internally.

All unused cores in cables shall be cut to a minimum length, long enough to connect to the furthest working-off point within the unit and shall be cut to equal length. The ends of the cores shall be tied together and sealed with self-amalgamating waterproof jointing tape. The unused cores shall be coiled and strapped in a suitable unobtrusive position.

20. Earthing

All street lighting and other electrically supplied street furniture shall be earthed and bonded in compliance with the latest edition of the ET 101 National Rules for Electrical Installations and the latest ESNB codes of practice.

Circuit protective and equipotential conductors shall be installed as shown on the Drawings and shall be green/yellow PVC or XLPE insulated or sleeved. Where bolted connections are required, these conductors shall be terminated in accordance with manufacturers' instructions in correctly sized purpose made lugs. Such connections shall be made with non-ferrous nuts, bolts and washers.

A circuit protective conductor shall connect the earth terminal on each luminaire to the main earth terminal associated with the service cut-out unit.

All extraneous conductive parts, as described in ETCI Wiring Regulations, and including doors to feeder pillars, lighting columns and lit sign units, shall be bonded to the main earth terminal using an equipotential bonding conductor of 6 mm² cross-sectional area when the lighting unit is directly serviced by a TN-C-S supply.

20.1 Earth bonding - Main, Auxiliary Section Pillars

- i. A main earth terminal (connector block) shall be mounted on the base-board or on the earth busbar in the case of the ABB type mini pillar, to which the following shall be connected.
 - (i) 6mm² PVC earth wire connected with a suitable crimped lug to the metal frame of the pillar;
 - (ii) 10mm² PVC earth wire to the earth electrode; and
 - (iii) 6mm² PVC earth wire to the neutral link or neutral busbar (i.e. Neutralising Link).
- ii. The outer sheath of the incoming and/ or outgoing service cables shall be connected to the main earth terminal at each section pillar.

20.2 Earth bonding - Lighting Column

- i. A main earth terminal shall be mounted on the base-board to which the following shall be connected.
 - (i) 2.5mm² PVC earth wire to the lantern earth terminal; and
 - (ii) 6mm² PVC earth wire connected with a suitable crimped lug to the metal frame of the column.
- ii. The outer sheath of the incoming and/ or outgoing service cables shall be connected to the main earth terminal at each column.
- iii. Within the rail underpass trunking and other similar forms of cable containment shall be bonded and along runs wherever the support system is not electrically continuous.

20.3 Earth Electrodes

An earth electrode shall be installed at each feeder pillar, either in the base of the pillar or in an adjacent suitable approved earth electrode enclosure. The earth electrode shall consist of a copper-coated or hot dip galvanised steel rod of minimum 12mm diameter and 1200mm long. A 16mm² stranded copper earth conductor shall be connected from the earth electrode to the main earthing terminal block, and 6mm² stranded copper earth conductor between the earth stud on the pillar frame and the earthing terminal block. The pillar door shall also be bonded to the earth stud on the pillar frame with a 4mm² stranded earth wire.

21. Underground and Ducted Cable

Cables shall have XLPE insulation and sheathing material. The identification of the conductors by colour shall be as per the ETCI Wiring Regulations and every core shall be identifiable by colour throughout its length. The sheathing material shall be appropriate to the ground conditions in which it will be laid. In ground that is liable at any time to become waterlogged, then the sheathing material shall have an ASTM F1249-1 tested maximum permeability of 2.0 g.d-1-2, 90% R.H, 1mm. The cables shall be 600/1000 V grade with steel wire or aluminium strip armouring to BS 6346 or BS 5467 and all conductors shall be of equal cross-sectional area. The Contractor shall provide to the Employer's Representative evidence that each cable length delivered to Site has been tested at the place of manufacture and complies with the testing requirements of BS 6346 or BS 5467 according to the cable used.

Service ducts shall be red in colour and stamped with the legend 'Public Lighting Duct'. For ESB Network duct requirements ESB Network should be consulted to confirm specification.

Cable covers for protection of underground cables shall comply with BS 2484 and shall be installed as described in Appendix 14/4. When cable covers are installed, marker tapes are not required.

Cable trenches shall be excavated to the lines described in Appendix 14/4 and in accordance with CC-SPW-0600 – Specification for Road Works Series 0600 – Earthworks - Section 2.

The depth of excavation shall be such that cables laid under verges, footways or open ground shall have a minimum cover of 500mm and under carriageways a minimum cover of 750 mm below formation. The minimum depth for other locations is specified in the National Rules for Electrical Installations.

Cables shall be laid without sharp bends and kinks and in accordance with any particular requirements in Appendix 14/4. If required, additional protection and support shall be provided as described in Appendix 14/4.

Where cables are laid across or within 500mm of filter drains they shall be contained within a duct. The duct shall be surrounded with 50mm of ST2 concrete in compliance with CC-SPW-02600 – Specification for Road Works Series 2600 – Miscellaneous - Section 2.

Cables following the same route shall unless otherwise described in Appendix 14/4 occupy the same trench with a clearance of 50mm between the outer sheath of the cables.

Power supply cables, other than those associated solely with the communications system, shall not be installed within 500mm of signal or communication cables, within 300mm of telecommunication cables or within 300mm of HV cables, unless otherwise described in Appendix 14/4.

Cables shall only be laid when the ambient temperature is above 0°C, and the cable has been stored at a temperature greater than 0°C for the previous 24 hours.

Cables shall not be bent to an internal radius of less than 12 times the external diameter of the cable or less than the radius recommended by the manufacturer, whichever is greater.

Sufficient length of cable shall be allowed for its termination. When termination does not proceed immediately following the installation of the cable, its end shall be sealed against the ingress of moisture. If such cable ends are buried, their positions shall be marked with a permanent marker block consisting of a 300mm square x 225mm deep precast concrete block having a mark as described in Appendix 14/4 indented into its top surface and recorded on the site records.

When duct or trough alignments differ from those of the trench the transition from one to the other shall not exceed 1:30 horizontally or vertically.

Cables laid in trench shall, unless otherwise specified in Appendix 14/4, be both bedded on and covered by a 100mm thickness of lightly compacted graded sand or equivalent material passing a 2mm BS sieve. Class 8 material complying with Table 6/1 and compacted to the requirements therein shall then be deposited to a thickness of 175mm prior to further backfilling as described below.

A yellow, self-coloured PVC or polythene plastic tape for cable marking, not less than 0.1mm thick and 150mm wide with the wording "Street Lighting Cables Below" printed in black along the full length so as to occupy not less than 75% of its available length and occurring at least at 1m intervals, shall be laid approximately 250mm above any power supply cable. Where several cables are laid in one trench, only one line of marker tape need be installed.

Where cables are required to be laid in ducts the Contractor shall swab through the duct prior to drawing in the cables and a further draw rope. On completion of cabling, ducts shall be left with a draw rope in place and re-sealed with split plugs, or suitable alternative material, to adequately seal the ducts against the ingress of foreign matter. Where cables are laid in troughs they shall be covered with sand, or equivalent material, passing a 2mm BS sieve up to the level of the cover.

Backfilling to cable trenches shall comply with CC-SPW-0600 – Specification for Road Works Series 0600 – Earthworks - Section 2 and to prevent damage by the ingress of foreign matter shall whenever practical be undertaken immediately after the specified operations preceding it have been completed. The Contractor shall backfill above the cable marking tape, duct or trough with Class 1, 2 or 3 material complying with Table 6/1 and compacted to the requirements therein and shall:

- i. spread and compact the material evenly without dislodging, disturbing or damaging cables, ducts or troughs; and
- ii. not use power rammers within 300mm of cables, ducts or troughs.

Where described in Appendix 2/2, buried cables shall be taken up and removed by the Contractor. Conductors shall be disconnected from the equipment in which they are terminated, the terminal screws and glands retightened, and the cable withdrawn clear of the equipment.

Unused cores in cables shall be dealt with as described elsewhere in this specification.

Unless ducts terminate at cabinets or mounting posts or columns, their ends shall be marked as described in Appendix 5/2, with marker blocks complying with the requirements stated above and location posts so that their location can be clearly identified without exploratory excavation.

Where ESB Network high voltage cables (11 KV / 22 KV) cables run in parallel with Public Lighting cables in ducts a minimum segregation of 300mm shall be maintained. Where ESB high voltage cables and Public Lighting Cables cross they shall do so at right angles. The requirement of crossing at right angles also applies to gas mains.

22. Cable Joints

Joints shall be made using jointing kits complying with BS 6910-1 which shall be installed in compliance with BS 6910-2.

Prior to any cable laying, the Contractor shall provide evidence to the Employer's Representative of the jointer's competence in the use of the adopted cable joint kit. A record shall be kept enabling cable joints to be identified with the jointer responsible for the work.

Cable joints shall be made where described in Appendix 14/4. Additional joints shall not be provided on cables in duct or trough. Approval is required from the Employer's Representative for additional joints using other fixing methods.

Jointing shall only be carried out when all materials to be used in the jointing are free from visible signs of moisture and joints shall be left protected from the weather during the curing period.

Joints shall be adequately supported at all times. Backfilling shall not take place until the joint is fully completed in accordance with the manufacturer's instructions including curing times and is in a fit condition to withstand any stresses which may be imposed upon it.

Where described in Appendix 14/4, a cable joint marker block, as described in Section 21 shall be placed over the cable joint and reference measurements taken from nearby permanent features.

All cable jointing shall be made under the protection of a specialist jointing tent.

23. Armoured Cable Terminations

Cables shall be individually terminated, and existing cables re-terminated, and secured at switches, cut-outs and other electrical apparatus by means of an armour securing clamp or an aluminium compression type gland complying with BS 6121-1, IS EN 62444 and a gland plate, all as described in Appendix 14/4.

The armour securing clamp or compression gland and plate assembly shall incorporate at least one non-ferrous earthing terminal.

The armour of SWA cables shall be made-off with proprietary, brass-armoured cable glands and shrouds to the latest version of BS 6121.

All glands shall be shrouded overall with PVC sleeves and the conductor shall be terminated with cable lugs.

An anti-oxidant mastic or paste protective coating shall be applied to all aluminium conductor terminals where they are exposed to the atmosphere.

Phase connections shall be clearly indicated by a suitable colour marking system.

24. Inspection and Testing to be Carried Out by the Contractor

Every Lighting Unit and network, on completion and before being energised, shall be inspected and tested to verify that the requirements of ETCI Wiring Regulations have been met. The method of testing shall be such that no danger to persons or property or damage to equipment can occur even if the circuit tested is defective.

The following tests shall be carried out in the sequence indicated below and recorded on a Schedule, in an appropriate format, which shall be submitted to the Employer's Representative immediately after completion of all the tests, including those on Lighting Units, within each network:

- i. For Lighting Units (b), (d), (f), (g) apply;
- ii. For networks (a), (b), (c), (e), (f), (g), (h), (i) apply;
- iii. Standard methods of testing are given in ETCI Wiring Regulations;
- iv. Cable sheath insulation test;
- v. Continuity of protective conductors including main and supplementary equipotential bonding;
- vi. Earth electrode resistance;
- vii. Insulation resistance at a test voltage of 500 V to be not less than 1.0 M ohm;
- viii. Insulation resistance at a test voltage of 500 V to be not less than 6 M ohm;
- ix. Insulation of the site-built assemblies;
- x. Polarity, including the continuity of circuit conductors;
- xi. Earth fault loop impedance at every cut-out; and
- xii. Operation of residual current devices.

The cable sheath insulation test shall be carried out using an insulation tester. The insulation resistance test of 1000 V, direct current, shall be applied and maintained for not less than one minute between the continuous cable armouring or earth conductor and the general mass of earth. The measured insulation resistance shall not fall below 1.0 M ohm for the full duration of the test. The cable sheath insulation test shall be carried out after the cable has been laid and the trench backfilled, but before jointing has taken place.

Voltage readings shall be taken at each feeder pillar and at the terminals of the last current-using equipment on each circuit, with all equipment energised.

The Contractor shall give not less than 7 days' notice to the Employer's Representative of his intention to carry out any of the tests specified and the Employer's Representative shall be given the opportunity to witness such tests.

The Contractor shall furnish the Employer's Representative with two copies of a certificate verifying compliance with ETCI Wiring Regulations upon satisfactory completion of the inspection and tests.

The Contractor shall ensure that all test instruments have been calibrated and adjusted in accordance with IS EN ISO 9001 and come complete with calibration certificates to verify that IS EN ISO 9001 has been complied with.

25. Preparation and Finish of Metal and Other Surfaces

Electrical components and ancillary equipment shall be prepared and finished in compliance with the requirement stated in Appendix 14/4.

References

25.1 TII Publications (Standards) Referencing

CC-SPW-00600 – Specification for Road Works Series 600 – Earthworks

CC-SPW-01200 – Specification for Road Works Series 1200 – Traffic Signs

CC-SPW-01300 – Specification for Road Lighting Columns and Brackets, CCTV Masts and Cantilever Masts

CC-SPW-01900 – Specification for Road Works Series 1900 – Protection of Steelwork Against Corrosion after Fabrication

CC-SPW-02600 – Specification for Road Works Series 2600 - Miscellaneous

CC-SCD-01301-01 – Standard Construction Details - Road Lighting - Lighting Columns - Fastener Head in Door Recess and Key

CC-SCD-01302-01 – Standard Construction Details - Lighting Columns and Brackets - Steel Lighting Column Door

CC-SCD-01401-01 – Standard Construction Details - Road Lighting - Lighting Column Connection

25.2 References to IS/EN/BS Standards

IS EN 55014-1 – Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus

IS EN 60598-1 – Luminaires. General requirements and tests

IS EN 60598-2-3 – Luminaires. Particular requirements. Luminaires for road and street lighting.

IS EN 60529 – Degrees of Protection by enclosures (IP Rating)

IS EN 12899-1 – Fixed, vertical road traffic signs. Fixed signs

IS EN 62031 – LED modules for general lighting. Safety specifications

IS EN 55015 – Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment

IS EN 61547 – Equipment for general lighting purposes. EMC immunity requirements

IS EN 61000-3-2 - Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

IS EN 61000-3-3 - Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection

IS EN 61000-4-5 - Electromagnetic compatibility (EMC). Testing and measurement techniques. Surge immunity test

IS EN 62471 – Photobiological safety of lamps and lamp systems

- IS EN 62262 – Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
- IS EN 62035 – Discharge Lamps (excluding fluorescent lamps). Safety Specifications.
- IS EN 61347-1 – Lamp control gear. General and safety requirements
- IS EN 61347-2-1 – Lamp control gear. Particular requirements for starting devices (other than glow starters)
- IS EN 61347-2-8 – Particular requirements for ballasts for fluorescent lamps
- IS EN 61347-2-9 – Lamp control gear. Particular requirements for electromagnetic control gear for discharge lamps (excluding fluorescent lamps)
- IS EN 61347-2-13 – Lamp control gear. Particular requirements for d.c or a.c. supplied electronic control gear for LED modules
- IS EN 60921 – Ballasts for tubular fluorescent lamps. Performance requirements
- IS EN 60923 – Auxiliaries for lamps. Ballasts for discharge lamps (excluding tubular fluorescent lamps). Performance requirements
- IS EN 60155 – Glow Starters for fluorescent lamps
- IS EN 61048 – Auxiliaries for lamps. Capacitors for use in tubular fluorescent and other discharge lamp circuits
- IS EN 61049 – Specification for capacitors for use in tubular fluorescent and other discharge lamp circuits. Performance requirements
- IS EN 60269-1 - Low-voltage fuses. General requirements
- IS EN 60898 - Electrical accessories. Circuit-breakers for overcurrent protection for household and similar installations. Circuit-breakers for a.c and d.c. operation
- IS EN 60947-2 - Low-voltage switchgear and controlgear. Circuit-breakers
- IS EN 60947-3 - Low-voltage switchgear and controlgear. Switches, disconnectors, switch-disconnectors and fuse-combination units
- i. IS EN 62444 - Cable glands for electrical installations
- IS HD 60269-2, BS 88-2 - Low-voltage fuses. Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to K
- i. IS HD 60269-3, BS 88-3 - Low-voltage fuses. Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications). Examples of standardized systems of fuses A to F
 - ii. IS EN ISO 9001 - Quality management systems. Requirements
- BS 5467 - Electric cables. Thermosetting insulated, armoured cables of rated voltages of 600/1 000 V and 1 900/3 300 V for fixed installations. Specification
- BS 5972 - Specification for photoelectric control units for road lighting
- i. BS 6004 – Electric Cables. PVC insulated and PVC sheathed cables for voltages up to and including 300/500V, for electric power and lighting

- ii. BS 6121-1 - Mechanical cable glands. Armour glands. Requirements and test methods

BS 646/BS 2950 - Specification for Cartridge fuse-links (rated up to 5 amperes) for a.c. and d.c. service/ Specification. Cartridge fuse-links for telecommunication and light electrical apparatus

- i. BS 6910-1 – Cold pour resin compound and heat-shrink cable in the voltage range up to 1000 V a.c. and 1500 V d.c., Specification for materials
- ii. BS 6910-2 Cold pour resin compound and heat-shrink cable in the voltage range up to 1000 V a.c. and 1500 V d.c., Code of Practice for on-site installations

BS 7654 – specification for single-phase street lighting cut-out assemblies for low-voltage public electricity distribution systems. 25A rating for highways power supplies and street furniture

BS 6346 Electric cables. PVC insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V

BS 2484 Specification for straight concrete and clayware cable covers

BS1490:1988 [LM6] replaced by IS EN 1676:2010 + IS EN 1559-1:2011 + IS EN 1559-4:2015 (IS EN 1706 - Aluminium and aluminium alloys. Castings. Chemical composition and mechanical properties [EN AC-44100])

25.3 Other Miscellaneous References

Illuminating Engineering Society (IES) - Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules, LM-80


Illuminating Engineering Society (IES) - Projecting Long Term Lumen Maintenance of LED Light Sources, TM-21

- i. The Electro-Technical Council of Ireland (ETCI) – ET 101 National Rules for Electrical Installations [Wiring Regulations]

ASTM F1249-1 replaced by ASTM International F1249 - 13 - Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

The latest ESN Regulations, Codes of Practice and Guidelines.



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