

Category 1 Standard

S1922 Requirements for Electrical Track Equipment

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1 Purpose

- 1.1 The purpose of this standard is to provide the minimum requirements for Electrical Track Equipment (ETE) used to control the delivery of the d.c. traction supply to London Underground's conductor rail network, including main lines, depots, sidings and shore supplies in depot sheds.

2 Scope

- 2.1 This standard:

- a) defines the minimum requirements for the performance of the ETE system;
- b) defines the specific requirements for Track Isolating Switches;
- c) defines the minimum acceptable condition for ETE including:
 - I) d.c. Cables and Terminations;
 - II) Conductor Rail Bonds;
 - III) Traction Bleed Resistors (when mounted trackside);
 - IV) Low Current d.c. Track Connections;
 - V) Track Isolating Switches;
 - VI) Circuit breakers (not encompassed by S1109 but including trackside siding contactors);
 - VII) Disconnection Panels;
 - VIII) Emergency Gap Jumper Cables and their storage cabinets;
 - IX) Equipment for Depot Shed Shore Supplies;
 - X) Equipment permanently connected to the conductor rails to indicate the presence of traction voltage (P-CRID).

- 2.2 This standard excludes the requirements for:

- a) equipment within the traction supply sub-station; and
- b) the conductor rails.

- 2.3 This standard supersedes 1-107 A3.

3 Requirements

3.1 System performance

- 3.1.1 The following performance requirements shall be met for the entire system which distributes power from sub-station to train. In achieving the required performance reference shall be made to relevant conductor rail and conductor rail insulator standards and practices.
- 3.1.2 The system shall be capable of providing for the continuous and short time current levels associated with the traction types, operating speeds and levels of train service on the route concerned.
- 3.1.3 Electrical Track Equipment shall be capable of withstanding through fault currents consistent with:
- a) a fault level at the sub-station source of 90kA;
 - b) the technical limitations of the equipment provided and in no case shall the disconnection time exceed 60 seconds. The let through I^2t shall not exceed $1.22 \times 10^9 \text{ A}^2 \text{ s}$ where I = current and t = time in seconds.
- 3.1.4 The system shall be capable of accepting the use of a short circuiting device as described in Engineering standard S1116 without leading to damage which would render the conductor rails unfit to remain in service.
- 3.1.5 The system shall withstand an environment as set out in the track asset engineering standards.

- 3.1.6 The system design and construction shall provide for operation in accordance with the LU Rule Book and shall meet, in particular, the requirements of the following:
- a) The Electricity at Work Regulations 1989;
 - b) The railways and other guided transport systems (safety) regulations 2006 (ROGS) HSE and ORR Safety Principles.
- 3.1.7 All Electrical Track Equipment shall be arranged and designed for easy access and maintenance.
- 3.1.8 It shall be possible to carry out maintenance with minimum disruption to the service.

Note: Easy access should entail sufficient space around or in front of the equipment. Alternatively, space should be available in front of the equipment either for any withdrawable feature or in situ maintenance.

3.2 Track Isolating Switches (TIS)

Note: London Underground's traction system is divided into a series of sections. When a partial shut-down of the traction system is required, it is advantageous to minimise the amount of the network that has to be shut-down.

To achieve this, d.c. sections are subdivided into smaller portions using Track Isolating Switches.

A TIS may also be used to electrically couple roads together for emergency feeding or voltage support.

TIS is the general term that is used for various types of traction switch utilised by LU and includes all section, isolation, change over and coupling switches.

3.2.1 Electrical performance

- 3.2.1.1 The TIS shall be of a double pole, single or double break design.
- 3.2.1.2 Main contacts shall be mechanically held in both the open and closed positions.
- 3.2.1.3 The two poles shall be separated by a suitably earthed metallic barrier or insulating barrier.
- 3.2.1.4 Circuit interruption shall be effected by physical separation of contacts and, where necessary, by subsequent arc extinction.
- 3.2.1.5 The TIS must be adequate to meet the needs of the train service and known future load requirements. The TIS shall be rated at 1000V d.c pole-to-pole and pole-to-earth as per system voltage stated in 1-122 (S1122)
- 3.2.1.6 The TIS shall be capable of withstanding a through fault current of 90,000A for 100 milliseconds. There shall be no damage to the main contacts or structural damage, which would render the TIS inoperative.
- 3.2.1.7 TIS can also be used for planned maintenance work (e.g. in depots and sidings) where one current section is switched off and the section is coupled with the adjoining current section to maintain the supply. There needs to be assurance the coupled sections can cope with the additional load and any far end faults.
- 3.2.1.8 Where space will not permit the installation of a load break switch, the installation of an off load switch will be permitted. The isolator shall be adequate to meet the needs of the train service and known future load requirements.

- 3.2.1.9 The TIS shall be capable of closing onto a fault current of 90 000A and carrying this current level for 100 milliseconds. There shall be no damage to the main contacts or structural damage which would render the TIS inoperative.

Application	Table 1 of EN 50123-4 category	EN 50123-1 definition	
		3.1.17 Independent manual	3.1.18 Independent power
Off Load fault make	V	Permitted	Permitted
Fault make load break	VI	Permitted	Permitted

Table 1 - Class of use and permissible operating mechanisms for Traction Isolating Switches.

3.2.2 Means of operation

- 3.2.2.1 TISs shall have one of the following means of operation:

- a) independent manual only;
- b) independent manual and independent power.

- 3.2.2.2 It shall not be possible for the mechanism to be left in such a condition that any energy which has been stored during the initial part of an incomplete operation remains in the mechanism when the operating device is released.

- 3.2.2.3 The TIS shall be capable of closing 60 seconds after the completion of the opening stroke.

- 3.2.2.4 The switch shall be capable of 3 consecutive open then close cycles at the minimum possible interval. After this operation there shall be no damage to the switch that would render it inoperative.

- 3.2.2.5 It shall be possible to padlock the TIS in the open position without the need to isolate the TIS.

3.2.3 Independent manual operation

- 3.2.3.1 Manual operation shall be by means of an operating device that is either removed and securely stored when not in use or is securely retained within the switch housing.

- 3.2.3.2 When a manual operating device is engaged into its operating position it shall disengage the remote control of the Remote Controlled Track Isolating Switch (RCTIS).

- 3.2.3.3 The manual operating device shall not foul the structure gauge when left in any operating position.

3.2.4 Independent power operation

- 3.2.4.1 When electric operation is provided, remote control and indication facilities shall also be provided.

- 3.2.4.2 When remote control facilities are provided, a lockable local / remote selector switch shall be provided at the RCTIS or the remote control panel, as appropriate to site operating configuration.

3.2.5 Construction

- 3.2.5.1 The RCTIS shall conform to the constructional requirements of BS EN 50123-3 or BS EN 50123-4 as appropriate to the intended location of the switch.

- 3.2.5.2 The TIS shall be of a suitably robust construction for the environment into which it is to be installed.

- 3.2.5.3 **Compartment**s - Segregated compartments shall be provided to BS EN 50123-6 and BS EN 61439-1:

- a) main isolating switch or isolator and cable terminations compartment;
- b) auxiliary equipment compartment;
- c) manual operation compartment;
- d) electric drive compartment.

3.2.5.4 Access

- a) Access to all compartments shall preferably be by means of hinged covers secured by door stays;
- b) All covers shall be retained by self retaining, tool operated fasteners;
- c) The tool operated fastenings shall be of a robust nature;
- d) The type of cover and fastening adopted shall be determined taking into account the location of the switchgear with respect to the railway so that doors left open do not become foul of gauge.

3.2.5.5 Enclosures

- a) All modules shall be mounted in robust enclosures suitable for the environment in which they are to be located;
- b) If the enclosure is not of an insulating material, all compartments shall be bonded to earth;
- c) When mounted in outdoor locations and Depots the outside of the enclosure shall be coloured yellow (No 309 of BS 381C 'Canary Yellow' or similar);
- d) When mounted in tunnels, the enclosure shall be dust proof to BS EN 60529 rated IP6X or better. This IP rating shall be maintained after installation at site and with the cables fitted;
- e) When mounted in outdoor locations the enclosure shall be drip proof. For insulated enclosures to BS EN 60529 vertical faces and the top rated IP54 or better and the bottom IP10 or better. For metal enclosures IP54 or better with anti-condensation paint and provision, where practicable, for anti-condensation heaters.

3.2.5.6 Labels

- a) Each module of each TIS shall be clearly labelled with the unique identification number of the TIS;
- b) It shall be possible to remove and replace these labels so that modules may be interchanged for maintenance;
- c) The labels shall remain legible at all times taking account of the environment in which they will be installed.

Note: The unique identification number is held in a register controlled by LU Power Engineer.

3.2.6 Remote control for RCTIS

Note: There are two types of remote control that may be employed:

- a) control via the central LU Power SCADA system; or
- b) local control that does not utilise the central LU Power SCADA system.

3.2.6.1 Remote control facilities shall be provided at the nearest station or at a suitable location within sidings or depots where the project has assessed and confirmed the need for this in conjunction with the line business unit and the sponsor.

3.2.6.2 To control the RCTIS the remote control unit shall have a three position trip / neutral / close spring-return-to-neutral switch, lockable in the neutral position.

3.2.6.3 An electrical interlock shall be provided to prevent the switch being opened remotely when the current is above its rated breaking capacity.

Note: This has previously been achieved with voltage sensors either side of the TIS.

3.2.6.4 Auxiliary compartment

- a) The control unit shall interface with an auxiliary module at the RCTIS;
- b) The auxiliary module shall contain all the interfaces for the remote control and monitoring functions and a telephone which shall be connected, via the controlling station to the LU internal telephone system.

3.2.6.5 Control unit

Each control unit shall have a circuit label with the identification number of the RCTIS it controls and a description of its location.

3.2.6.6 Replication of controls / indications

Volt free contacts shall be provided on the control unit to allow all the controls and indications to be replicated at a central control room via the LU Power SCADA system.

3.2.6.7 Local / remote switch (when no SCADA control is utilised)

The local / remote selector switch shall transfer control between the RCTIS and the remote control unit.

3.2.6.8 Local / remote switch (when SCADA control is utilised)

- a) Indication of the position of the local / remote selector switch shall be provided at the central control room via the LU Power SCADA system;
- b) The local / remote selector switch shall transfer control between the control unit and the central control room;
- c) The local / remote selector switch shall be clearly labelled "Warning: Only to be switched to local control with the permission of the power control room".

3.2.7 Indications

3.2.7.1 Long life LED technology shall be employed for all lamps.

3.2.7.2 The remote control unit, where the control is local to the switch area (depot or station) but does not utilise the central LU Power SCADA system, shall provide indications of the following states using lamps:

- RCTIS closed;
- RCTIS open;
- Drive supply available;
- Disconnected auxiliary contacts;
- Open inhibited.

3.2.7.3 A "lamp on / off" test switch shall be provided. An unlatched pushbutton shall be provided to test each lamp. All the lamps and switches shall be clearly labelled.

3.2.7.4 Mechanical indication

- a) A mechanical indication which is positively driven in both directions shall be provided on the TIS to show if the TIS is open or closed;
- b) The indication shall be clearly visible with all covers fastened in position. The closed indication shall show "Closed". The open indication shall show "Open" Only one indication shall be visible at a time. The indicator shall be covered by a pivoting cover to prevent contamination of the viewing window.

3.2.8 Drive power

3.2.8.1 Electric

- a) Power to the RCTIS shall be provided from a 230V 50 Hz supply;
- b) The tolerance limits for low voltage supplies are specified in 1-124.

3.2.8.2 Power for controls / indications

- a) The remote control and indication facilities shall be supplied by means of a transformer rectifier unit;
- b) The transformer rectifier unit shall be fed from a 230V 50Hz supply via a fused spur and it shall have a 110V (50-0-50V) d.c. output;
- c) The tolerance limits for low voltage supplies are specified in 1-124.

Note: A multiple number of control units may be supplied from a single power source if site specific requirements deem it suitable and cost effective.

3.2.9 Terminations

3.2.9.1 Main cables

- a) Cable terminations onto the TIS shall be suitable for accommodating two 935 sq mm, single core cables onto each side of each pole of the device;
- b) The cable has a smooth over-sheath of either Low Smoke Non Halogen type or neoprene depending on whether it is for use within the tunnels or above ground.

Note: Refer also to standard S1108 DC Traction Feeder Cables. This cable has a minimum bending radius of 420mm. Cable entry will be from the top side or the bottom as site limitations dictate.

3.2.9.2 Auxiliary switches

- a) Auxiliary switches shall be directly driven by the main operating shaft;
- b) All auxiliary switches are to be convertible to normally open or normally closed;
- c) In addition to the auxiliary switches required to comply with this standard, one normally open and one normally closed auxiliary switch are to be provided as spare;
- d) All switches shall be easily removable for maintenance.

3.2.10 Reliability

Note: TISs are placed at strategic positions throughout the LU d.c. rail network and allow the amount of track which must be isolated during an emergency to be kept to a minimum. TISs are either normally open or normally closed throughout most of their lifetime and will only be operated infrequently.

The TIS must have a high degree of reliability with the minimum need for maintenance. The tenderer shall provide details of the guaranteed mean time between failure of the TIS to open or close on command.

3.2.11 Type testing

3.2.11.1 A comprehensive test programme shall be prepared by the manufacture for approval by LU for all new switches to be used on the railway.

3.2.11.2 This shall include type tests to BS EN 50123-3 or BS EN 50123-4.

3.2.11.3 Where available, type test certificates from an accredited test house may be submitted for consideration by LU as an alternative to undertaking further separate tests or where tests have previously been accepted as part of LU's product approval process and registered and approved as part of that process.

- 3.2.11.4 Routine tests shall be carried out on all equipment in accordance with BS EN 50123-3 or BS EN 50123-4.

3.3 Emergency Gap jumper cables

- 3.3.1 If a train becomes stranded on a conductor rail gap a jumper cable is connected between the socket on the train and the nearest conductor rail. This arrangement provides a temporary traction supply. It is essential that these devices are suitably maintained to reduce the risk of injury, and are used in accordance with the rules relating to the safe method of use (their use being restricted to authorised persons).
- 3.3.2 The unit consists of a Train Receptacle Plug, Rail Attachment and associated cables.

3.4 Permanent Current Rail Indication Device (P-CRID)

The requirements below only apply where it has been decided that PCRIDs should be installed. As of March 2011 P-CRIDs are only installed on JNP infrastructure.

- 3.4.1 The P-CRID shall be installed at the departure end of platforms, and at the change of substation traction current sections along the railway.
- 3.4.2 The device shall be housed in an enclosure suitably IP rated for the environment in which it is to be installed.
- 3.4.3 The P-CRID shall have illuminated indications showing the power status as “On” or “Off”.
- 3.4.4 It shall be designed to incorporate internal diagnostic circuits which will illuminate the “Fault” indication when a malfunction of the device has been detected.
- 3.4.5 The design shall incorporate a means of detecting that the device is permanently connected to the conductor rails, with any loss of connection bringing up the “Fault” indication.
- 3.4.6 The device shall have an independent source of power which is capable of illuminating an indication for at least 48 hours following the discharge of traction current.
- 3.4.7 The performance figures and withstand voltages of the device shall be in accordance with those specified in LU standard S1115, Performance and Maintenance of Current Rail Indicator Device (CRID).
- 3.4.8 When installed at stations, the P-CRID shall be positioned so that it can be viewed from a place of safety without the requirement of personnel having to access the track environment.
- 3.4.9 The P-CRID shall be earthed in compliance with 1-106 Earthing and bonding of LU electrical networks.
- 3.4.10 The P-CRID shall be connected to the current rails using appropriately rated DC fuses housed in approved rail mounted fuse bases.
- 3.4.11 A permanent label shall be affixed to the outside of the P-CRID indicating unambiguously the section of track that the device is monitoring.