

Category 1 Standard

S1120 Power Cable Route Design, Testing and Recovery Requirements

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1 Purpose

- 1.1 The purpose of this Standard is to define the minimum requirements for the design of cable routes and the installation and testing of power supply and control cables.

2 Scope

- 2.1 This Standard applies to all cabling assets for which the LU Power Engineer is accountable, i.e.:

- a) 400V distribution power cabling;
- b) traction and non-traction d.c. cabling;
- c) 11kV and 22kV cabling and associated pilots;
- d) cabling within 11kV and 22kV substations.

- 2.2 Cables defined as Station Sub-distribution Assets (E&M) are excluded.

Note: The responsibility for the operation, maintenance and renewal of the items as listed above are with the Infracore contractors for items 2.1 a) and b) and the Power Service Contractor for items 2.1 c) and d).

- 2.3 This issue of the Standard replaces 1-120 A3

- 2.4 Sections 3.5, 3.6 and 3.7 do not apply to the Power Service Contractor.

3 Requirements

3.1 Cable Route Design

3.1.1 General

- 3.1.1.1 The route shall provide adequate support and, where necessary, mechanical protection for the number and types of cables required for the installed cables lifetime, based on a minimum of 40 years.
- 3.1.1.2 The route construction used at each location shall be the most appropriate of those types detailed within this Standard or an alternative construction of at least equivalent performance.
- 3.1.1.3 The route design shall take full cognisance of the physical characteristics of the cables to be installed, including minimum bending radii, support distances and method of installation. Provision for future use by other disciplines should also be considered, where this is practicable.
- 3.1.1.4 The cable and route design shall take full cognisance of the current carrying capacity of the circuits under all foreseeable environmental and operational conditions including the heating effects from adjacent assets.
- 3.1.1.5 The route design shall ensure that the thermal expansion / contraction of the cable due to cyclic loading and solar heat gain can be accommodated without damage to the cable(s) or route. The degree of sag between hangers shall be sufficient to permit free movement of the cable(s).
- 3.1.1.6 The route design shall take full cognisance of any mechanical forces generated during the passage of fault currents and ensure they can be accommodated without damage.



3.1.1.7 Parallel redundant power circuits and parallel redundant pilot cable circuits shall be segregated in order to obtain maximum security of supply or function, e.g. on trackside routes parallel circuits shall be installed on either side of the track or in separate tunnels to reduce the likelihood of common mode failures. : It is acknowledged that full segregation is not practicable for all or part of the route, For short lengths of route (i.e. less than 10 metres) the following alternate segregation methods, in order of preference, may be applied:

- a) Separation by at least 500mm
- b) Separation by a physical barrier

It is accepted that for the first few metres out from the source/destination switchboard/pilot box that full separation as outlined above is rarely possible.

3.1.1.8 The route design shall, where practicable, ensure ease of accessibility for future maintenance of the route or replacement of cables.

3.1.1.9 The route design shall not facilitate unauthorised interference with cables or the cable route.

3.1.1.10 Cables routed in public areas shall be protected against unauthorised or accidental contact. Methods shall include shielding and routing at height. Where cables and routes encounter station areas their design and installation shall take due cognisance of LU Category 1 Standard 1-351.

3.1.1.11 Routes adjacent to staff walkways shall be positioned so as not to restrict its use or cause a hazard.

3.1.1.12 Cable routes adjacent to road vehicle routes at vulnerable locations on LU property shall be protected.

3.1.1.13 If a route is to be crossed by road vehicles it shall be designed so that neither the route nor cables will suffer damage.

3.1.1.14 The route shall not present easy means of trespass, e.g. cable riser supports used as a climbing frame.

3.1.1.15 Cables and cable routes shall be designed in accordance with BS 7671.

3.1.2 Clearances

3.1.2.1 Cables and cable routes:

- a) shall not infringe the Structure Gauge;
- b) shall be kept clear of drainage channels, manhole covers, lineside equipment cabinets, buried services and other areas to which access may be required;
- c) shall not cause height or width restrictions on designated walkways or obstruct access and egress in cable basements;
- d) shall be kept clear of other buried services; and
- e) shall not affect signal sighting.

3.1.3 Electromagnetic compatibility

3.1.3.1 The design of cable routes shall conform to the requirements of LU Category 1 Standard 1-122.



3.1.4 Consultation

- 3.1.4.1 During cable route design, consultation shall be held between LU and third parties to ensure that the proposed cable route does not adversely affect LU and to ensure that all obligations to third parties are addressed.

3.1.5 Routes at bridges and other structures

- 3.1.5.1 At Overbridges, Underbridges and other structures, where special routes are required the design shall be such that:

- a) minimum handrail heights at Underbridges shall not be compromised;
- b) the structural integrity of any bridges or other structures shall not be degraded.

- 3.1.5.2 Fixings to bridges or structures shall only be made with the prior approval of the relevant asset owner.

3.1.6 Post routes

- 3.1.6.1 The design of post routes shall ensure the stability of the route, and that all posts remain upright when loaded with cables to maximum capacity, taking into account foreseeable loading and ground conditions.
- 3.1.6.2 A minimum clearance of 1500mm shall be provided, where practicable between the back of the post and any fence or structure. This is to minimise the potential for vandalism and assist in maintenance.
- 3.1.6.3 Where more than one post run is installed in parallel, the minimum distance between the faces of the posts of adjacent runs shall be 1450mm, where practicable. This is to minimise the potential for vandalism and assist in maintenance.
- 3.1.6.4 The installation of post routes shall not affect the stability of embankments.

3.1.7 Bracket routes fitted to walls and structures

- 3.1.7.1 Where the railway line is adjacent to a wall or structure and there is insufficient room to install a post route, cables may be carried on brackets directly attached to the wall or structure.
- 3.1.7.2 All brackets shall be suitable for any foreseeable imposed loadings.
- 3.1.7.3 Reference shall be made to LU Category 1 Standard 1-198 for signalling segregation requirements.

3.1.8 Routes in cable shafts and headings

- 3.1.8.1 Where different types of cables are routed through common cable shafts, safety critical cables such as signalling and telecoms shall be segregated by a fire resistant screen.
- 3.1.8.2 Shafts shall be provided with platforms at 3m intervals throughout the height of the shaft and inclined ladders for access.
- 3.1.8.3 Fire compartmentation arrangements shall be provided within shafts and headings as may be necessary to comply with the locations Fire Risk Assessment and to ensure compliance with LU Category 1 Standard 1-085.
- 3.1.8.4 Cable shafts in substations shall have a wall 300mm high installed around the head of the shaft to prevent flooding. Railings shall be installed to prevent personnel from tripping over this wall.



- 3.1.8.5 The design and installation of the cable route shall not compromise the integrity of any existing firewalls and other segregation structures.

3.1.9 Surface concrete troughing

- 3.1.9.1 In locations where sufficient clearances are available and ground conditions are suitable, routes may consist of concrete troughing laid at ground level.
- 3.1.9.2 Multiple cables may be installed within a single trough provided that:
- a) the current rating of the cables meet the specified current carrying capacity of the circuits after the reduction in rating due to all mutual heating effects has been taken into account;
 - b) no more than three cables, of which no more than two may be high voltage cables, may only be installed within a single trough. An associated three-phase group of single-core high voltage cables shall be counted as one cable;
 - c) high voltage cables of different voltage ratings shall not be installed in the same trough;
 - d) troughs containing high voltage cable(s) shall contain no other cables except pilot cables.
- 3.1.9.3 Troughs shall be set into the ground sufficiently to offer stability, minimise ingress of soil or ballast and not present a tripping hazard.
- 3.1.9.4 The line of route shall follow the alignment of the adjacent railway track and shall be free of sudden changes in horizontal or vertical alignment, wherever practicable
- 3.1.9.5 The inside of troughs shall provide smooth surfaces such that no abrasion of cable sheaths or displacement of lids occurs due to the expansion and contraction of cables.
- 3.1.9.6 Trough lids shall be installed to span troughing joints and shall fit together to provide continuous cover.
- 3.1.9.7 Where it is considered necessary to take special precautions against unauthorised lid removal, stainless steel bands or locking devices shall be provided.
- 3.1.9.8 Where a troughing route is in or adjacent to a walkway, the route shall not cause a hazard. The make-up material shall be such as to ensure the stability of the route.
- 3.1.9.9 Troughs shall not be used under railway tracks.

3.1.10 Preformed concrete cable trenches

- 3.1.10.1 Preformed trenches are preferred inside substation buildings where cable basements are precluded, in transformer enclosures, substation compounds having vehicle access and in any open ground situation where direct burial or use of buried ducts is not practical or safe. Other forms of suitable containment may be utilised where they can be shown to be more efficient or cost effective
- 3.1.10.2 All trench covers shall be designed to withstand the imposed load and, where relevant, to take account of vehicle axle weights and frequency of passage.
- 3.1.10.3 Trenches shall be sloped towards drainage points at a minimum gradient of 1%.
- 3.1.10.4 Cable shall either be installed on racks or hangers that shall be firmly supported to the bottom or sides of the trench or by cleats to the trench sides.



3.1.10.5 Cable entrances through the trench wall shall be by ducts of adequate size and number for the relevant cables.

3.1.10.6 Where cable trenches enter a building or substation the point of entry shall be waterproof and at least one hour fire resistant.

3.1.11 Duct routes

3.1.11.1 Duct routes installed in open ground, shall be installed with a minimum depth to the top of the uppermost duct of 600mm, with a minimum separation of 100mm being maintained between adjacent ducts.

3.1.11.2 Ducts and associated joint locations shall be of propriety manufacture and constructed from durable, low smoke zero halogen (LSZH) material resistant to oil, de-icing fluid and herbicides.

3.1.11.3 Ducts shall have a minimum internal diameter of 150mm except that where ducts are to contain no more than one high voltage cable or one pilot cable a minimum internal diameter of 100mm is permissible.

3.1.11.4 Spare ducts shall be always provided unless local conditions make it impracticable.

3.1.11.5 Manholes shall be provided at oblique changes of direction and, on straight runs, at intervals of not more than 120 m.

3.1.11.6 Where manholes are provided they shall:

- a) be located clear of the cess so as not to interfere with the track or drainage;
- b) facilitate the installation and maintenance of cables;
- c) ensure that no standing water will accumulate;
- d) be suitable for any loadings experienced; and.
- e) be constructed so that their covers may be lifted by two persons.

3.1.12 Direct burial

3.1.12.1 Cables may be buried direct in the ground only where no other method of route construction is practicable and in compliance with the requirements of the New Roads and Street Works Act 1991 (NRASWA).

3.1.12.2 Direct burial routes shall be confined to areas of open ground that do not constitute part of a railway track, cess, embankment or cutting.

3.1.12.3 Cables shall be a minimum of 800mm below the surface of the ground.

3.1.12.4 Cables shall be surrounded by at least 100mm of soft sand that will not chemically attack the cable material.

3.1.12.5 On top of the sand backfill there shall be continuous cable markers positioned directly over each cable. Each cable marker shall have a minimum width of 150mm and shall be continuously and indelibly marked as described in Section 3.4 of this Standard.

3.1.12.6 Excavated material used to refill the trench above the cable markers shall be riddled through a 10mm mesh screen. The trench filling shall be thoroughly compacted at 200mm intervals of depth.

3.1.12.7 At roads, pathways and in landscaped areas, the reinstatement shall be to a standard at least equal to the original condition and shall, where appropriate, include re-planting or re-turfing.