

Category I Standard

S1926

Design, Manufacture, Testing and Maintenance of Short-Circuiting Devices

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1 Purpose

- 1.1 The purpose of this Standard is to define the requirements for conductor rail short circuiting devices.

2 Scope

- 2.1 This Standard applies to the procurement of short circuiting devices (SCD) for use on the LU network and covers their design, manufacture, testing and maintenance.
- 2.2 This standard replaces S1116 A2. The Standard has been re formatted and re-numbered.
- 2.3 This Standard supports the following LU Policies:

Note: The identification of Policies shown below shall have no material impact upon Suppliers beyond the obligations already contained in this Category 1 Standard. They are provided for LU reference purposes only.

Number	Title	Version
1-01101-004	Service Operations	A1
1-01102-001	Health and Safety	A1
1-01102-002	Safety Decision Making	A1

- 2.4 This standard incorporates technical changes to the end shield, handle positioning and labelling.

3 Requirements

3.1 Performance

The SCD shall perform the short circuiting task in such a manner as to minimise hazard to the operator.

Note: SCDs are used when the traction supply has been switched off in an emergency or when maintenance is taking place on the tracks, to prevent, or reduce the effect of premature current restoration.

SCDs are also used in emergencies as a means of applying a short circuit and initiating operation of the electrical protection, thereby disconnecting electrical supplies from the conductor rail.

Information pertaining to the use of the SCD is contained in the relevant LU Rule Book

The LU magnetic type short circuit bar is specifically excluded from use for testing protection.

3.2 Construction

- 3.2.1 The SCD shall be constructed per the drawings listed in 6.1.3.
- 3.2.2 The SCD shall principally consist of:
- a) an insulated and rigid conducting main bar;
 - b) a handle;
 - c) protection shields;
 - d) coils and contact blocks;
 - e) a retention unit where specified.

- 3.2.3 The SCD shall be constructed such that it locates accurately across the positive and negative conductor rails. The contact block centres shall be compatible with the LU running & conductor rail section as detailed in LU standard 1-164.
- 3.2.4 The SCD shall provide sufficient electrical and mechanical contact between the contact blocks and the tops of the current rails to ensure that the device is fully compliant with the electrical performance requirements described in 3.4.

Note: The electro-magnetic SCD was first produced in the 1980's. In the early 2000's it was realised that it would not fit on all tracks when the maximum tolerance on the position of the conductor rail was considered. To address this issue the Mark 2 SCD was developed, with the original being designated Mark 1, and contained an elongated contact head at the negative end to cater for variation in conductor rail separation. Following the introduction of Number 7 Composite Conductor Rail in 2014, it was then identified that there was potential for the arc shield of the SCD to catch on the flange of this Number 7 rail causing the SCD not to make contact. To address this issue modifications were made by shortening the arc shield of all SCDs with consequent changes to the handle position; to identify those SCDs that had been modified they have been designated Mark 1A and Mark 2A. SCDs of both Mark 1A and Mark 2A design are permitted. All remaining Mark 1 and Mark 2 SCD's should be converted to Mark 1A or Mark 2A design at or before their next insulation tests.

- 3.2.5 The overall dimensional envelope within which an SCD will be accommodated is given in the following drawings:
- a) 2-9562-L39550 for existing rolling stock designs; and
 - b) 2-9562-L53015 for new rolling stock designs introduced to the LU system after January 2005.
- 3.2.6 The SCD shall be capable of being manoeuvred into and out of the cab of a train without hindrance. It shall be possible for the user to place the SCD in the operating position using only one hand.
- 3.2.7 The SCD shall be designed to be carried by one person. The total weight shall not exceed 7.2kg for the 2-9562-L39550 design and 9.4kg for the 2-9562-L53015 design.

3.3 Mechanical performance

3.3.1 General

All bolts and screws shall be tightened to a torque value that shall keep the fixings tight and ensure a good electrical path but shall not cause damage to the parts that are joined together.

3.3.2 Insulated conducting main bar

- 3.3.2.1 The main bar shall consist of a length of rigid conducting bar, double insulated, with a separate non-conducting handle.
- 3.3.2.2 The main bar insulation shall be double layered with yellow on black colours to allow easy visual inspection of insulation damage.
- 3.3.2.3 The inner black layer shall be specifically voltage graded to the requirements stated in 3.4.1.1, with the combined double layer grading meeting these requirements overall.
- 3.3.2.4 The outer yellow layer, which when cut to expose the inner black layer will give ready indication of physical damage, is to have a minimum thickness of 0.5mm.
- 3.3.2.5 The insulation shall specifically maintain its electrical and mechanical integrity when subjected to water absorption and solvent attack as described in 3.12.2.2.
- 3.3.2.6 The insulation shall fit around the bar such that it shall not slide or rotate.

- 3.3.2.7 The polarity of each end of the insulated main bar shall be clearly indicated. The out of balance, lower end of the insulated main bar, when hand held as described in 3.3.3.4, shall be identified by a red colour and the word 'POSITIVE'. The opposite end of the insulated main bar should be identified by a blue colour and the word 'NEGATIVE'.
- 3.3.2.8 The polarity indication shall be positioned at the end of the insulated main bar and easily visible to the operator:
- a) Positive - red heat shrinkable thin wall insulation tubing, 100mm long.
 - b) Negative - blue heat shrinkable thin wall insulation tubing, 100mm long.

3.3.3 Handle

- 3.3.3.1 The handle shall be attached to the main insulated bar in such a way that the handle section is parallel with the bar.
- 3.3.3.2 The handle shall grip the insulation such that it will not slide or rotate. At the same time the handle shall not be attached so as to cause damage to the handle or the insulation.
- 3.3.3.3 The handle shall be located towards the negative contact block, causing an inherent imbalance such that the positive contact naturally points downwards. This imbalance shall not be so great as to cause the SCD to be cumbersome when being carried.
- 3.3.3.4 When supported by the handle as described in 3.3.3.3, with no restraining movement, the SCD will be inclined to an angle of 10° to 20° from the horizontal.
- 3.3.3.5 The handle and the clamp shall be coloured orange NCS 0090 Y30R or white.

3.3.4 Protective shield

- 3.3.4.1 At each end of the main insulated bar shall be a protection shield which has the additional purpose of assisting to locate the SCD squarely on the conductor rails.
- 3.3.4.2 The protection shields shall protect the user from injury due to possible arcing when the SCD is applied or removed from live conductor rails.
- 3.3.4.3 The protection shields shall be attached to the coil and contact blocks and shall be mechanically durable to withstand damage during normal use. The protection shields shall have a finish such that electrical and mechanical integrity is maintained when subjected to water absorption and solvent attack as described in 3.12.2.2.

3.3.5 Coil and contact block

- 3.3.5.1 Behind each protection shield shall be a coil block providing an electromagnet which shall become magnetised when current flows through the bar, causing the contact blocks to be magnetically attracted to the conductor rails.
- 3.3.5.2 The electromagnetic forces generated by this arrangement, when combined with gravitational forces, shall be sufficient to ensure that the SCD remains in place against any electromagnetic or other displacement forces and specifically those generated by re-energisation attempts.
- 3.3.5.3 Within this arrangement will be contact blocks to provide a good contact surface to the conductor rail.
- 3.3.5.4 Any insulating bushes or materials are to be designed and made from a material having an electrical insulation capability sufficient to prevent the electromagnet core and coil block from shorting out under the conditions in 3.4.2.
- 3.3.5.5 Any machined slots, holes or openings remaining following the assembly of the coil and contact blocks shall be filled with a sealant to prevent the ingress of dust and moisture. This sealant shall be suitable for use at the maximum temperature the SCD could attain after performing the duty required by 3.12.3 from an ambient temperature of 35°C.

3.3.6 Retention unit

- 3.3.6.1 The SCD shall accommodate the provision of a retention unit to prevent its accidental removal from the tracks.
- 3.3.6.2 The retention unit shall be capable of exerting a force of 100N between the conductor rails and the SCD.
- 3.3.6.3 The construction of the retention unit shall be such that when subjected to the conditions described in 3.8 and 3.12.2.2, its mechanical and electrical integrity shall be maintained.
- 3.3.6.4 The retention unit shall clamp on to the insulation in such way that it shall not slide or rotate. At the same time the unit shall not be attached so tightly as to cause damage to the insulation.
- 3.3.6.5 The retention unit shall use the running rail between the conductor rails as an anchor for the retention of the SCD.
- 3.3.6.6 It shall be possible to lock the retention unit with a 6mm hasp padlock.

3.4 Electrical performance

3.4.1 Insulation

- 3.4.1.1 The handle and insulated areas shall, when the SCD is used in accordance with working instructions described in 3.1, protect the user against system highest voltage of 900V DC to earth and transient voltages of up to 4kV DC to earth.
- 3.4.1.2 Where a retention unit is fitted, the retaining connection between the running rail and the SCD shall be electrically insulated, protecting the user as defined in 3.4.1.1.

3.4.2 Current Carrying Capacity

- 3.4.2.1 The SCD shall be capable of sustaining worst case conditions (determined from 3.12.3) in the event of the supply being connected while the SCD is shorting the conductor rails.
- 3.4.2.2 The SCD shall be suitable for operation with the LU traction power supply system and on those sections of Network Rail supply over which LU trains operate. A general description of the traction system is given in 5.5.2

3.5 Fire safety performance of materials

3.5.1 General

- 3.5.1.1 All materials and constructions shall meet the fire safety test criteria in 1-085 and shall have the following characteristics when subjected to fire:
 - a) low flammability;
 - b) low smoke emission;
 - c) nil emission of halogens;
 - d) minimum emission of other toxic fumes.
- 3.5.1.2 The supplier shall provide a materials inventory with an evaluation of fire safety.

3.6 Maintainability

Regular inspections of the SCD shall be undertaken to ensure its integrity and its continued ability to perform to this Standard and ensure the safety of personnel. The design of the SCD shall consequently allow for the maintenance or easy replacement of all the components.